APPLICATION

Study field "Power Industry, Electrical Engineering, and Electrical Technologies" for assessment

Study field	*Power Industry, Electrical Engineering, and Electrical Technologies*
Title of the higher education institution	*Rīgas Tehniskā universitāte*
Registration code	*3341000709*
Legal address	*KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050*
Phone number	*67089300*
E-mail	*rtu@rtu.lv*

Self-evaluation report

Study field "Power Industry, Electrical Engineering, and Electrical Technologies"

Riga Technical University

Table of content

I - Information on the Higher Education Institution/College

1.1. Basic information on the higher education institution/ college and its strategic development directions, including the following information:

Riga Technical University was founded in 1862 as Riga Polytechnic, later Riga Polytechnic Institute, and is the oldest technical university in the Baltic States. Following the restoration of the Republic of Latvia in March 1990, Riga Polytechnic Institute was renamed Riga Technical University (RTU). Over years RTU has become the leading centre of higher engineering education and science in Latvia, obtained a positive assessment of international experts and has been accredited by the Supreme Education Council of the Republic of Latvia.

RTU values include sustainable development, quality, openness and cooperation, creativity, academic freedom, motivation to explore and discover.

At the beginning of academic year 2020/2021, an academic and scientific staff of 1,024 people work at nine faculties of RTU (Faculty of Architecture; Faculty of Civil Engineering; Faculty of Computer Science and Information Technology; Faculty of E-Learning Technologies and Humanities; Faculty of Electronics and Telecommunications; Faculty of Electrical and Environmental Engineering; Faculty of Engineering Economics and Management; Faculty of Mechanical Engineering, Transport and Aeronautics; Faculty of Materials Science and Applied Chemistry) and four RTU Study and Science Centres in Cēsis, Liepaja, Ventspils and Daugavpils carrying out high-quality academic activities and scientific research at a contemporary level. RTU is the second largest university in the Republic of Latvia in terms of student number and has educated and trained more than 160,000 graduates in total.

RTU carries out active study and research work, acquiring new partners worldwide, working together on project implementation, student exchange and the development of joint study programmes. Active development of a student campus is underway in Ķīpsala, where new faculty buildings are being built, while those built during earlier years are getting a new look, modern content and design.

Many research and scientific projects are being carried out in cooperation with RTU partners, which result in both new patents and successful business activities. RTU successfully develops cooperation to strengthen its role in the development of higher engineering education in the world and in the development of Latvia.

RTU has defined its mission – we are building a competitive, educated, innovative and creative future, the vision – an internationally competitive, dynamic and modern university of science and technology.

Accredited RTU study directions and a number of study programmes in May 2021:

Study direction	**Number of study programmes**
Architecture and Construction	20
Economics	3

Study direction	Number of study programmes
Energy, Electrical Engineering and Electrical Technologies	14
Physics, Materials Science, Mathematics and Statistics	7
Internal Security and Civil Defence	6
Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Control and Computer Science	37
Chemistry, Chemical Technology and Biotechnology	9
Mechanics and Metalworking, Thermal Energy, Thermal Engineering and Mechanical Engineering	27
Manufacturing and Processing	6*
Translation	2
Management, Administration, Real Estate Management	21
Environment Protection	6
Total:	**158**

* Two study programs are not subject to re-accreditation.

The offer of RTU study programmes is in compliance with the forecasts with regard to the needs of the labour market in both Europe and Latvia in the coming decade. The RTU study programme offer ensures education and training of the specialists in information and communication technologies (ICT), engineering, management and humanities, for which a significant shortage in the labour market is predicted.

In recent years, the number of foreign students studying to obtain a degree or qualification in Latvia has increased. In addition, international student mobility growth is projected to continue also in the future. In the academic year 2019/2020, there were by 25% more foreign students studying at RTU in comparison with the academic year 2018/2019. Taking into account the above mentioned, RTU has great opportunities to further increase the number of foreign students. It also provides an appropriate offer of RTU study programmes in English – 16 Bachelor study programmes, 27 Master study programmes, and 13 Doctoral study programmes, moreover, this list is updated from year to year.

In November 2020, 14,006 students studied at RTU – 10,307 studied at undergraduate study programmes, 3,184 studied at graduate Master degree programmes and 515 – at the Doctoral study programmes.

The guiding principle of RTU Strategy for 2021–2025 is the proactive link between the activity of the university and the needs of the national economy, focus on high quality and effectiveness. The basis for the activity of RTU is the study process built on science, innovation and in cooperation with the industry, which ensures preparation of specialists required by the Latvian national economy, thus serving as a foundation for sustainable growth of Latvia. The RTU’s strategy for the new programming period is a consecutive continuation is the previous strategy of the university for 2014-2020. It has been developed in compliance with the objectives and priorities defined in Latvian development planning documents.

According to the National Development Plan for 2021-2027 of Latvia, fundamental changes are planned in the near future in four directions – Equal Rights, Quality of Life, Knowledge Society, and Responsible Latvia, in the achievement of which a high-quality study process, excellent research, as well as sustainable innovation and commercialization activities play an important role, which are important elements in RTU's vision to become an internationally competitive, dynamic and modern university of science and technology.

Keynote of the RTU Strategy: High quality and effectiveness – proactive link between the activity of RTU and the needs of the national economy. RTU is one of the leading science and technology universities of the Baltic and Nordic region, which is acting based on a study systems built on research, innovation and cooperation with the industry. RTU prepares European and global-level engineers – leaders: developers of new technologies.

In order to implement RTU's vision to become an internationally competitive, dynamic and modern university of science and technology, RTU's strategy defines four main objectives for the next programming period, three of which are related to the implementation of basic university functions: excellent science, quality studies and sustainable valorisation. The fourth, institutional excellence, is related to the university support function and the development of internal governance in the six areas: digitalisation, sustainable development, effective financial and administrative action, internationalisation, communication and cooperation, human resources development. For all the objectives identified in the strategy define specific tasks to be performed and result indicators to make it possible to follow the implementation of the strategy so that RTU can realise its vision.

The implementation of the RTU Strategy is approved by a decision of the RTU Senate. Following the approval of the Strategy, RTU Rector once a year ensures definition of the annual RTU aims and tasks with clear performance indicators set at the level of each RTU unit. RTU Strategy is implemented, and the results achieved are analysed annually with regard to the defined tasks.

RTU Strategy is published at https://www.rtu.lv/en/university/strategy.

1.2. Description of the management of the higher education institution/ college, the main institutions involved in the decision-making process, their composition (percentage depending on the position, for instance, the academic staff, administrative staff members, students), and the powers of these institutions.

The structure and administration of RTU are established in compliance with the University vision, mission and objectives and taking into account the specifics of the University management. The administrative structure is based on a decentralized decision-making process and obligations arising from the Law on the Higher Education Institutions, the Constitution of RTU, resolutions of RTU Senate, the orders issued by the Rector, as well as other RTU documents. The functions of various organizational units have been approved in their regulations approved by the Senate. Overall, RTU management can be divided into three levels: university level, administration level and faculty level.

At the University level, there is the Constitutional Assembly (200 representatives – 120 academic personnel representatives (60% of the total number), 40 student representatives (20% of the total number) and 40 general staff representatives (20% of the total number). The Assembly includes all members of the RTU Senate. The conditions for the formation of the Assembly are defined in Article 30 of the RTU Constitution – see the file of Annex 01 of the list of Internal regulations), the Senate (50 Senators – 38 academic personnel representatives (75% of the total number), 10 student representatives (20% of the total number) and two general personnel representatives (5% of the total number). The conditions for the election of the representatives of the Senate are defined in the attached Article 7 of the Regulation of the Senate of RTU - see the file of Annex 02 of the list of Internal regulations), Scientific Council (composed of Deputy Deans in for research, Vice-Rector for Research, Deputy Vice-Rector for Research; the Rector, Vice-Rector for Academic Affairs, Vice-Rector for Strategic Development, Vice-Rector for Finance and the Chair of the Senate also have the rights of membership of the Council). At the level of administration, the operational management of the university is exercised by the Rector, whereas the Board of the Rector plays an advisory role in the adoption of such decisions, with the participation of the Rector, Chair of the Senate, Vice-Rectors, Administrative Director, Deputy Rector for International Academic Cooperation and Studies, Director of the Legal Department, Director of Infrastructure Development Department, President of the Student Parliament; the Deans Council comprising the Rector, Deans, directors of studies and research centres, Director of Riga Business School, Chair of the Senate, Vice-Rectors, Deputy Rector for International Academic Cooperation and Studies, Director of Infrastructure Development Department, President of the Student Parliament; operational management meetings uniting the Rector, Administrative Director, Deputy Vice-Rector for Research in Scientific Work, the heads of administrative departments (department directors, unit managers). At the faculty level, the highest decision-making bodies are faculty councils whose composition depends on the size of the faculty.

External partners and stakeholders are involved in the University management through the RTU Advisory Board (27 members). It provides an opportunity to receive independent opinion on important issues and possible solutions from various perspectives. Each faculty also has its own Advisory Board, which provides its own vision for improving the supply of study programmes in line with sectoral needs and market trends.

Each faculty also has its own student self-government, while RTU Student Parliament coordinates faculty student self-governments. Students are represented in all RTU decision-making bodies and can therefore participate in the University strategic decision-making.

The Rector, Vice-Rector for Research, Vice-Rector for Academic Affairs, Vice-Rector for Finance and Vice-Rector for Strategic Development are the senior officials of RTU. The Rector implements the general administrative management of RTU and represents RTU without a specific mandate. The Rector is elected by the Constitutional Assembly for a period of five years for no more than two consecutive terms for the same person. The Rector is elected, approved in office and removed from office pursuant to the regulatory enactments governing higher education institutions.

The operational management of RTU is exercised independently, in accordance with the delegation of the Rector, by the Vice-Rector for Research, Vice-Rector for Academic Affairs, Vice-Rector for Strategic Development and Vice-Rector for Finance. The Senate elects the Vice-Rector for Research, Vice- Rector for Academic Affairs, Vice-Rector for Strategic Development and Vice-Rector for Finance based on the recommendation of the Rector for the term of office of the Rector. The Rector may also delegate certain functions to other RTU officials and, on the basis of the Rector's proposal; other Vice-Rector positions may be created by a Senate decision.

The Vice-Rector for Research supervises and is responsible for Doctoral study programmes and research work, including support to young researchers, research infrastructure, research funding, applied research, intellectual property protection, RTU scientific publications and scientific conferences. The Vice-Rector for Academic Affairs supervises and is responsible for the study process at the Bachelor, Master, first and second-level professional study programmes, further education, including training programs, security and quality assurance in studies, credit points, determination of academic staff positions and workload, as well as the selection and admission of students. The Vice-Rector for Strategic Development is responsible for the development strategy and its successful implementation, supervises the implementation of projects important for the development of RTU, and represents the interests of RTU in interaction with public authorities, partners and the public. The Vice-Rector for Finance is responsible for the financial management processes of RTU and for allocating and planning financial resources to ensure the functioning of RTU and implementation of the development strategy.

The accounting, study administration, science administration and human resources administration at the university are centralized. Other administrative processes, such as procurement and project management, are centralized to the extent necessary to avoid institutional risks. At the same time, a decentralized management system has been provided at a high level at RTU, with a certain degree of autonomy for each academic unit. This means they have their own budget and self-governing structure, which allows defining and meeting the objectives of the organizational unit. This approach motivates the heads of departments to be proactive, to plan the development of the unit, and to apply for funding.

RTU governance structure information is published at https://www.rtu.lv/en/university/structure-and-administration.

1.3. Description of the mechanism for the implementation of the quality policy and the procedures for the assurance of the quality of higher education, as well as the stakeholders involved in the development and improvement of the quality assurance system and their role in these processes.

The RTU has established an internal quality management system that respects the standards of Part 1 of the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG).

RTU internal quality management system works in line with the “Excellence approach” (approved on 30 January 2017 at the meeting of the RTU Senate, Minutes No 606), as well as the “RTU Quality Policy” (approved by the Senate on 25 September 2017, Minutes No 612).

The Quality Policy is focused on the implementation of the RTU mission and the achievement of the strategic objectives. The Quality Policy lays out the framework and pathways for development and improvements of the RTU Strategy, research, study process and organization. The University Quality Policy is aligned with the European Association for Quality Assurance in Higher Education (ENQA) standards and guidelines. The RTU Excellence Approach and quality policy are mutually integrated documents which require RTU to use the quality model of the European Foundation for Quality Management (EFQM).

The EFQM quality model assumes cooperation with student representatives, partners, professional associations, student organizations, other higher education institutions, businesses and organizations. RTU maintains an open dialogue to explore the needs of the parties involved and to respond appropriately by developing feedback to day-to-day and long-term cooperation.

By establishing links with the parties involved, the administration of RTU contributes to the development of excellence and ensures the clarity, unity, building of the work environment and diversity management of the objectives to be achieved.

RTU staff participates in quality assurance by providing suggestions and feedback to improve the RTU quality system. The heads of the RTU departments are responsible for carrying out internal quality assurance procedures and processes in their departments.

Based on the results of regular student and graduate surveys, improvements in the quality of the study process are being planned.

Cooperation with partners, suppliers and other stakeholders takes place in accordance with the RTU Strategy, establishing appropriate cooperation networks and identifying appropriate policies, activities and processes for effective cooperation aimed at ensuring the quality of the RTU and acquisition of feedback. To ensure the topicality and continuous development of existing study programmes and before the introduction of new study programmes the interests of all stakeholders in modern and interdisciplinary technology education are considered.

External stakeholders (public authorities, cooperation partners, representatives of the public) assess the study process and its results in State Examinations, practical placements (internships) and accreditation, and contribute to improving the content and quality of study programmes.

More on this point is set out in Section 2.1.

RTU Excellence Approach is published at
https://www.rtu.lv/en/university/strategy/rtu-excellence-approach.

RTU Quality Policy in Latvian is published at
https://www.rtu.lv/lv/universitate/dokumenti/kvalitates-politika (English translation is in the file of Appendix 03 of the list of Internal regulations).

1.4. Fill in the table on the compliance of the internal quality assurance system of the higher education institution/ college with the provisions of Section 5, Paragraph 21 of the Law on Institutions of Higher Education by providing a justification for the given statement. In addition, it is also possible to refer to the respective chapter of the Self-Assessment Report, where the provided information serves as evidence for the full compliance, partial compliance or non-compliance.

1.	The higher education institution/ college has established a policy and procedures for assuring the quality of higher education.	Complies In line with the quality model introduced by RTU, process analysis and improvement are ongoing. Performance indicators and the results of the assessment of various surveys are analysed. The quality report data are compiled after the end of the academic year. Annual agreements on the target study process performance indicators are signed with the faculties; the quality is assessed by analysing the achievement of the defined objectives relative to the plan. For more details, see the 5th row of this table.
2.	A mechanism for the creation and internal approval of the study programmes of the higher education institution/ college, as well as the supervision of their performance and periodic inspection thereof has been developed.	Complies The development of study programmes takes place in accordance with the “Procedure for the application, elaboration and amendment of the study programmes” (approved at the Meeting of RTU Senate on 26 April 2021, Minutes No 649). The departments and institutes implementing the study process, Faculty Councils, the Office of Vice-Rector for Academic Affairs, the Student Parliament and the Senate are involved in ensuring the internal study quality of RTU. These institutions carry out comprehensive assessment of the new study directions and study programmes, the changes to the study directions and programs and the annual reports of the improvement of the study directions. At RTU, the operation of the internal quality assurance mechanism takes place at the level of the Rectorate, faculties, study directions and study programmes. At the level of the Rectorate, the internal study quality control of RTU is carried out by the Office of Vice-Rector for Academic Affairs. The Study Department performs: (1) the maintenance and control of the Study Programme Register, which involves control of the conformity of the study curriculum to the aims, tasks and learning outcomes of the study programme, as well as the control of changes; (2) maintenance and control of the Study Course Register, which involves control of the conformity of study course descriptions with the learning outcomes, as well as quality control of study course descriptions; (3) periodical student polling at the University level.

3.	The criteria, conditions, and procedures for the evaluation of students' results, which enable reassurance of the achievement of the intended learning outcomes, have been developed and made public.	Complies The evaluation of learning outcomes takes place in accordance with the "Regulation on the Assessment of Learning Outcomes" (approved at the Meeting of RTU Senate on 29 May 2017, Minutes No 610) and "Regulation on Final Examinations at RTU" (approved at the Meeting of RTU Senate on 26 April 2021, Minutes No 649).
4.	Internal procedures and mechanisms for assuring the qualifications of the academic staff and the work quality have been developed.	Complies In order to ensure the qualification and performance quality of academic staff, professional advancement needs are regularly assessed when evaluating the results. Professional advancement training modules are developed by collecting information from: (1) academic staff surveys on professional advancement needs once in two years; (2) analysis of student polling results; (3) cooperation with student self-governments; (4) world trends and good practices of other Latvian universities in the field of professional advancement of academic staff; (5) information provided by academic staff on professional advancement topics of interest; (6) proposals from the heads of academic units for professional advancement of academic staff. The Centre for Academic Excellence (CAE), a teaching and learning centre, was set up at the end of 2018; its aim is to develop a strategy for the professional advancement of academic staff, including in line with Article 16 of Cabinet Regulations No 569. Other tasks of CAE are detailed in Section 3.5. Academic units organize regular or one-time professional advancement activities having assessed the need for professional training of academic staff. The units assess whether it is more appropriate to participate in a particular event for certain representatives of academic staff, all members of the unit or to invite also members from other units.

5.	The higher education institution/ college ensures the collection and analysis of the information on the study achievements of the students, employment of the graduates, satisfaction of the students with the study programme, efficiency of the work of the academic staff, the study funds available, and the disbursements thereof, as well as the key performance indicators of the higher education institution/ college.	Complies
		Student expectations and satisfaction with the curriculum and study process are identified in sequential and planned surveys at all stages of study. Student surveys are organized in accordance with the Regulations on “Student Polling for Assessment of the Study Process” (approved at the Meeting of RTU Senate on 27 January 2014, Minutes No 577). The aim of polling is to clarify the adaptation of first-year students to the university system and the satisfaction of all students with the study process, lectures, and practical classes after each semester, the satisfaction of students with the services offered by the University, and the overall satisfaction of graduates with the study programme. The results of the surveys are available to academic staff, heads of organizational units and students in a summarized form. Annually, the State Revenue Service provides information on the employment of RTU graduates. The Total Quality Management System of RTU analyses performance results of the study process, comparing the characteristics of the study programmes, including the resulting performance indicators related to the study process in the overall EFQM quality model of RTU. At the beginning of September of each year, a faculty Activity Plan on study process indicators are drawn up: (1) number of students; (2) number of graduates; (3) number of graduates who complete their studies on time; (4) number of students expelled from University; (5) number of foreign students; (6) average age of elected academic staff; (7) number of study programmes implemented in English; (8) average indicator of the evaluation of faculty academic staff; (9) number of persons with a scientific degree elected to academic positions (%); (10) number of foreign guest lecturers. The established Faculty Study Activity Plans for the following year is drawn up by Faculty Deans, together with Deputy Deans for Academic Affairs and institute directors; they are approved by the Rector of RTU. RTU administration meets with representatives of faculties to evaluate the faculty activity plans on study process indicators, evaluating the progress in the previous academic year and defining the indicators to be achieved in the next two academic years. These indicators are used to monitor the study process performance of the faculty. These indicators and other aspects influence the amount of performance-based funding allocated to the faculty and contribute to the achievement of the objectives set forward in the RTU Strategy. The study process funds are administered in accordance with methodologies approved by the Senate or as stipulated by the Vice-Rector for Finance. Principles of the methodologies motivate the heads of departments to be proactive, to plan the development of the unit, and to apply for funding. These methodologies are described in more detail in section 3.1. of the self-assessment report.The Total Quality Management System of RTU analyses performance results of the study process, comparing the characteristics of the study programmes, including the resulting performance indicators related to the study process in the overall EFQM quality model of RTU. At the beginning of September of each year, a faculty Activity Plan on study process indicators is drawn up: (1) number of students; (2) number of graduates; (3) number of graduates who complete their studies on time; (4) number of students expelled from University; (5) number of foreign students; (6) average age of elected academic staff; (7) number of study programmes implemented in English; (8) average indicator of the evaluation of faculty academic staff; (9) number of persons with a scientific degree elected to academic positions (%); (10) number of foreign guest lecturers. The established Faculty Study Activity Plans for the following year are drawn up by Faculty Deans, together with Deputy Deans for Academic Affairs and institute directors; they are approved by the Rector of RTU. RTU administration meets with representatives of faculties to evaluate the faculty activity plans on study process indicators, evaluating the progress in the previous academic year and defining the indicators to be achieved in the next two academic years. These indicators are used to monitor study process performance of the faculty. These indicators and other aspects influence the amount of performance-based funding allocated to the faculty and contribute to the achievement of the objectives set forward in the RTU Strategy.

6.	The higher education institution/ college shall ensure continuous improvement, development, and efficient performance of the study direction whilst implementing their quality assurance systems.	Complies At the level of the faculty and study direction, internal quality is ensured by the Faculty Council, the Study Direction Committee and Directors of the study direction, Directors of the study programmes, administration of the institutes and chairs implementing study programmes. Within the framework of the study programme, internal quality is ensured by the program director and by the academic staff implementing the program. Internal quality control at the level of the study programme is carried out by the administration of the relevant institute or chair. In order to ensure continuous development of the study programmes, RTU Study Direction Committees monitor academic activities in the relevant study direction and are responsible for the curriculum and quality of the study programmes within the study direction, including the accreditation of the study direction. Inclusion of employer representatives in the Study Direction Committee is a mandatory requirement. Study Direction Committee acts in accordance with the “Regulation of the Study Direction Committee” (approved by the Resolution of RTU Senate Meeting on 26 April 2021, Minutes No 649). The basic tasks of the Study Direction Committee are: (1) to analyse the situation in the labour market and make suggestions for the development of new study programmes as well as for the closure of the outdated study programmes; (2) to carry out expert assessment of the curriculum and quality of the study programmes, assess their compliance with the defined objectives and compliance with the research area represented and labour market requirements; (3) to organize and monitor the accreditation of the study direction and the licensing of study programmes; (4) to analyse the assessment and recommendations made by external experts and organize elimination of identified shortcomings; (5) to carry out an analysis of the study direction self-assessment report as well as the annual reports on study direction development activities; (6) in order to achieve strategic objectives of the University, to assess the proposed changes to study programmes with a view to increasing the quality of all study programmes included in the study directions; (7) to analyse the results of student, graduate and employee surveys and organize elimination of identified shortcomings, as well as organize additional surveys.

II - Description of the Study Direction (1. Management of the Study Direction)

1.1. Economic and/or social grounds for the creation of the study direction and the relevant study programmes, the assessment of the interrelation among the study programmes, as well as the analysis of the significance (singularity) of the study programmes in comparison with other similar study programmes in Latvia and abroad.

With the Decision No 54 of the Study Accreditation Commission of the Ministry of Education and Science of the Republic of Latvia dated 29 May 2013, the study field "Power, Electrical Engineering and Electrical Technologies" and all the study programmes contained therein were accredited for a period of six years (up to 28 May 2019, with an extension of up to 30 June 2022). This study field at Riga Technical University (RTU) is implemented at the Faculty of Electrical and Environmental Engineering (FEEE) (until 2020, named the Faculty of Power and Electrical Engineering (FEEE)) and the Faculty of Mechanical Engineering, Transport and Aeronautics (FMETA).

Currently, 14 study programmes are implemented in the study field "Power, Electrical Engineering and Electrical Technologies", among which there are two new Master level programmes and several programmes which implementation is not planned to be continued in the next accreditation period. A full list of the currently implemented programmes of this study field is provided in the Table below.

Name	Level	Faculty	Changes	Comment on the programme changes
Adaptronics	professional Bachelor studies	FEEE		
Railway Electrical Systems	professional Bachelor studies	FMETA	To be closed	Will be added to another FMETA programme
Railway Electrical Systems	professional Master studies	FMETA	To be closed	Will be added to another FMETA programme
Computerised Control of Electrical Technologies	professional Bachelor studies	FEEE		
Computerised Control of Electrical Technologies	PhD studies	FEEE		
Computerised Control of Electrical Technologies	professional Master studies	FEEE		
Computerised Control of Electrical Technologies	academic Master studies	FEEE	To be closed	Instead, prof. Master programme "Adaptronics" is created

Power and Electrical Engineering	academic Master studies	FEEE	To be closed	Instead, prof. Master programme "Smart Power Systems" is created
Power and Electrical Engineering	First level professional higher education	FEEE	To be closed	
Power and Electrical Engineering	Second level professional higher education	FEEE	To be closed	Instead, prof. Master programme "Smart Power Systems" is created
Power and Electrical Engineering	academic Bachelor studies	FEEE	Will not be continued	Instead, a new prof. Bachelor programme “Smart Power Systems” will be created
Power and Electrical Engineering	PhD studies	FEEE	Modernised	The name changes to “Smart Power Systems”
Power and Electrical Engineering	First level professional higher education	FEEE	To be closed	
Adaptronics	professional Master studies	FEEE		
Smart Power Systems	professional Master studies	FEEE		

All programmes implemented in the study field are oriented towards electrical engineering, are unique in Latvia (see, in addition, the characteristics of each study programme) and cover the levels of studies from a bachelor to a doctoral degree. There are separate themes that can also be learned in other Latvian universities, but more generally and not at all levels of study. FEEE (formerly called the Faculty of Electrical Engineering and later the Faculty of Power and Electrical Engineering) has been pursuing higher education and scientific activity in electrical engineering since 1958 and, during this time, a huge methodological base in electrical engineering has been accumulated. The academic staff of the are the authors of most teaching books and monographs in Latvian dedicated to electrical engineering.

Since 2019, RTU has been implementing the project “SAM 8.2.1. Reduction of fragmentation and strengthening of resources sharing of study programmes at Riga Technical University”, which aims at reducing the fragmentation of study programmes and strengthening sharing of resources. Whereas, its specific objective is to implement the new 17 STEM study programmes in the EU languages referred to in the RTU Development and Consolidation Plan of Study Programmes approved by the Ministry of Education and Science (MES), the development and implementation of one joint PhD study programme and the closure of the existing 39 study programmes by 30 November 2023. The project aims at updating the range of STEM study programmes offered by RTU by modernising and making cross-disciplinary STEM study programmes attractive to foreign students. Within the framework of the project in the study field “Power, Electrical Engineering and Electrical Technologies”, two new study programmes have been developed – the professional Master study programme “Smart Power Systems” and “Adaptronics”, which obtained licences in

2020, with the closure of 7 existing study programmes.

The study programme “Computerised Control of Electrical Technologies” offers Bachelor, Master and PhD level education in electrical technologies and automatics, electrical machines and equipment of the electrical engineering, electronics, information and communications technology sectors, as well as energy electronics subsectors, and provides for obtaining the professional qualifications of Electrical Engineer and Leading Electrical Engineer. The programme “Computerised Control of Electrical Technologies” has been implemented for 20 years already, certainly with different improvements.

The Bachelor and Master study programmes “Adaptronics” have new interdisciplinary programmes in electrical technologies and automatics, as well as in energy electronics subsectors, with deep adaptive systems and information technologies that can be applied to the development of modern automation technologies. They are unique because there are the only programmes implemented in the Baltic States with such a specific cross-disciplinary profile – in the European Union, there are only two universities that implement such engineering study programmes, with specialisation in Adaptronics – the University of Duisburg-Essen and the Technical University of Darmstadt. It is developed to provide opportunities for learning the use of robotics and artificial intelligence in automatic management systems that support the modern industry tendencies. Eventually, the “Computerised Control of Electrical Technologies” and “Adaptronics” programmes are planned to be combined, leaving only one programme in the “Power, Electrical Engineering and Electrical Technologies” study field at all levels of study focused on electrical technologies and automatics, electrical machines and equipment, and energy electronics subsectors. It is planned to be implemented following changes in the qualification structure of the Latvian energy industry and in conformity with new qualifications or professional standards “Engineer in Electrical Technology and Automatics” and “Leading Engineer in Electrical Technology and Automatics”, which are currently only at the project stage.

The study programme “Smart Power Systems” offers the Master level, whereas the programme “Power and Electrical Engineering” - PhD level education in the electrical engineering, electronics, information and communications technology sectors, electrical energy, power supply and electrical machines and equipment subsectors, and enables the professional qualification of Leading Electrical Engineer to be obtained. A new professional Bachelor programme “Smart Power Systems” has also been developed, which will replace the academic Bachelor programme “Energy and Electrical Engineering”. A licence for this programme is obtained in 2021. Significant changes are also planned to the PhD programme “Energy and Electrical Engineering”, including the change of name to “Smart Power Systems”.

When comparing the research programmes under RTU field “Power, Electrical Engineering and Electrical Technologies”, which are planned to be implemented during the next accreditation period (prof. Bachelor and prof. Master programmes “Adaptronics”, prof. Bachelor, prof. Master and Doctor programmes “Computerised Control of Electrical Technologies”, as well as prof. Bachelor, prof. Master and Doctor programmes “Smart Power Systems”) by other study programmes of a similar theme in Latvia, it can be concluded that they are unique because they are the only ones that correspond to the competencies included in the professional standards of Electrical Engineer and Leading Electrical Engineer. Except for the first level professional study programmes, which are being implemented at colleges, only the professional Bachelor programme “Applied Power Engineering” of Latvia University of Life Sciences and Technologies is being implemented in the field of Power, Electrical Engineering and Electrical Technologies in Latvia, but it is focused on the professional standard “Engineer in Power Systems”, which is intended for more general expertise in power engineering.

In Latvia, there are many study programmes relating to electrical engineering that are implemented in the field “Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Control and Computer Science”:

- RTU - "Smart Electronic Systems”, “Transport Electronics and Telematics”, “Automation and Computer Engineering” and “Intelligent Robotic Systems";
- Transport and Telecommunication Institute - "Electronics" and "Robotics";
- Ventspils University of Applied Sciences - “Electronic Engineering”, “Electronics” and “Ship Navigation Electronics”.

These programmes look more at the themes of electronics and ICT and are focused on professional standards such as Electronic Engineer and Radio Electronic Engineer.

Separate study programmes related to electrical engineering are also implemented in Latvia in the study field “Mechanics and Metalworking, Heat Power Engineering, Thermal Engineering and Mechanical Engineering”:

- RTU - "Mechatronics", “Railway Engineering”;
- Latvian Maritime Academy - “Marine Electrical Automation”.

These programmes are more focused on mechanics or the specifics of railway or marine electric systems.

RTU study programmes in the study field “Power, Electrical Engineering and Electrical Technologies”, which are planned to be implemented in the next accreditation period, generally contribute to the modernisation of the national economy of the Republic of Latvia, focusing on the realisation of innovative solutions in a variety of sectors that are unthinkable without the participation and contribution of well-prepared electrical engineering specialists and electrical technology automation specialists. Energy and energy efficiency are one of the most important aspects that determine the competitiveness and economic growth of Latvian companies. The knowledge and skills acquired during the studies in the field of Power, Electrical Engineering and Electrical Technologies enable students to develop equipment and systems necessary for the generation, transmission and distribution of electricity, automation of production, transport, services and household sectors and improvement of energy efficiency already during the development of their graduation papers.

1.2. Aims of the study direction and their compliance with the scope of activities of the higher education institution/ college, the strategic development directions, as well as the needs and the development trends of the society and the national economy.

RTU study programmes in the study field “Power, Electrical Engineering and Electrical Technologies” 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 excellency.

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 field "Power, Electrical Engineering and Electrical Technologies", which are planned to be implemented in the next 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", the EC Europe's Green Course initiative. 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;
- National Energy and Climate Plan for 2021-2030;
- National Development Plan for 2014-2020 and National Development Plan for 2021-2027 (draft);
- Strategy for the Low-Carbon Development of Latvia until 2050 (draft).

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. FEEE is implementing all 11 ongoing Energy NRP projects, four of which correspond directly to the field of Power, Electrical Engineering and Electrical Technologies.

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:

- A high-quality study process. 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-disciplinarity. 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.

1.3. SWOT analysis of the study direction with regard to the set aims by providing explanations on how the higher education institution/ college expects to eliminate/ improve weaknesses, prevent threats, and avail themselves of the given opportunities, etc. The assessment of the plan for the development of the study direction for the next six years and the procedure of the elaboration thereof. In case there is no development plan elaborated or the aims/ objectives are set for a shorter period of time, information on the elaboration of the plan for the development of the study direction for the next assessment period shall be provided.

In order to ensure the quality of the study field, a report on the development of studies is drawn up each year and evaluated by an expert appointed by the Vice-Rector for Academic Affairs. The report is approved by RTU Senate. The required section of the development report is a SWOT analysis which allows for a focused presentation of the work done and an indication of the problems. It is an essential tool for achieving the goals of the study field.

SWOT Analysis of the Study field

Strengths:

- Preparation of specialists urgently needed for the national economy;
- In professional Bachelor and Master programmes, the possibility of obtaining a degree and professional qualifications at the same time;
- High-developed infrastructure, modern and fully equipped lecture rooms and laboratories;
- Very good teaching base in electrical engineering, electronics, electric machines and drives, energy electronics and other electrical and automatic control technologies;
- Diverse, professional and qualified academic staff who develop their competences through regular participation in scientific conferences;
- Rich and modern library accessible 24 h;
- Management of the study field ensures continuous development and quality control of the study process. The quality system at RTU is developed as the RTU excellence approach, providing quality studies and research and continuous development;
- Continuous development of the study process involving students. Maintaining close links with students, enabling them to respond promptly to issues related to the quality of their studies;
- Wide international cooperation with foreign universities, as well as opportunities to study at foreign universities;
- Available places of internship during studies that allow to be involved in appropriate work while still studying;
- Capacities to continue studies at the next level of study;
- The implementation of studies provides operational and close links with employers, enabling to obtain up-to-date information on the needs of the labour market in Latvia and the development of the economy, as well as to get technical assistance;
- Good cooperation with foreign technical universities, enabling students to be sent periodically

to foreign technical universities for advanced training purposes;

- A high proportion of young lecturers in the programme and an active increase in their qualifications;
- Studies allow students to learn widely the technological achievements of foreign firms;
- Different exchange programmes are available to support the development of practices and study process;
- Agreements with JSC Rīgas elektromašīnbūves rūpnīca, JSC Latvenergo, JSC Sadales tīkls, JSC Augstsprieguma tīkls, Ltd. Latvijas Finieris, EK-Sistēmas and other enterprises that facilitate organisation of internship;
- Professional programmes are implemented for both full- and part-time studies;
- Assessment of qualification papers is performed by the State Examination Commission, in the work of which specialists from manufacturing companies are involved;
- Training programmes for foreign students of different levels are implemented.

Weaknesses:

- Lack of knowledge among students in physical subjects, which causes problems in studying in this field, leading to a difference between able students and those who cannot master the study courses;
- The need to align the unequal level in preparedness of students creates additional load on academic staff and hinders the development of student research skills and professional competence;
- Substantially different levels of initial training of foreign students, different awareness of the cultural and educational process and motivation;
- Some students have insufficient motivation;
- Students are forced to work to earn their living, which in turn encumbers the study process;
- Insufficiently used mobility opportunities for students and academic staff;
- Insufficiently developed RTU international brand to compete successfully with the same level universities of other countries in attracting foreign students.

Opportunities:

- Opportunities for study abroad in the framework of exchange programmes, participation in academic staff mobility programmes, international experience in projects, etc.
- Students can use laboratories and work at different scientific projects.
- Improvement of existing study programmes and development of new study programmes, assessing developments in the fields of studies in line with trends in the labour market.
- Digital infrastructure and its use enable training to be provided to both full-time and part-time students, including videoconferencing audiences, can help to improve the range of services and attract students who cannot attend lectures regularly.
- Attraction of additional funding and extending international cooperation through participation in national and European programmes and projects (National Research Programmes, projects funded by the Latvian Council of Science (LCS), Horizon 2020, Horizon Europe, etc.), as well as in the development of applied research and in cooperation with companies in the implementation of market-oriented research.
- Employers and employees of enterprises have links with the programme implementers and students.
- Development of qualification works with parts of the project contributes to strengthening the scientific potential of higher education and cooperation with manufacturing companies.
- Employers are allowed to assess and choose new specialists already during their studies.
- Employers assess the quality of the programme and make proposals to improve it.
- Employers provide oriented material and technical assistance in the implementation of the

programme.
- The ability to attract funds from different exchange programmes for both the procurement of training facilities and improvement of internship organisation.
- The ability to train students with the participation of JSC Latvenergo specialists, by using the material base of laboratories of Latvenergo.

Threats:

- Lack of a sustainable strategy in Latvia's higher education policy;
- Insufficient state funding and distribution of financial resources among the study fields, reduction of state funded budget places;
- Lack of financial capacity to attract guest lecturers;
- Need of more diverse forms of teaching methods in study courses;
- High academic and organisational workload of academic staff leaving few opportunities to conduct research;
- Provision of full-scale computer software licenses;
- Difficulties in attracting tuition fee paying students due to the low solvency of residents in Latvia and the low number of entrants in electrical engineering;
- Reduction of the number of entrants in the field of electrical engineering.

In order to maintain the quality of the programmes of the study field “Power, Electrical Engineering and Electrical Technologies” and to modernise and improve it, the following activities are planned for the period of 2020-2025:

- To ensure the internationalisation of study programmes by promoting the implementation of study programmes in English and by attracting foreign students;
- To intensify cooperation with foreign universities;
- To develop academic capacity through the involvement of students, young scientists, guest lecturers and industry professionals;
- To improve study courses and learning methodologies by providing advanced learning materials and developing e-learning tools for students;
- To popularise the work of students in groups oriented for study projects;
- To ensure an opportunity to provide module training;
- To improve continuously the technical equipment of the study process to ensure training in line with modern industrial technologies;
- To ensure the skills and educational capacity of academic staff in Latvia and abroad;
- To promote international cooperation by encouraging students and academic staff to make more active use of the opportunities offered by the ERASMUS+ mobility programme;
- To apply for and implement international and local research projects;
- To increase involvement of industry professionals in the provision of studies, both in the status of guest lecturers and in the state examination commissions;
- To ensure opportunities for internship at leading Latvian companies and to increase the number of companies with which cooperation agreements have been concluded;
- To ensure access for students to the latest electrical engineering literature;
- To be involved in supplementing of resources of RTU Scientific Library.

Development measures, as well as measures for eliminating weaknesses and threats, are provided in Annex 3 “Study Field Development Plan for 2020 – 2025”.

Matters regarding development of study programs, academic activities, study contents and quality in the study field “Power, Electrical Engineering, and Electrical Technologies” are settled in the field commission. The commission includes directors of study programs, representatives of the relevant science fields and field professionals, which are not employees of RTU, leading academic personnel from the study field as well as student representatives in as observers (see annex Field commission members of the study field “Power, Electrical Engineering, and Electrical Technologies”). The proposals on development plans of study programs for the field commission are elaborated within the departments implementing the study programs – in the study field “Power, Electrical Engineering, and Electrical Technologies” these are Institute of Industrial Electronics and Electrical Engineering and Institute of Power Engineering of the faculty of Faculty of Electrical and Environmental Engineering.

1.4. The structure of the management of the study direction and the relevant study programmes, and the analysis and assessment of the efficiency thereof, including the assessment of the role of the director of the study direction and the heads of the study programmes, their responsibilities, and the cooperation with other heads of the study programmes, as well as the assessment of the support by the administrative and technical staff of the higher education institution/ college provided within the study direction.

In general, management of the study field “Power, Electrical Engineering and Electrical Technologies” and the relevant study programmes is ensured by the FEEE and FMETA councils, the study field commission and the head of the study field, the heads of study programmes, the administration of institutes or departments implementing the study programmes, as well as student self-governments of FEEE and FMETA. The study field at Riga Technical University is mainly ensured at FEEE.

In total, the study field has 14 study programmes (until the accreditation of the study field or mid-2022, there will be 11 programmes) and they are administered by 4 heads of study programmes. The study field commission includes heads of all programmes, representatives of employers and a representative of students (see Annex “Composition of the Study Field Commission”).

The programmes of the study field at the Faculty are implemented by two FEEE institutes:

- Institute of Industrial Electronics and Electrical Engineering
- Institute of Power Engineering

One or more study programmes included in the study field are implemented by each of the institutes. Institutes and their departments provide training and methodological work: develop and renew study courses, ensure the conduction of relevant study courses, supervision of the graduation papers and perform other activities related to teaching, methodological and scientific work.

Other organisational units of RTU – faculties and institutes – are also involved in the implementation of the FEEE study programmes of the study field, e.g., RTU Faculty of E-Learning Technologies and Humanities and its Institute of Applied Linguistics, Faculty of Computer Science and Information Technology and its Department of Engineering Mathematics, Faculty of Materials Science and Applied Chemistry, Faculty of Mechanical Engineering, Transport and Aeronautics, Faculty of Civil Engineering.

The FEEE team consists of three heads of the study programmes and administrative and academic staff involved in the implementation of each programme – nine employees in total. The staff carry out study support processes, such as the organisation of study work, the provision of public and international relations, student records, technical support in the study programmes of the study field and other works related to the implementation of the study programme. The most important positions of administrative and technical staff include assistant project manager, assistant manager, senior student service specialists, public relations specialist, senior computer system and computer network administrator and laboratory managers.

Currently, there are two project supervisor assistants involved in the implementation of the study field at FEEE whose main responsibilities and competence are supervision and management of the administrative work in general. Their duties also include the organisation of business correspondence, the circulation of information, including with cooperation organisations in Latvia and abroad, the coordination of telephone calls, e-mails and correspondence flows, planning the work schedule of the manager, organising appointments and receptions. They may also carry out simple financial records at the department, analysis, assessment and control of documentation, as well as the drawing up of various types of activity-related reports at the order of the manager and the solution of problems or substandard situations.

The assistant manager is a financial specialist competent in the planning and monitoring of the financial flows of the organisational units, providing support in the drawing up of applications and reports required in the study process and scientific projects.

The competence of office administrator includes the implementation of the administrative (office) work, the servicing of visitors and students and the solution of standard situations or their delegation to the responsible specialists, including forwarding of complaints or applications to the relevant organisational unit for consideration. They should be able to explain the differences in study programmes and university services and provide assistance in decision-making. The office administrator may also be responsible for the procedures of the circulation of documents within the organisational unit, including the drawing up of student files and their transfer for record keeping.

FEEE has two senior student service specialists whose main tasks include organising and maintaining of record keeping of the organisational unit, ensuring the student admission process, creating study lists, informing students about changes in the study process, servicing visitors and students and solving problems. They may advise and provide information on the study opportunities and further education. They should be able to explain the differences in study programmes and university services, help in decision-making. At the order of the manager, they compile and analyse the required data, draw up the necessary reports and perform other duties at the order of the manager of the organisational unit.

The duties of the public relations specialist at FEEE are carried out by one person whose primary duties and competence are the formation of a positive image of FEEE, including translation of various materials and documents, as well as the drawing up of informative materials, collecting, systematising and updating information about the organisational units, improvement and updating of the website. One of the main responsibilities is the development and implementation of the marketing plan. The public relations specialist has to maintain constant contacts with international cooperation partners of FEEE and work at attracting new partners, organising visits of the partners, settling formalities, accepting delegations, etc.

There is one senior computer and computer network administrator whose main responsibilities and competence are maintenance, installation and configuration of hardware and office equipment. He performs diagnostic tests of the system and resolves complex problems in the system or integrates systems and addresses interoperability problems. He is responsible for administering operating systems and application (software) packages with a large number of users, including regular system tests. The computer network administrator plans and coordinates the continued functioning of the system, analyses the necessary improvements, evaluates possible solutions and provides recommendations for the management.

The faculty also has a scheduler who is responsible for planning of lectures and practical classes, and premises for the study programmes included in the study field and the coordination and monitoring of changes.

Internal quality control at the faculty and at the level of the study field is ensured by the Vice Dean for Academic Affairs. The quality of the study programme is ensured by the head of the study programme and the academic staff involved in the implementation of the programme, whereas the whole process is controlled by the administration of the responsible institute or department. Once a year, the abstracts of the study courses, curriculum of the study programme, the methodological materials, as well as recent study literature and methodological guidelines for study papers (reports, term papers, internship reports and graduation papers) are reviewed. The academic staff and the administration of the study programme participate in various experience exchange activities, cooperating with the higher education establishments in other countries, participating in the meetings with representatives of relevant institutions and entrepreneurs, as well as discuss the current developments in the field, analysing the results of the students' research papers and projects.

The responsibilities and duties of the head of the study programme are provided in the job description. The most important of them include: management of study programme development, improvement of the curriculum in compliance with the requirements of the scientific fields or the sectors of the national economy, implementation of quality assurance, supervision of study plan development, promotion of internationalization, cooperation with RTU Study Department providing the input of data in the information system, as well as the cooperation with other departments of RTU that are involved in the implementation of the study programme. The administration of the Faculty constantly monitors the compliance of the premises and technical equipment with the modern quality requirements; as a result, appropriate multimedia equipped classrooms are ensured. Support functions for the development and implementation of study programmes are provided by RTU Study Department. RTU Programme Management and Curriculum Design Unit plays an important role in supporting the improvement of the study programme.

RTU has established a rigid system for the management and development of study programmes. Proposals to introduce any changes in the curriculum are made by the Study Field Committee based on the recommendations of the academic staff, references from employers, suggestions from the Student Self-government, as well as observing the latest trends in the national economy and the labour market. The Study Field Committee requests the Faculty Council to review and approve them. Based on the decision of the Faculty Council, the RTU Senate approves changes in the study field. Amendments in the structure of study programmes are approved by the order of RTU Vice-Rector for Academic Affairs. Technical support of the study field is provided by the Record-Keeping Department of a respective study programme as well as IT Department. Such cooperation in the implementation of the study programmes within the study field is to be evaluated as efficient and stimulating the development of the study field.

1.5. Description and assessment of the requirements and the system for the admission of students by specifying, inter alia, the regulatory framework of the admission procedures and requirements. The assessment of the study period, professional experience, and the options for the students to have their previously acquired formal and non-formal education recognised within the study direction by providing specific examples of the application of these procedures.

The admission process and procedure of students’ matriculation is stipulated in the RTU Admission Regulations, which are elaborated based on the Law on Higher Education Institutions and Regulations of the Cabinet of Ministers No 846 issued 10 Oct 2006 ''Regulations on Requirements, Criteria and Procedures for Enrolment in Study Programmes'', as well as the specific requirements of study programmes and the industry. The RTU Admission Regulations are approved by the RTU Senate and published on November 1 each year (see the files of Annex 29-34 of the list of Internal regulations).

Admission requirements are logical, understandable, and linked to the goals defined in the RTU Strategy. Admission system is state-of-the-art, easily accessible, logically structured, and is evolving in line with today's digitalization trends, providing the potential students with the convenient and easy to use application to university registration tool.

Applicants are admitted to full-time and part-time undergraduate programmes based on the results of the Centralized Examinations (CE) in Mathematics, the Latvian language and the Foreign Language, and the final grades in individual subjects obtained in the Secondary Education, and the entry test results. If, in addition to these CEs, the applicant has a CE in Physics or Chemistry, the results of these CEs are taken into account in the ranking calculation.

In order to participate in the competition for the state budget funded seats, the rating in Mathematics CE is calculated as the average value of all Mathematics CE rating sections and must be at least 12 percent. An applicant with a CE in mathematics of less than 12 percent may apply only for a tuition fee.

To determine the candidate's rank in the competition, each CE rating, calculated as an average of all CE evaluation sections, and each entry test (if any applies) is multiplied by the appropriate weighting factor and the resulting multiplications are added together. Some study programme applicants must pass an entry test, the result of which shall be multiplied by an appropriate weighting factor and summed up in the total calculation of rank.

Persons, who have received secondary education prior to 2009 (including), as well as persons, who have received secondary education abroad, or persons, who were exempted from passing the secondary education state examinations in accordance with the procedure set by regulatory enactments, may be admitted to the study programmes based on their year grades in the secondary education document in the subjects mentioned in the RTU Admission Regulations, which must be successfully passed. Up to 2019, the admission based on the secondary education year grades was attributed to persons who completed secondary education prior to 2004. In general, the RTU Admission Regulations follow Regulations of the Cabinet of Ministers No 846.

Persons who have completed secondary education and have not passed any of the CEs mentioned in the RTU Admission Regulations or have failed the year grade, shall pass the CE in accordance with the Cabinet of Ministers Regulations No 335 "Rules on the content and procedure for centralized examinations".

Persons who have not passed CE in Latvian and who do not meet the requirements of RTU Admission Regulations, shall pass the entrance examination in Latvian as prescribed by RTU. The result is evaluated in percentage.

In compliance with Cabinet Regulations No 543 adopted on 29 September 2015 “Regulations on Replacement of the Foreign Language Centralized Examination in the General Secondary Education Program by Foreign Language Examinations Conducted by International Testing Institutions”, CE in the foreign language can be replaced with a foreign language examination conducted by an international testing institution the certificate of which must be presented to the RTU Admission Committee.

The applicants who have acquired a bachelor's degree in a field relevant to the study programme are enrolled to the graduate study programmes. The applicants take part in the competition with a weighted average grade from the Bachelor or professional study programme records. The weighted average grade is calculated as the sum of all the grades received in each study course multiplied by the credit points acquired in the study programme and is divided by the total number of credit points within the study programme. If credit points are not verified, the number is calculated as the multiplication of the grades and contact hours obtained in each study course divided by the total number of contact hours.

Before applying for the doctoral studies, the candidate and the Head of the PhD Study Programme must agree upon the possible scientific advisor / consultant and receive his/her written consent. The PhD Thesis scientific advisor may be from another scientific establishment; however, the applicant must also choose the scientific advisor / consultant from RTU. Every year, the RTU Senate approves the regulations for the admission of doctoral students for the study year, which set deadlines for the submission of admission documents. The applicants for Doctoral study programmes, can submit application for full-time studies by arriving at the Doctoral Studies Department, bringing the required documents, within the admission deadlines. Documents necessary for the competition are compiled by RTU Doctoral Studies Department. After the collection of documents, the PhD Studies Department submits them to the Scientific Committee of the respective Faculty, which draws the Ranking table of the applicants according to the evaluation criteria set by the Faculty Scientific Committee and approved by the order of RTU Vice-Rector for Research. The Ranking table is submitted to Admission Committee of doctoral students. The Admission Committee is approved by an order of RTU Vice-Rector for Research.

Taking into account the spread of Covid-19 and in order to facilitate the admission process of applicants for studies at RTU, starting from the summer of 2020, the admission process was improved.

There are two ways to apply for the state budget funded seats in undergraduate study programmes:

- Electronically in the Joint Enrolment Undergraduate Study Programme information system, using the e-service portal (https://www.latvija.lv). Given the spread of Covid-19, with the summer 2020 admission, secondary school graduates of the 2019/2020 school year can approve the electronic application remotely without arriving in person. If the secondary education was obtained abroad or until 2019/2020 school year, the applicants must confirm their electronic applications by arriving at the designated locations within the deadlines and presenting the originals of the required documents;
- Arriving at the RTU Admission Committee in person, presenting the originals of the required documents.

To apply for the state budget funded seats in the graduate study programmes RTU undergraduate study programme graduates can submit their applications online on RTU portal ORTUS. Taking into account the spread of Covid-19, with the summer 2020 admission, also graduates of other Latvian state-accredited higher education institutions' undergraduate study programmes can submit applications electronically on the RTU website, or by visiting RTU Admission Committee.

Applicants who do not qualify for the state budget funded seats and applicants who have received their education outside Latvia, as well as in other specific cases, must appear in person at the RTU Admission Committee within the admission deadline, with the required documents.

In view of the dissemination of Covid-19, and in order to improve the admission process at RTU and to facilitate the application of entrants for studies at RTU, electronic application for tuition fee studies at undergraduate and graduate study programmes will be introduced in summer 2021.

Recognition of previously acquired formal and non-formal education at RTU is carried out in accordance with the "Regulation on the Recognition of the "Courses Completed at Other Universities and RTU Study Programmes" (Resolution of RTU Vice-Rector for Academic Affairs No 02000-1.1/29 as of 4 April 2016) and the "Procedure for Recognition of Competencies Developed Outside Formal Education or From Professional Experience and Learning Outcomes Achieved in Previous Education at Riga Technical University" (approved at the Meeting of RTU Senate on 23 September 2019, Minutes No 632). Also available online on the RTU website - Study Regulations https://www.rtu.lv/lv/studijas/bakalaura-limena-studijas/studiju-reglaments in Latvian.

RTU Admission Regulations are published at https://www.rtu.lv/lv/studijas/uznemsana/uznemsanas-noteikumi (for local students) and at http://fsd.rtu.lv/ (for foreign and exchange students).

The opportunities for recognising a study period, professional experience, formal and non-formal education within the study field are a convenient and relatively simple procedure for the students. When a student submits an application accompanied by the necessary documents regarding the learning and professional experience of previous similar study courses, it is evaluated. In order to implement the recognition of professional experience, students must submit a description of their professional activity, which is evaluated by the commission taking a decision on the conformity of professional activity with the requirements of the study programme. Additional discussion may be possible, if necessary, to clarify the unclear issues.

Within the framework of the study field, the recognition of professional experience takes place on a regular basis, every semester, particularly over the past two years, which is explained by the widely available training process organised by non-educational institutions in the industry, associations, non-governmental organisations, etc.

At the study programme "Power and Electrical Engineering", it is possible to recognise the previously acquired professional experience with the internship provided for in the study programme. Such a procedure is logical because a student who has worked in the industry for at least 10 years is a professional in their field. Documents of a number of students have been evaluated and their prior education and/or professional experience have been recognised, including internship.

Recognition of study courses obtained in formal education at all programmes of the study field takes place almost every semester at the request of students.

For students of Bachelor and Master study programmes, who matriculated at later stages of study, recognition of study courses acquired at their previous study level, or the first level of higher vocational education (college) programmes, is performed, provided that the study courses and their volume correspond to RTU study programmes.

1.6. Assessment of the methods and procedures for the evaluation of students' achievements, as well as the principles of their selection and the analysis of the compliance of the evaluation methods and procedures with the aims of the study programmes and the needs of the students.

Assessment of student learning outcomes is carried out in accordance with the "Regulation on the

Assessment of Learning Outcomes” (approved at the Meeting of RTU Senate on 27 May 2017, Minutes No 610), which is available on Studies Regulations page of RTU web page (https://www.rtu.lv/writable/public_files/RTU_studiju_rezultatu_vertesanas_nolikums.pdf in Latvian) English translation is Annex 04 in the zip folder "List of Internal regulations"). Summative assessment system is used in appraisal of student achievements, it implies that the final grade is composed of numerous components.

In the course descriptions of the study programme there is a set of relevant knowledge, skills and competences and their evaluation system, defined learning outcomes for the achievement of which credit points are awarded.

Pedagogical methods used in the implementation of study courses, as well as assessment forms and methods are selected by the instructors responsible for the study courses in compliance with course curriculum and specifics of the programme, as well as student needs. A member of academic staff should inform students about particular assessment criteria at the fist lecture/practical class.

The main advantage of the summative assessment system is that the final grade is made up of several components. Therefore, the students may contribute to their final grade working during semester. Criteria for assessment of the study courses and individual/home tasks are published on ORTUS e-study system beforehand. During semester, the assessment for each home task, test, report, presentation and any other task is ascribed certain weight in the final grade. Exam grade may not exceed 50% of the final grade. Academic staff may take into consideration and also assess student attendance. Assessment structure for the study course is determined by the academic staff themselves, abiding the resolution of RTU Senate that the exam grade may not contribute more than 50% to the final grade. Selecting assessment criteria and methods for evaluation of student achievements, specifics of each study programme and learning outcomes are taken into consideration.

In order to advance professional pedagogical competences of the academic staff, courses and seminars on the newest pedagogical methods are organized regularly. Qualification advancement is provided at both the University and faculty level, organizing academic conferences and methodological seminars. The Centre for Academic Excellence has been established and successfully operates at RTU; it organizes various events aimed at professional advancement of academic personnel at the University level.

(In addition, see the description of each study programme.)

Pedagogical methods for the implementation of study courses, as well as assessment methods, are selected by the academic staff responsible for the study course, in accordance with the specific nature of the course content and study programme, as well as the needs of students.

On the basis of the Rules of Procedure, the academic staff of each study course develop criteria for obtaining an assessment and inform students about them. Informing students of the study programme about the criteria and conditions for the assessment of study courses is ensured:

- in situ during the implementation of the study course. Upon commencing the implementation of each study course, the responsible academic staff make a presentation in the first lecture regarding the study course, its aims and tasks, the content of the study course, the learning outcomes, the set requirements, the form of checking mastering of the subject (a test or an examination), the timing, length and conditions of the examination (including the number of questions), the requirements for obtaining a positive assessment and the evaluation criteria.

- prior to the examination (in the event of a test, during the last lecture before the test, in the event of an examination – during a tutorial), the academic staff inform about the set requirements, the form of checking mastering of the study course (a test or an examination), the timing, length and conditions of the examination (including the number of questions), the requirements for obtaining a positive assessment and the evaluation criteria.
- before the examination (a test or an examination) – prior to starting the check, the academic staff inform about the set requirements, the form of checking mastering of the study course (a test or an examination), the timing, length and conditions of the examination (including the number of questions), the requirements for obtaining a positive assessment and the evaluation criteria.

The introduction of students to study courses within the framework of the study programmes is ensured on two levels:

- via the ORTUS internal system of the University, according to the order of the Vice-Rector for Academic Affairs on the use of RTU e-learning system for study courses. The ORTUS portal is available to all students and an e-learning environment has been established within the framework of the ORTUS system which is intended for communication between students and academic staff and, among other things, includes descriptions of all study courses of the study programme, including the course code, name, status, level and type, thematic area, organisational unit and academic staff ensuring the implementation of study courses, number of credit points, abstract of study courses, as well as aims, tasks, expressed in competencies and skills, learning outcomes and their assessment. Descriptions of study courses are compiled in the catalogue of study courses and publicly available without registration to any user (see https://international.rtu.lv/riga-technical-university-rtu/bachelors-studies/). In the e-learning environment, the information available to the student on the course includes the description of the study course and its plan, the information published by the academic staff on requirements, assessment, evaluation of tests and training materials.
- in situ during the implementation of the study course. Upon commencing the realisation of each study course, during the first lecture, the responsible academic staff provide an introduction to the course, its aims and tasks, the content of the course, the learning outcomes, the set requirements, the form of checking mastering of the course (a test or an examination), the timing, length and conditions of the examination (including the number of questions), the requirements for obtaining a positive assessment and the evaluation criteria.

Informing the students of the study programme regarding the assessments received during the examinations of their study courses and the justification thereof is ensured in accordance with Articles 3.8 and 6 of the Regulation on the Assessment of Learning Outcomes:

- In the ORTUS system. The e-learning profile of each study course includes the “Assessment” section, where information is available on the results of tests (interim tests, for example, home works and individual works, and final works – an exam or a test) and their explanations.
- After a test. At the request of students or at the initiative of the academic staff, the instructor organises individual meetings with the student in order to discuss the answers provided in the examination and the assessment obtained.

RTU does not stipulate specific requirements regarding the attendance of classes, except for students of the first year for whom the attendance of classes is mandatory in accordance with the Rector's Order on the Procedure of Studies for the First Year Students. Regarding other years of study, departments and academic staff may determine their requirements for attending classes, having informed students about it at the beginning of the course:

- verbally informing students about the aim, content, progress, compulsory training, course

evaluation criteria and terms and conditions for tests;
- by handing out a printed plan of the course or/and placing it in the ORTUS e-learning environment, where themes included in the course, a breakdown of lessons (theoretical lecture, practical classes or laboratory work), and compulsory classes to be attended.

Attendance of students is registered in the attendance sheets. The attendance sheets include a course plan (theme, date) and the place for the lecturer's signature. In order to ensure the registration, during the first lecture, each student is issued the attendance sheets (or, in the event of non-attendance of the first lecture, the attendance sheet is issued by the academic staff at the request of the student), in which the responsible academic staff sign for each of the classes attended by the student.

In order to ensure feedback between students and the academic staff of the specific study course, the knowledge assessment of students and the monitoring of their independent study works is performed continuously during the semester through seminars and discussions, between the tests.

The evaluation of the graduation papers (Bachelor and Master Theses) is based on the respective RTU regulations (including on submission of an appellation on the graduation or state examinations and the procedure of its consideration).

The final grade of the graduation papers is composed of:

- the arithmetic average of individual assessments of members of the State Examination Commission on the graduation paper and its presentation, including the assessment of the scientific adviser as a member of the respective commission;
- the assessment of the reviewer of the graduation paper;
- performance of students in the development of the graduation paper during the semester.

1.7. Description and assessment of the academic integrity principles, the mechanisms for the compliance with these principles, and the way in which the stakeholders are informed. Specify the plagiarism detection tools used by providing examples of the use of these tools and mechanisms.

Since 2010 all students that gradate from any RTU study programme should upload electronic versions of their graduation papers in ORTUS portal in order to improve the quality of graduation papers, create a bibliographic database of the graduation papers and introduce an automated control system for detecting plagiarism. RTU uses two major plagiarism control tools in the study process:

1. Since 2015 graduation papers of study programmes of the study direction have been checked in the joint computerised plagiarism control system (JCPCS), which unites numerous Latvian universities and colleges. RTU uses the system in cooperation with the University of Latvia. This system is used to check graduation papers after their uploading to the ORTUS environment. JCPCS complements and extends plagiarism identification opportunities.
2. Starting from 20 December 2017, RTU has been having TurnitIn®, the world’s leading tool for the correction of written papers and combating plagiarism that is used daily by millions of students and academics around the world. TurnitIn® tool is integrated with RTU ORTUS e-study system and provides full service of submitting, correcting, verifying the originality (plagiarism) and return of the submitted papers. TurnitIn® offers two main platforms: a platform that automatically checks for the percentage of non-genuine content (plagiarism)

and a platform that allows to electronically correct the submitted papers. This tool is used to check all the electronic versions of graduation papers submitted for defence and further control measures are operatively implemented for potential plagiarism detection.

Graduation papers are checked in both systems in parallel, thus using the advantages of both systems. The developed Doctoral Theses are in a similar way controlled with extreme scrutiny. Since 1997, the Researcher Code of Ethics has been effective at RTU (see the file of Annex 19 of the list of Internal regulations). Academic Integrity Code, approved at the RTU Senate meeting of 29 February 2016. The aim of the Academic Integrity Code is to strengthen academic culture and integrity in the academic environment of RTU, to explain the concept of academic integrity and related actions, to define main procedures in examination of academic fairness violations. (see https://www.rtu.lv/writable/public_files/RTU_rtu_studiju_reglaments_7.1.1.4..pdf in Latvian).

There are procedures defined, how the report on the violation of the student's academic integrity is filled, registered, reviewed, and appealed. Informing and educating students about the aspects of academic integrity takes place both within the study courses and in specially organized seminars.

Both students and academic staff have access to the book “Glossary for Academic Integrity” published by RTU publishing house (available at http://www.academicintegrity.eu/wp/glossary/).

In addition, RTU participates in different initiatives that bring forward and solve academic integrity related issues. RTU is a member and one of the founders of the European Network for Academic Integrity (ENAI), where it is involved in active work sharing experience, keeping updated about academic integrity related issues, and organizing conferences. The Dictionary of Academic Integrity Terms and Guidelines is one of the newest aids that has been developed and published by RTU Press. In the framework of Specific Support Objective (SSO) 8.2.3 of the project “Development of Efficient Management of Riga Technical University”, RTU, in cooperation with the University of Latvia (UL) and Rīga Stradiņš University, develops educational aids, as well as participates in the establishment of the Latvian national academic integrity organization and development of plagiarism control tools.

The organisational units implementing the study programme have developed a control mechanism, i.e., the initial check is performed in the process of interim assessment, which is performed by the work of the Advisory Examination Commission. When the student comes to these examinations, he or she should submit the electronic version of the performed work and the paper is checked in free plagiarism control tools in presence of the student. When students draft their graduation papers, they are instructed about plagiarism and its consequences several times. Methodological materials contain detailed instructions on correct presentation of references. This process allows to reduce plagiarism and highlights faults in the student’s paper, which needs to be rectified. The generally accepted “good practices” show that more attention should be paid to the papers showing 20 percent or more matches. A message is received from the system, when the match level is higher than 20%. The papers are examined, reasons of matches in the text are evaluated and a decision is made whether the student should be allowed to defend his or her thesis.

During the reporting period, the percentage of plagiarism in the Bachelor and Master programmes did not exceed 22%. The generally accepted “good practice” indicates that increased attention should be paid to those papers where the percentage of plagiarism is or exceeds 20%. For papers with a level exceeding 20%, additional expertise is carried out. The organisational unit evaluates what constitutes the percentage of plagiarism. When assessing the papers, it is concluded most frequently that the percentage of plagiarism is composed of the text of the forms in the paper, names of standard sections (Introduction, Conclusions, etc.), as well as the content of different laws and regulations and the information contained on web pages of companies or institutions, which students have copied in their paper with a provided reference or mentioning the source in the text.

Some examples from different study programmes.

In academic year 2018/2019, Turnitin plagiarism checker identified 44% of plagiarism in the Bachelor Paper of the student of the academic Bachelor programme. Part of the plagiarism was made up of the title page, the evaluation page and the contents of the list of sources of information, but most of the similarities were in the body of the paper. At the beginning of the paper there was a lot of directly captured text, at least from different sources and with references, and in the end, references were inappropriately inserted or omitted in the practical results. The paper was returned to the student for correction. The student corrected part of the text at the beginning of the paper, significantly reducing direct textual similarities, and corrected or inserted missing references. As a result, the Commission admitted the paper for the viva voce examination yet at the end of the spring semester on a reserved date for the delayed papers.

In academic year 2018/2019, Turnitin plagiarism checker identified 46% of plagiarism in the Bachelor Paper of the student of the professional Bachelor programme. Part of the plagiarism was made up of the title page, the evaluation page and the contents of the list of sources of information, but most of the similarities were in the body of the paper. To a large extent, the annotation and introduction were copied. The paper was largely composed of a literature analysis, at the beginning of which there was a general description of the situation consisting of materials copied from different sources with few adjustments to the text. Further, there was a description of the theoretical material, which made up a large part of the paper. This description was mainly created using one textbook and parts of it from works of other students. In many places, references to the borrowed text, formulas, and pictures were missing. At the end of the paper, there was an example of calculations that mostly looked like having been done independently. Three of the conclusions contained direct similarities with other works. Accordingly, due to the high volume of similarities and insufficient references, the paper was returned to the student for significant corrections, requiring the reduction of similarities in the body of the text, full insertion of references, change of the annotation and introduction and corrections to the conclusions. Unfortunately, the changes made during the summer holidays have been insufficient and the acceptable version of the work has not been received up to now.

In academic year 2019/2020, the Turnitin plagiarism checker identified 43% of plagiarism in the Bachelor Paper of the student of the academic Bachelor programme. Part of the plagiarism was made up of the title page, the evaluation page and the contents of the list of sources of information, but most of the similarities were in the body of the paper. To a large extent, the contents of the annotation were copied and the body of the paper contained large parts directly copied, where there were insufficient references to figures and formulas in individual chapters. The paper was returned to the student for adjustment and, after sufficient corrections, was admitted to viva voce examination at the beginning of the autumn semester.

1.8. Specify the websites (e.g. the homepage) on which the information on the study direction and the relevant study programmes is published (in all languages in which the study programmes are implemented) by indicating the persons responsible for the compliance of the information available on the website with the information published in the official registers.

Detailed information on the study field and the study programmes pertaining to it with the indication of the languages of instruction is available at RTU web page:

1. RTU web page, in the section on education opportunities in the Latvian language (https://www.rtu.lv/lv/studijas) (responsible person – I. Bušovska, Head of the Admission Department);
2. RTU web page, in the section containing comprehensive information on education opportunities in the English language (https://www.rtu.lv/en/studies) (responsible person – I. Tipāns, Director of the International Cooperation and Foreign Students Department);
3. Interactive web pages dedicated to RTU study fields, study programmes therein, as well as the detailed description of the offered study courses in the Latvian and English languages (https://stud.rtu.lv/rtu/vaaApp/sprpub) and (https://stud.rtu.lv/rtu/discpub/list?english) (responsible person – G. Alksnis, Head of the Programme Management and Curriculum Design Unit);
4. Web page designed for the foreign student target audience on RTU study programmes implemented in English and student mobility opportunities (https://international.rtu.lv, https://apply.rtu.lv) (responsible person – I. Tipāns, Director of the International Cooperation and Foreign Students Department).
5. FEEE section of the website on programmes in Latvian https://www.rtu.lv/lv/FEEE/toposajiem-studentiem-FEEE/studiju-programmas-3 (responsible person – Zane Urtāne)
6. FEEE section of the website in English https://www.rtu.lv/en/university/structure-and-administration/faculties/electrical-and-environmental-engineering (responsible person – Zane Urtāne)

II - Description of the Study Direction (2. Efficiency of the Internal Quality Assurance System)

2.1. Assessment of the efficiency of the internal quality assurance system within the study direction by specifying the measures undertaken to achieve the aims and outcomes of the study programmes and to ensure continuous improvement, development, and efficient performance of the study direction and the relevant study programmes.

RTU operates pursuant to “Constitution of Riga Technical University” (approved by the Law “On the Constitution of Riga Technical University”, the law was adopted in the Parliament on 23 October 2014 (see the file of Annex 01 of the list of Internal regulations.).

In order to efficiently control implementation of RTU Strategy, RTU Strategy Management System has been established, which provides that strategic aims, activities and tasks are cascaded to the level of definite organizational units and their staff.

RTU has an internal quality management system in place in accordance with the RTU Quality Policy updated and approved at the meeting of RTU Senate on 25 September 2017, Minutes No 612 (see: RTU Quality Policy) and the RTU Excellence approach approved at the meeting of RTU Senate on 30 January 2017, Minutes No 606 (see: RTU Excellence Approach). Since the study direction is one out of 12 study directions implemented by RTU, and its internal quality system is closely related to RTU Quality Management System.

RTU Quality Policy is aimed at implementation of RTU mission and achievement of strategic aims – scientific research, academic, infrastructure and organizational excellence, and recognizability. The

Quality Policy provides the framework for implementation of RTU Strategy, and the paths for development and improvement of research, study process and organization. RTU Quality Policy is reconciled with the ENQA standards and guidelines. RTU Excellence Approach and Quality Policy are reciprocally integrated documents, which determine that RTU employs the EFQM quality model.

Starting with December 2018, RTU has been a member of the European Foundation for Quality Management, having joined the global quality cooperation network.

RTU Excellence Approach (see the figure in file "RTU Excellence Approach") has been elaborated in order to promote purposeful development of the University as an excellent organization, and RTU Constitution, Strategy and Quality Policy are integrated therein; it is based on the Standards and Guidelines for Quality Assurance in European Higher Education Area (ESG) developed by the European Association for Quality Assurance in Higher Education and the basic principles of the EFQM Excellence Model.

The structure of RTU Excellence Approach (see the figure in file "Structure of RTU Excellence Approach") is designed in accordance with the criteria of the EFQM Excellence Model and forms the basis for the maintenance of performance at a high level, a prerequisite for its continuous improvement, as well as for achievement of sustainable results of RTU activities and excellence. Student results are a separate criterion, they are also in part transferred to the main activity results; thus, the quality of the study direction is closely related to RTU quality management.

To promote introduction of the model of the EFQM total quality management system, as well as to assist in the compilation of a self-assessment report, a working group was established at RTU on 29 September 2017 (Rector's order No 01000-1.1/225), which comprised representatives of RTU administration, faculties and Student Parliament (18 in total).

Potential problems were identified and suggestions for improvement of RTU Quality Policy, including improvement of academic quality, were made at the meetings of the working group. In the period of one year, the working group considered compliance to nine criteria of the EFQM model and analysed 101 sub-criteria, having identified 133 problems in total and having made 146 suggestions. The priority problems were included in RTU Development Plan as tasks set for a definite term to be solved by the respective organizational units. Quality model review report is drawn up with regard to the Quality System, which identifies the areas that should be improved. Performance indicators and results of student polling are integrated in RTU Quality System.

Application of RTU Excellence Approach is based on process-oriented activities and includes clear process flow and their interaction. Striving for excellence, RTU actively works on process planning, definition of its aims and interaction analysis. RTU has developed criteria and methods for ensuring efficient process operation and management. RTU conducts the process analysis and provides recommendations and suggestions on process improvement, which are discussed with process managers and persons responsible for process procedures; later they are approved as performable tasks with a definite completion term. Task creation and control tools inbuilt in the Document System, reports on task performance at the organizational unit level provide the necessary support for achievement of performance indicators of the annual aims and tasks set in RTU Strategy. For example, development of the uniform study programme application structure and assessment criteria is one of the tasks for the process "Provision and Organization of Studies" approved in the system with the completion term set until 31 December 2020; they were developed and approbated on the study programmes developed within SSO 8.2.1 project.

The departments and institutes, faculty councils, the service of the vice-rector for academic affairs, the service of the vice-rector for development, the student parliament and the RTU Senate are involved in ensuring internal quality of studies at RTU. These institutions comprehensively evaluate the study directions and programmes to be newly created, as well as changes to study directions and programmes, evaluate annual self-assessment reports of study directions. The internal quality assurance mechanism of studies at RTU is functioning at the level of administration, faculties, study directions and study programmes of the university.

Study Direction Committees at RTU supervise academic activities in the respective study direction and are responsible for curriculum of the study programmes within the study direction, including accreditation of the study direction. Members of student self-government are involved in ensuring the quality of the study direction and study programmes implemented therein; they actively participate in the work of the decision-making bodies of the University: RTU Constitutional Assembly, RTU Senate, RTU Senate commissions and faculty councils.

At the level of the Faculty and the study field, the internal quality is ensured by the FEEE Council, the study field commission and the head of the study field, the head of the study programme, the administration of the institute or the department implementing the study programme, as well as the self-government of FEEE students. Internal quality control at the level of the Faculty and the study field is ensured by the Deputy Dean for Academic Affairs at the Faculty or by their delegated person or commission.

As specific measures undertaken to ensure continuous improvement and development of the study field and its programs, 25 meetings of the Study field commission, that have taken place within the assessment period (since 2013.) can be mentioned, within which several improvements in the study programs have been elaborated. Moreover, study program directors organise meetings with last year students in order to get feedback for improving the study process and contents. Latest of such meetings have taken place on 13th of November 2020. With students from professional bachelor study program “Adaptronics” and on 3rd of June – with students from professional bachelor study program “Computerised Control of Electrical Technologies”

2.2. Analysis and assessment of the system and the procedures for the development and review of the study programmes by providing specific examples of the procedures for the development of new study programmes within the study direction (including the approval of study programmes), the review of the study programmes, the aims, and regularity, as well as the stakeholders and their responsibilities. Description of the mechanism for obtaining and providing a feedback, including with regard to the work with the students, graduates, and employers.

Study programme development and revision processes are regulated according to the "Procedure for Application, Elaboration and Amendment of the Study Programmes" (published at https://www.rtu.lv/writable/public_files/RTU_studiju_reglaments_4.6._programmu_izstradasanas_kartiba.pdf (in Latvian); English translation is Annex 06 in the zip folder "List of Internal regulations"), which in detail specify activity sequence and parties involved, starting with drawing up an application for new study programme elaboration and finishing with study programme closure. Procedures are reconciled with the effective national regulatory enactments pertaining to study programme licensing and amendment.

Revision of the study programme curriculum is the responsibility of the Study Direction Committee. The responsibilities and activities of the committees are regulated by the “Regulation on the Study Direction Committee” (approved at the RTU Senate on 26 April 2021, Minutes No 649; published at https://www.rtu.lv/writable/public_files/RTU_studiju_reglaments_4.7._studiju_virziena_komisijas_nolik ums.pdf, (in Latvian); English translation is Annex 07 in the zip folder "List of Internal regulations").

Expert assessment of the study programme is performed by the Study Direction Committee, then – by the Faculty Council or the councils of several faculties involved. The expert assessment procedure is finalized by the Study Department. The Study Direction Committee evaluates the quality of the draft study programme and the compliance of its curriculum to the planned aims and tasks.

In order to analyse study directions and to receive feedback, RTU has developed a polling cycle:

- When starting studies at RTU, a survey of students is conducted about expectations from studies, availability of information, admission process. The survey is conducted electronically on the ORTUS portal.
- Each semester, the polling of the students at a study programme is conducted to find out student opinion about instructor’s work quality and obtain evaluation of the study programme. Polling is conducted electronically in *ORTUS* portal, the results are received by each instructor personally and the head of the organizational unit. The summary of the results is summarised at department meetings, at the meeting of the Study Direction Committee and the meeting of the Faculty Council.
- After each graduation round, polling of the graduates of Bachelor and Master programmes is conducted. The results are taken into consideration in the improvement of the study programmes within a study direction and discussed at methodological seminars.
- Annual polling of Doctoral students and PhD alumni has been introduced, it is also planned to conduct surveys of PhD entrants. The polling on the admission procedure and study process has been launched. The summaries of results are published on ORTUS portal. The results are taken into consideration in the improvement of Doctoral study process and the quality of support provided to doctoral students.
- It is also planned to run regular centralised polling of RTU employers. Polling of employers presently takes place at the end of internship of each student, as well as within the scope of development of study programmes.

From the spring semester of academic year 2020/2021, a mid-semester questionnaire has also been introduced.

The following mechanisms are used to obtain feedback from employers.

RTU Council Convention, composed of representatives of different sectors, advises RTU Senate and Rector on the RTU Development Strategy. It has the right to propose an issue to the Senate and the Constitutional Assembly. The RTU Strategy and its development program are presented in the RTU Council Convention, the decision-making bodies, as well as to cooperation partners, industry associations and leading companies, with feedback and suggestions being incorporated into the RTU documents.

The involvement of stakeholders and the realization of major projects is the responsibility of the Vice-Rector for Strategic Development. He clarifies existing needs, coordinates key priorities and activities, implements recommendations and promotes the sustainable development of the RTU.

Employers, as providers of the internship of RTU students, after completing the practice, prepare online feedback on the knowledge and skills of the student, thereby also assessing the relevance of the knowledge provided by the study programme to the needs of the industry.

Employers' feedback is obtained also from the Council Convention, composed of representatives of different sectors and industry associations, as well as from the assessments provided by employers on the portal prakse.lv (RTU is the most recommended university at https://www.prakse.lv/top for several consecutive years (information available only in Latvian)).

Feedback within study programmes is received through every semester student polling, regulated by the “Regulation on Student Polling for Assessment of the Study Process” (approved at the RTU Senate on 27 January 2014, Minutes No 577; published at https://www.rtu.lv/writable/public_files/RTU_anketesanas_nolikums.pdf (in Latvian); English translation is Annex 20 in the zip folder "List of Internal regulations").

Study programme course abstracts and course programmes, methodological materials, newest educational literature and methodological instructions for study papers (reports, study papers, internship reports and graduation papers) are reviewed once an academic year.

Courses and seminars on latest teaching methods are organised for academic staff, as well as attendance of courses to improve qualification is promoted. Academic staff and heads of study programmes participate in different experience exchange activities cooperating with universities of other countries, meeting representatives of respective institutions and businessmen, as well as discussing among themselves latest developments in the sector, research papers and projects of students by analysing their results.

The Study Direction Committee analyses recommendations from employers and external experts, which are used as the basis for improvement of the study programmes.

In order to receive feedback from RTU graduates, RTU Alumni Association has been established. It actively operates at the University (http://alumni.rtu.lv/, https://www.facebook.com/RTUAlumni/ (information available only in Latvian)) and runs an online community platform (https://rtuconnect.net/), which aims at developing alumni traditions. In order to ensure the transfer of experience from graduates, RTU Alumni Association provides mentor training, database maintenance, as well as mentor and mentee matching. RTU Alumni Association organises various events, which bring graduates back to the University, allow for networking, cooperation among the graduates and with the University, and integration in University activities. RTU Grand Graduation Ceremony is a major event introduced by RTU Alumni Association; it gathers the respective year graduates from all nine RTU faculties, academic and general staff, as well as guests.

To review the programmes of the study field, the heads of the study programmes organised meetings involving the academic staff and students. Jointly, they analysed the study process, what was taught and what was missing. In the light of the recommendations, amendments were made to the programmes.

2.3. Description of the procedures and/or systems according to which the students are expected to submit complaints and proposals (except for the surveys to be conducted among the students). Specify whether and how the students have access to the information on the possibilities to submit complaints and proposals and how the outcomes of the examination of the complaints and proposals and the improvements of the study direction and the relevant study programmes are communicated by providing the respective examples.

In order to promote continuous improvement of the quality of studies and provide students with the opportunity to submit proposals and complaints on various study-related issues in accordance with the ESG, in the reporting period from 2013 to mid-2019, at RTU, the examination of students’ recommendations and complaints was carried out; this was done by involving the structural units to which the applications related, as well as the student self-government of the respective faculty.

A new document was approved in 2019 and now student complaints and proposals are considered in compliance with the Procedure for Submission and Examination of RTU Students’ Proposals and Complaints (published at https://www.rtu.lv/en/university/proposals-and-complaints and available in the section "Other Annexes").

The Procedure stipulates how RTU students may submit suggestions and complaints concerning the study process and other issues and determines the terms for consideration of applications and summary of application statistics.

Under the new arrangements, a total of 137 complaints/proposals were received between August 2019 and November 2020, 11 of which were submitted anonymously. Of the submissions there were 30 complaints, 80 problems and 27 suggestions across nine topics (subject: the number of complaints or problems / the number of proposals received):

- Study process: 53 / 10
- Sports: 4 / 2
- IT issues: 10 / 5
- Maintenance of infrastructure issues: 7 / 3
- Accommodation related issues: 74 / 1
- Scholarships: 3 / 1
- Foreign students’ questions: 11 / 3
- Library: 1 / 0
- Other: 16 / 2

Evaluating the submitted complaints on the issues of the study process, 10 of them were related to the planning of study schedules, non-timely posting on the ORTUS e-learning system, another nine were related to communication between an academic staff member and a student. Complaints were also received about remote and face-to-face lecture planning – students were not able to move from home to the faculty and vice versa within the breaks. Proposals were received for the development of new study programmes, introduction of additional classes, training of academic staff related to the use of Microsoft Teams and Zoom. It was also offered to purchase a Grammarly Premium subscription for students.

With regard to economic matters, complaints were submitted about the cleanliness of shared facilities at faculties and the quality of water at drinking water points. In terms of accommodation, students complained about the unavailability of tumble dryers.

IT issues were mostly related to the system overload, due to which it was not possible for students to authenticate on the ORTUS portal. A recommendation was received regarding the security of the ORTUS portal URL, which raised students’ concerns about the secure transmission of their data.

Complaints about sports issues concerned the amount of money awarded to sports undergraduate (100 EUR) and graduate (10 EUR) students.

Other complaints were about alleged harassment and two suggestions for infrastructure improvements – the construction of roofed bicycle sheds, the lack of facilities around faculties and student accommodations and some applications about tuition fee issues.

FEEE administration always listens to offers and complaints of students and follows that all issues are resolved. Student Self-government of FEEE operates actively, organising meetings with mentors of each group in order to talk about the current information and problems. In the event of any deficiencies, representatives of the Student Self-government immediately address the administration to eliminate them.

During the period of assessment within the framework of the study field, a small number of complaints were received in writing and all of which were addressed in accordance with the set procedure, e.g.:

1) An application was received from a student of the Bachelor programme “Power and Electrical Engineering” on the replacement of an instructor for an examination in the study course “Electrical Systems”, stating that this instructor did not correctly assess the results of the examination. Addressing the application, an examination commission of the study course “Electrical Systems” was established for the conflict settlement procedure, headed by the FEEE Deputy Dean for Academic Affairs, with participation of the academic staff of the study course “Electrical Systems”, independent academic staff member – a representative of the Institute of Power Engineering, and the field specialist.

The student passed the examination successfully.

2) An application was received from a student of the Master programme “Power and Electrical Engineering” that a conflict arose between the student and the instructor as a result of which the student could not pass the examination successfully.

Addressing the application, to resolve the conflict, an examination commission for the study course “Automation of Electric Power Generation and Transmission at Power Plants” was established for the conflict settlement procedure, headed by the FEEE Deputy Dean for Academic Affairs, with participation of the academic staff of the study course “Automation of Electric Power Generation and Transmission at Power Plants”, independent academic staff member – a representative of the Institute of Power Engineering, and the field specialist.

The student passed the examination successfully.

3) A student of the Bachelor programme “Computerised Control of Electrical Technologies” submitted an appellation complaint on the course of the state examination and the assessment of the commission. In the opinion of the student, the course of the state examination and the assessment of the commission were unjustified and incorrect. An appellation commission was established. The commission studied the situation regarding the complaint, listened to the opinions of the involved parties and evaluated all received documents – the student’s appellation complaint, the review of the Bachelor Paper with the project part, Minutes No.11100-3.2.1/25 of the meeting of the State Examination Commission. Having evaluated the situation, the commission decided that the assessment of the State Examination Commission would remain in force.

2.4. Provide information on the mechanism for collecting the statistical data, as developed by the higher education institution/ college. Specify the type of the data to be collected, the collection frequency, and the way the information is used to improve the study direction.

RTU Quality Policy provides the framework for implementation of the Strategy, the paths for development and improvement of research, study and organization processes. RTU Quality Policy and implementation thereof employ a fact-based approach - decisions are based on the acquired objective data, information analysis and monitoring.

RTU draws up quality reviews based on the analysis of processes and their results. Quality reviews are drawn up once a year, summarizing the data on performance indicators of RTU administration, core activities and support processes.

28 performance indicators characterizing process quality are set for one of the RTU core activity process "Organization and Management of the Study Process". The data are summarized once a year for the previous academic year by study level and study programme.

Performance indicators characterize the quality of entrant enrolment process, study process planning and the quality of implementation of studies - implementation of the initial admission plan, number of matriculated entrants vs. number of entry applications, number of entry applications with RTU as the first priority vs. all matriculated students, number of graduates vs. total number of students, number of exmatriculated students (except for graduates) vs. total number of students, number of students with academic arrears vs. total number of students, number of students exmatriculated due to academic failure vs. total number of exmatriculated students, number of timely signed learning agreements vs. all signed learning agreements, etc.

Observing the current study programme performance, reachable qualitative or quantitative aims are set for the indicators when possible, e.g., 65 percent of graduates of RTU undergraduate study programmes continue studies at graduate study programmes.

The data in the quality review that is submitted to RTU administration are analysed by study level, by faculty and study direction. Indicators of numerous study programmes are compared with the general average RTU level.

The Study Department organizes further review and data forwarding to the faculties and directors of the study programmes, whereas process managers introduce the necessary improvements. Changes to the approved processes occur in cooperation with quality management specialists.

In addition to performance indicators characterizing study process quality, which are summarized in the review, a study programme quality visualization tool has been created in Power BI environment, which will be used to reflect Bachelor and Master study programme performance in an academic year with the help of radar chart. In the chart, study programme results at each study level will be presented comparatively - in relation to the best performance at the respective level. The tool is envisioned for the directors of the study programmes and faculty administration to facilitate collection of transparent information on each study programme performance considering numerous indicators simultaneously, as well as to rank the programme in relation to the best performance. It will be also possible to compare the programme performance in several academic years. The tool is currently at the development and test phase. Performance indicators of 11 study programmes are planned to summarize in the radar chart: academic staff vs. number of students, academic staff with scientific degree, ratio of graduates to the number of matriculated students, number of students who continue studies (not exmatriculated), proportion of foreign students, number of outbound mobility students, Bachelor programme graduates who continue studies at RTU, number of matriculated students from the respective Bachelor study programmes, average assessment of the study programmes in student polls, number of study materials published on ORTUS e-study system and applicability thereof, as well as financial revenue generated by study programmes per student. Comparative reviews of the study programmes results will be available to directors of all RTU study programmes. It is planned to develop and improve the tool for collection of statistical data necessary for evaluation of the study programme performance and data visualization within the framework of SSO 8.2.3 project.

In addition, RTU Study Department summarizes and annually submits until 15 October to the Central Statistical Bureau and the Ministry of Education and Science a statistical review "Review of the University, College at the Beginning of Academic Year 20_/20_" (Cabinet Regulations No 812 of 20 December 2016, Annex 5 (https://likumi.lv/doc.php?id=287576 (in Latvian)). The Review contains the following information (sources of information and/or RTU employees responsible for data collection are indicated in parentheses).

- Distribution of students by study programme (Study Management System| Reports | University Review at the Beginning of the Academic Year).
- Enrolment results (University Review at the Beginning of the Academic Year).
- Students having obtained a degree or qualification in the academic year (University Review at the Beginning of the Academic Year).
- Distribution of enrolled students by age (University Review at the Beginning of the Academic Year).
- Distribution of students by age (University Review at the Beginning of the Academic Year).
- Distribution of students having obtained a degree or qualification by age (University Review at the Beginning of the Academic Year).
- University staff in the reporting year as of 1 October (Administrative Office);
- Premise floor area (the Unit of Legal Provision in Real Estate Issues).
- University revenues in the previous year (Planning and Economic Analysis Unit).
- Budget expenditure of the University in the previous year (Planning and Economic Analysis Unit).
- Number of students, who reside in student hostels (Study Organization Unit).
- Number of students by the language of instruction.
- Distribution of enrolled students by place of residence (University Review at the Beginning of the Academic Year).
- Number of mobility students in the total number of students (University Review at the Beginning of the Academic Year).
- Number of mobility students in the total number of students who have obtained a degree or qualification (University Review at the Beginning of the Academic Year).
- Own revenue from allocation of the mobility student tuition fees by country in the previous year (International Cooperation and Foreign Students Department).
- Revenue from allocation of foreign financial study grants by country in the previous year (Project Financial Management Unit).
- Revenue from allocation of foreign financial study grants for research by country in the previous year (Project Financial Management Unit).

Summarized statistics on the number of students/graduates is used for the following purposes:

- Improvement of the study direction. For example, if at some study programme the annual number of student dropouts is much higher than the number of graduates who obtained degree/qualification, the causes of such a situation are sought for with scrutiny.
- If at some study programme the number of enrolled students decreases annually, the cause should be identified, and potential programme closure should be considered.
- Allocation of financing (for state budget funded seats).

Compilation of RTU information materials, press, etc.

2.5. Description and assessment of the integration of the standards set forth in Part 1 of the ESG. Specify which of the standards are considered a challenge and which require special attention.

In the context of the study quality assurance policy, one of the challenges to be emphasized is the organization of the RTU working environment so as to motivate the staff and students to realize the mission, vision and goals of the university and to ensure the excellent quality of the University activities. In the context of study programme development and validation, one of the challenges is to reach agreement on the common structure and curriculum of separate sections for the study programmes submitted for licensing. It is promoted by the Study Department, which deals with developing the study programme description template and completing the sections applicable to the RTU in general. In the context of student-centred learning, teaching and assessment, perceiving the development of curriculum and study forms as one of the most significant challenges of today's higher education, RTU has established the Centre of Academic Excellence, which acts as a bridge between teaching and learning cultures. The challenge lies in a relatively low activity of local students in using exchange programmes for studies abroad. To compensate for it RTU promotes international opportunities by inviting guest lecturers and conducting study courses with foreign students. In the context of information management, it is considered how the data on employment of graduates from the State Revenue Service could be linked to specific study programmes. In addition, in this context, the question of choosing the most appropriate method for mapping study programmes is evaluated taking into account the great variety of RTU study programmes. Active professional development of the academic staff is also taking place within SSO 8.2.2 project "Strengthening the academic staff of Riga Technical University in the areas of strategic specialization"

The description of the integration of the standards included in the first part of the ESG is given in the attached document "ESG_standards_integration_description.pdf".

II - Description of the Study Direction (3. Resources and Provision of the Study Direction)

3.1. Provide information on the system developed by the higher education institution/ college for determining the financial resources required for the implementation of the study direction and the relevant study programmes. Provide data on the available funding for the relevant study programmes, as well as the sources of the funding for the scientific research and/or artistic creation activities and their use for the development of the study direction. Provide information on the costs per one student (for each relevant study programme of the study direction) by specifying the headings indicated in the calculation of costs and the percentage of the funding among the indicated headings.

According to the Conceptual Report “Introduction of a New Higher Education Financing Model in Latvia” approved by the Cabinet of Ministers on 29 June 2015 (http://likumi.lv/ta/id/274944-par-jauna-augstakas-izglitibas-finansesanas-modela-ieviesanu-latvija in Latvian), Latvia has introduced structural reforms in the sector to ensure the development of an efficient and sustainable higher educational system. A three-pillar funding model has been introduced to reconcile the supply offered by higher education with the needs of Latvia's economic development and labour market, high-quality research-based higher education content and performance management in higher education institutions. The base funding for provision of the study process is the 1st pillar, performance funding is the 2nd pillar, and development funding is the 3rd pillar.

The first pillar, or base (base funding), is implemented through state budget funded study seats.

Determination of the number of state budget funded study seats is regulated by Sections 51 and 52 of the Law on Higher Education Institutions (http://likumi.lv/ta/id/37967-augstskolu-likums#p-50515 in Latvian).

RTU funding from the basic state budget is made up of the study base financing corresponding to the list of study programmes and the number of students; it is used to cover such expenses as utilities, taxes, infrastructure maintenance (including data for the Student and Graduate Register), purchase of equipment and supplies, staff remuneration, and funding for research activities.

The number of study seats is allocated after discussions with the Ministry of Education and Science. Funding from the state budget is allocated for full-time studies.

The amount of study base funding is determined on the basis of the number of study seats determined by the state at RTU, as well as the state-defined study seat basic expenses and study cost coefficients in the thematic areas of education.

Study cost coefficients for thematic areas of education are indicators that determine the amount of study seat costs in the respective thematic area of education in relation to the basic costs of the study seat.

The cost coefficients for the study programmes in the thematic areas of education for Bachelor and professional study programmes are set by in Annex 1 of Cabinet Regulations of 12 December 2006 “Procedure for Financing Higher Education Institutions and Colleges from the State Budget” (https://likumi.lv/doc.php?id=149900 in Latvian) (further in the text - the Regulations).

Values of study cost coefficients are 1.5 times higher for Master study programmes and three times higher for Doctoral programs than the study cost coefficients specified in Annex 1 to the Regulations for the respective thematic area of education.

The amount of the study funding granted to the institution of higher education or college from the state budget for the implementation of Bachelor, professional and Master study programmes is calculated using the following formula:

$Fs = Tb \times [S(ki \times ni) + 1{,}5 \times S(ki \times mi)] + Sb \times S(ni + mi)$, where

Fs – amount of study financing;

Tb – basic costs of the study seat;

ki – coefficient of the study costs in the relevant field of education (Annex 1 to the Regulations);

ni – the number of study seats for a higher education institution or college at undergraduate and professional study programmes in the relevant thematic area of education;

mi – the number of study seats at the Master study programmes in the relevant thematic area of education;

Sb – study seat social security expenses at undergraduate, professional and Master study programmes (Annex 2 to the Regulations).

The basic costs of a study seat and the social security expenses of a study seat are determined in accordance with Annex 2 to the Regulations.

Each year, the Ministry of Education and Science calculates the basic costs of a study seat for the following budget year and, by November 1 of the current year, coordinates the calculations with the Ministry of Finance and those Ministries which have higher educational institutions and colleges subordinated to them.

RTU funding from the state basic budget for the provision of study seats in the respective academic year is distributed in accordance with the decision of RTU Senate "Methodology for the distribution and use of funding for the structural units of RTU in academic year 2020/2021" (see the file of Annex 16 of the list of Internal regulations; hereinafter – the Methodology). The Methodology is reviewed and revised every year and is subjected to any necessary changes.

RTU has a decentralized budget, and each organizational unit is allocated a separate budget. In a general sense, a budget is a plan of revenues and expenditures for a specific period of time, work, event or function. The revenues and expenditures of RTU shall be administered in accordance with principles approved by the Senate or as stipulated by the Vice-Rector for Finance.

According to the Budget Allocation Methodology, the financing is allocated to the organizational units either according to the financial or budget year or immediately after receiving the financing. The financial or budget year of RTU organizational units is from October to September of the following year, and for this period the financing is calculated and distributed:

- Subsidy or basic budget funding (training of state budget funded students) is divided into monthly limit – 1/12 of the estimated annual funding per month is allocated to the organizational unit;
- Tuition fee funding (training of tuition fee-paying students, including funding paid by students for settling academic arrears) is allocated twice a year (in October and April) as a monthly limit – 1/6 of the estimated funding per semester is allocated to the unit monthly;
- Performance funding (research support funding) is allocated as a monthly limit – 1/12 of the estimated annual funding is allocated to the unit per month;
- Research base funding (research support funding) is allocated as a monthly limit – 1/12 of the estimated annual funding is allocated to the unit per month;
- funding for foreign student fees is distributed four times a year, taking into account that the largest amount of the planned workload is allocated to the structural unit at the beginning of each semester (October and April), the remaining part of funding - at the end of the semester.

Each head of RTU organizational unit is provided with remote access to operational financial information on the unit's budget, including the envisaged workload and correspondingly allocated funding for the implementation of study programmes and study courses in subsequent periods. Based on this information, the head of the organizational unit plans the work of the unit at the beginning of each financial or budget year, including remuneration issues for academic staff members who are subordinate to the head of the unit, and develops a procurement plan for the following year in compliance with the implementation and development of the study programme or study course, etc.

According to the World Bank research on higher education governance in Latvia, which was conducted in 2017 and 2018, the World Bank concluded that RTU used the opportunities offered by the system-level funding model reform to gradually adjust the internal distribution of decision-making powers by strengthening the position of deans. Prior to the introduction of the second pillar of the state funding model, RTU funding was provided to units below the level of faculties. To address the issue of weak positions of deans, more than half of the new 2nd pillar performance income is used to provide funds to faculties where the dean is the budget holder. First, it opens up new opportunities for faculty-level strategic development. Second, deans now have greater opportunities to ensure the development of faculties, which is their responsibility. Third, since the academic year 2019/2020, deans of the faculties have additional funding from the tuition fees of foreign students.

In academic year 2019/2020, RTU has made changes in the Methodology to ensure that the basic state budget funding for the provision of study seats is distributed by study programmes and thematic areas of study courses, ensuring precise distribution of funding according to the indicators by which RTU receives the state budget funding. In addition to the seats financed by the state basic budget, the study programme financing also consists of tuition fee revenue from the resources of natural or legal persons, which can be divided into two subgroups:

1. revenue from local fee-paying students;
2. revenue from foreign fee-paying students.

Funding from local fee-paying students is allocated in compliance with the Methodology where, in order to provide greater opportunities for the development of fee-based study programmes, for several academic years, a significant amount of the funding received has been channelled to the Head of study programme, who may appropriately use this funding to renew facilities and attract higher level specialists for the implementation of the study process, etc.

Funding from foreign fee-paying students in a respective academic year is allocated in accordance with the Resolution of RTU Senate On Approval of the "Methodology for Allocation of Funds for Study Process Provision at the International Cooperation and Foreign Students Department" in the Respective Academic Year (see the file of Annex 41 of the list of Internal regulations; hereinafter – Methodology2). Methodology2 is revised and approved every year taking into account necessary changes.

In academic year 2019/2020, RTU made significant changes to Methodology2 with an aim to bring it closer to the Methodology governing budget allocation, thus facilitating the work process of the persons responsible for the implementation of the study programmes – both by aligning funding allocation periods and principles. The new Methodology2 provides funding for the structural unit responsible for implementation of the study programme for its development similarly as in Methodology. However, two new coefficients are introduced in the calculation of study course funding - the correction factor for the number of students and the sustainability coefficient of the study programme, as well as whether foreign students acquire the study course together with local students. The financial surplus, which is formed from the application of both coefficients and the acquisition of joint study courses, is directed to the structural unit responsible for implementation of the study programme.

Analysing the financing procedure of the study programmes and the study directions at RTU as a whole, it can be seen that the state basic budget and local fee-paying student funding in the long run are determined taking into account the basic principles established by the state. In the process of determining the amount of funding, the study cost coefficients of the thematic areas of studies and the values of the study cost coefficients according to the level of the study programme, as well as the number of students at the study programme and the study courses implemented therein are taken into account. As mentioned above, by using study cost coefficients of the thematic areas of studies, it is possible to determine the amount of financing required for the implementation of a particular study programme and study course. In the Methodology for academic year 2018/2019, RTU Senate approved that in the future the study cost coefficients of the thematic areas of studies would be applied individually to each study course of the study programme, thus ensuring even more appropriate amount of financing for the implementation of study courses included in the study programmes. In order to implement this system, the Expert Committee was established by order of the Vice-Rector for Academic Affairs, who determined thematic areas of studies for each study course. RTU has the following thematic areas of studies and the applicable coefficients:

Thematic area of RTU study courses	RTU coefficient

Architecture and urban planning	3.5
Aviation transport	4.2
Construction	2.9
Civil engineering and real estate management	1.71
Civil and occupational safety	2.9
Civil defence	4.2
Computing	2.9
Computer training	2.42
Economics	1.4
Electronics and telecommunications	2.9
Power and electrical engineering	2.9
Physics	3.2
Geodetics and cartography, geomatics	2.9
Innovation	2.9
Engineering drawing	2.9
Quality management	2.9
Chemistry and chemical technology	3.2
Applied arts and design	3.5
Mathematics and statistics	2.42
Material sciences	3.2
Medical engineering	2.9
Mechanics, mechanical engineering, construction of machines and mechanisms	2.9
Internal security and customs	4.2
Pedagogy	1.67

Heat engineering, heat, gas and water technology	2.9
Social sciences	1.4
Sports	2.0
Textile technology	2.9
Law	1.4
Transport	2.9
Management and administration	1.4
Languages	3.2
History and philosophy	1.4
Environmental engineering and management	3.2
Logistics	1.8

From academic year 2019/2020, similar principles are introduced also in Methodology2 and applied to study programmes, where the total number of foreign students in all academic years is greater than or equal to 90. The study programmes with less than 90 foreign students have a support mechanism, which envisages financing from the total funding of the foreign students, in order to ensure an adequate amount of funding for the implementation of the study courses of the study programmes.

In order to ensure the functioning and sustainable development of study programmes, RTU has been improving the Methodology and Methodology2 for each academic year in accordance with changes in the external and internal environment, thus also eliminating possible risks in the implementation process of the study programme or its study courses. The transition process involves all stakeholders, thus ensuring transparency, as well as a transparent decision-making process. The required changes are at first initiated by RTU Vice-Rector for Finance, and additional changes can be initiated by any RTU employee by submitting a request to RTU Vice-Rector for Finance or to the Finance and Budget Committee of RTU Senate. The Finance and Budget Committee of RTU Senate consists of about 20 senators (deans, heads of organizational units of faculties, professors, as well as student representatives) who have voting rights, as well as nine RTU Senate advisors, who are mainly representatives of various administrative units, such as vice-rectors, heads of departments etc. Once the Finance and Budget Committee of RTU Senate has considered and evaluated the proposals, it shall propose amendments to the Methodology or Methodology 2 or develop a new version of the document(s) for the next academic year for approval by the RTU Senate 50 senators. It should be noted that historically changes in the Methodology or Methodology2 have been proposed after performing a thorough analysis, including mitigation of their possible negative impact on the implementation of study programme courses.

Funding of the study field “Power, Electrical Engineering and Electrical Technologies” has been stable during the recent years. The main flow of the funding of the study programmes is ensured by the state budget subsidies: in academic year 2013/2014, it constituted 91%, but, with the increase of the number of foreign students, it was 86% in academic year 2019/2020. The state budget funding was the highest in academic year 2014/2015. Now the funding has a tendency to increase. In total, during the reporting period, it constituted EUR 13 907 512.17.

During the reporting period, the total funding of the study field constituted EUR 15 937 591; of which tuition fees by local students made up EUR 1 518 289.27, with a tendency to decrease; tuition fees by foreign students accounted for EUR 387 990.25. Tuition fees by foreign students in academic year 2019/2020, in comparison with academic year 2018/2019, increased by 30%. Faster increase in tuition fees by foreign students was observed in academic year 2016/2017 (from EUR 9 305.27 to EUR 72 668.15).

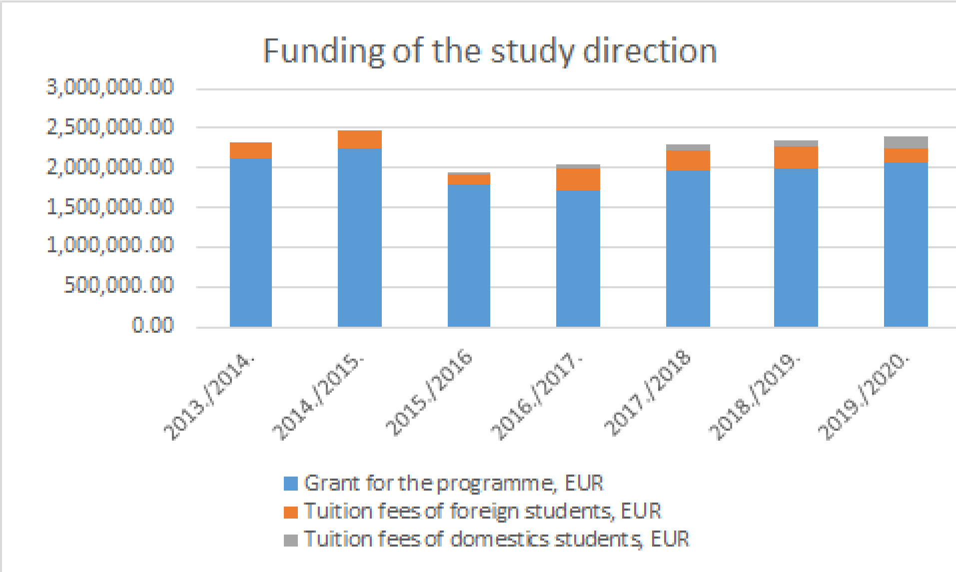

Fig.: Funding of the study field "Power, Electrical Engineering and Electrical Technologies"

Since the beginning of financial year 2018/2019, heads of RTU organisational units, in addition to the information on the budget of each organisational unit subordinate to them, have been provided with a regularly updated overview of the overall financial results of the study process, thereby providing not only the Dean but also heads of institutes, heads of departments and other organisational units with objective information on the performance results. The introduction of the report ensures not only openness of information, but also a possibility for the Faculty Dean and the Council to react promptly in situations where it is required, such as the review of individual spending positions within the framework of total funding.

The funding of the main organisational units implementing the study field "Power, Electrical Engineering and Electrical Technologies", thus also funding for the implementation of study programmes and for the maintenance of study programmes related to the improvement of the study process (e.g., scientific research bases), are composed of the following resources:

- Subsidy from the state budget for the implementation of the study programme;
- Financing from businesses and individuals to cover tuition fees, including tuition fees by foreign students;
- Financing from other sources (projects, contract work, etc.): these funds are allocated indirectly to the implementation of academic study programmes – purchased infrastructure for laboratories (equipment inventory, etc.) and practice (e.g., modelling computer programs) and lectures (e.g., scientific literature, scientific paper databases);
- Indirect funding - (1) European Union and national funding programmes for the qualification upgrade of academic staff and (2) European Union programmes and national funding

programmes for the implementation of academic staff and student exchange trips. Due to the fact that these funds are not directly listed in RTU financial systems, because they are often individual payments to the academic staff and students, their financial summary is not available and is not reflected in the report.

Research base funding (base funding provided by the state) is allocated among faculties according to the performance-based output indicators, i.e., number of publications (weighted by impact and citation), money attracted by research projects and industry contracts, and defended Doctoral Theses (considering also the time it takes to complete Doctoral studies). The calculation is made based on the transparent methodology, which was approved by the Scientific Council (the document: "Methodology for Allocation of Research Base Funding to RTU Organizational Units") on 20 November 2018. A decision regarding allocation of the budget among faculty institutes is made within faculties (by the Faculty Councils).

RTU also makes three project calls a year with internal funding. The 1st project call aims at supporting publication activities of young scientists. The 2nd call supports projects where RTU cooperates with industry partners, and this call is aimed at promoting inter-faculty and inter-disciplinary research within six research platforms of RTU. The goal of the 3rd call is to involve graduates in the research process. The regulation documents are usually approved by the Scientific Council of RTU. However, the decisions regarding selection of particular researchers or projects are made by expert groups organised by the Office of Vice-Rector for Research, on the faculty level or the research platform level (Council of Coordinators of Research Platforms; decision of RTU Senate No. 600 "On Approval of the Regulation of Coordinators' Board of the Research Platform at Riga Technical University" as of 23 May 2016. Projects are administered by the Office of Vice-Rector for Research. The Office also coordinates administration of the externally funded research projects, e.g., within Horizon 2020 programme etc. Research projects funded by the EU Structural Funds are administered by the Office of Vice-Rector for Strategic Development.

The Internal Research Excellence Grant for young scientists is a new initiative, with an aim to attract talented young researchers to RTU and provide with funding, which allows establishing new research groups in a prospective research field. Funding for a 3-year period is based on international competition under conditions similar to EC ERC grant, and international call and evaluation performed by external, i.e., foreign well-recognized researchers. The final decision for awarding the grant is made by the Scientific Council of RTU.

RTU Research Support Fund (decision of RTU Senate No. 585 "RTU Regulation of Research Support Fund" as of 15 December 2014) aims at providing financial support for various research related activities, such as support for maintenance of research equipment, protection and licensing of intellectual property, covering of expenses related to the Doctoral study process, publishing of scientific journals, participation and organisation of scientific conferences, support to researchers in establishing new laboratories in a prospective research field. The Research Support Fund is an instrument to support research activities, which foster the development of the strategically important research fields. 10 % of the research base funding (state budget funding) is allocated to the Research Support Fund every year. Establishment of seven new laboratories or centres has already been supported by the Fund by June 2020, e.g., RTU High Energy Particle Physics and Accelerator Technology Centre (for cooperation with CERN), Biochip Laboratory, Scientific Laboratory of Experimental Mechanics of Materials, Scientific Laboratory of Electromechatronics, Research Centre of Communication System Technologies, Research Laboratory of Technologies of Electrical Engineering and Ergonomics. Scientific Council has decided to support on a competitive basis at least one new prospective research direction every year (decision of RTU Scientific Council No. 04000-3/09 dated 21 September 2020.

In academic year 2019/2020, 54 Doctoral students of RTU received a doctoral research grant. Financial amount for one doctoral grant was 10,000 EUR. Beneficiaries were elected to the position of research assistant or researcher. The aim of RTU doctoral grants is to support research related to the Doctoral Thesis and to promote the defence of the Doctoral Thesis in the 4th year after the commencement of Doctoral studies.

3.2. Provide information on the infrastructure and the material and technical provision required for the implementation of the study direction and the relevant study programmes. Specify whether the required provision is available to the higher education institution/ college, availability to the students, and the teaching staff (the specific equipment required for the relevant study programme shall be indicated in Part III, Chapter 3 below the respective study programme).

The construction of RTU Ķīpsala Campus began in 1965 with the aim to create a unified study and research centre. The construction process is underway, and it is envisaged to host the majority of university students in Ķīpsala from 2021. After completion of the construction, RTU Ķīpsala Campus will become the most modern engineering study centre in the Baltic States.

The issue of sustainable development is taken into account in the construction process of the campus. Recognizing its concern for sustainable development and demonstrating its willingness to engage in the promotion of sustainable development, RTU has joined the Sustainable Development Solutions Network, which seeks to achieve the 17 UN Sustainable Development Goals (SDGs) by 2030. RTU is currently the only organization in the Baltic States that has been admitted to the network.

Through its networking activities, RTU, as a higher education and research institution, has prioritized the achievement of seven UN SDGs that coincide with RTU research platforms. RTU considers the provision of quality education and the promotion of lifelong learning to be its primary goal. RTU also intends to contribute to research and innovation in sustainable and modern water technologies, power systems, infrastructure and urban environment. The University is also committed to promoting the creation and distribution of sustainable products.

RTU buildings are equipped with state-of-the-art climate control equipment, technical solutions that are remotely controlled and provide the opportunity to track energy consumption to make buildings more comfortable for students, academic staff, researchers and guests. One of the results achieved in the development of RTU infrastructure is the participation in the Green Metric Ranking, which recognizes RTU Ķīpsala Campus as the 40th greenest campus in the world and RTU – as the 95th greenest university in the world (https://www.rtu.lv/en/university/for-mass-media/news/open/rtu-one-of-the-top-100-greenest-universities-in-the-world). In the Baltic region, RTU is a leader in terms of green thinking infrastructure.

To reduce human impact on the environment and climate change, RTU is committed to introducing the concept of Green Ķīpsala at its campus by 2023. To achieve the goal, RTU is improving its infrastructure in compliance with sustainability principles, changing student and staff habits, and using innovative green products and technologies developed by RTU researchers in Ķīpsala Campus infrastructure.

The infrastructure of Ķīpsala Campus provides students, staff and guests with all the necessary services and utilities, e.g., it is possible to park a bicycle and a car, quench one’s thirst at water drinking points. Developing the infrastructure, care is taken of all groups of people, including people with disabilities: each building has parking lots, easy access to classrooms, laboratories and other facilities, the use of Braille to provide essential information, as well as all sanitary facilities are designed according to the requirements. The association of people with disabilities and their friends APEIRONS (https://www.apeirons.lv/) commends RTU for its achievements in infrastructure related issues for people with disabilities.

At RTU Ķīpsala Campus, there are currently 54 classrooms, 187 laboratories, 19 special training rooms, 10 computer classrooms, 12 workshops and several research centres of national importance. The Campus also houses a hostel with 950 beds and a special area for people with disabilities.

Foreign students, visiting lecturers and university guests can use the renovated RTU student accommodations (Āzenes 22a, Riga).

Other elements of RTU infrastructure are also available for the needs of students and lecturers - canteens and cafes located in each of the RTU complexes, photocopiers, hostels, RTU sports and recreation centres, swimming pool, etc. RTU premises are equipped with drink and snack vending machines.

Wi-Fi is provided in all classrooms of the Campus which allows students to access study materials placed on the RTU study portal ORTUS.

The Faculty of Electrical and Environmental Engineering (FEEE) is located at 12/1 Āzenes Street, Riga. A part of the laboratory facilities is located in RTU Lab Building, at 1 Paula Valdena Street. FEEE has a well-developed infrastructure in the vicinity, including accessible bus stops, cafés, a supermarket and a fitness centre.

A total useful FEEE floor area is 5137.3 m2 including six storeys with the appropriate facilities. The faculty ensures access opportunities for people with disabilities. Bike parking area and car parking lots are available. The building is equipped with a drinking water point, a lift, an open learning room/reading room, a variety of recreation rooms, lecture halls (theatres) and staff rooms, meeting rooms, various laboratories, cafeteria, a variety of drink and snack vending machines are installed on the premises.

Campus 12/1 Āzenes Street		
Intended use of rooms	Number of rooms	Useful area m2
Meeting rooms/ conference room	5	202
Computer rooms	5	249.9
Lecture hall (theatre)	7	497.1
Classrooms	38	664.6
Assistant professor/post-graduate student rooms	5	165.9

Canteen	1	412.8
Library	1	32.9
Work room/ workshop	8	222.2
Laboratory facility	30	1788.2
Reading room	1	104.6
Academic staff rooms	21	415.3
Storage room	16	190
Lobby	3	58
Server rooms	2	31.5
Student Union and record management	2	68.1
Kitchens	6	34.2
Total	151	5137.3

Owing to a high level of digitalization, the available infrastructure and material and technical facilities for the implementation of the study field and corresponding study programmes provide an opportunity to increase the University's competitiveness, improve operational quality and efficiency, as well as to make information available by integrating IT solutions into administrative, academic and research processes of the University and providing administrative and academic staff with modern, reliable, secure and unified IT infrastructure and quality IT services.

The Information Technology Department works in three areas:

1. Creation, development and maintenance of an integrated information system of RTU providing support for administrative, academic and research work of RTU;
2. Provision of high-quality and uninterrupted voice and data communication services throughout the territory under the control of RTU, as well as maintenance of RTU data centres and key network resources;
3. IT service support, incl. providing information on new IT solutions, giving necessary consultation and organising IT training.

To ensure easy and efficient identification of IT users, an IT user identity management system has been introduced; as a result, each IT user has a unique electronic identity that is valid in all information systems. In addition to the aforementioned, a user session management system is ensured in IT systems, which means that there is no need for IT users to re-authenticate when logging in to RTU information systems. It gives the experience of using a unified integrated information system without having to memorize different identification data and re-enter them, implementing different IT application scenarios.

All IT users are provided access to the centralised portal ORTUS (https://ortus.rtu.lv – screenshots of the interface are attached in "RTU IT sistēmu saskarnes / Screenshots of RTU IT systems"), which functions as a single digital gateway, combining information from all RTU information system components and providing users with an easy-to-use way of accessing the directory of all IT services in one place.

The Centralised Study Management System is used for efficient administration of the study process, which ensures digital provision of the study life cycle, incl. Electronic Register of Study Programmes (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub – screenshots of the interface are attached in “Screenshots of RTU IT systems”), drawing up learning agreements and enrolment of students in study programmes, Register of Study Courses (its public part is available at https://info.rtu.lv/rtupub/disc2/list – screenshots of the interface are attached in “Screenshots of RTU IT systems”), designing student’s individual study plans, drawing up orders, implementing study courses and study process, registering grades, recognising study courses, awarding qualifications, administering payments, hostel information, gathering information to issue diploma supplements, etc. This system is one of the main cornerstones in the administration of RTU study process.

To ensure effective implementation of the study process, Moodle e-learning system is used, where all relevant information is compiled in an automated way (study courses, users, groups, access rights, etc.). This system ensures student-instructor communication. The academic staff members place various electronic materials, assessment tests, homework assignments, information on a particular study course, etc. in the system. Students can also view their financial information on the ORTUS portal, as well as make request for documents (references, transcripts of records, copies of a learning agreement, etc.). For distance learning, RTU academic staff has options to use *Zoom* or *Microsoft Teams* videoconferencing platforms.

Since 2007, more than 130,000 unique study course sites have been generated in the e-learning environment of RTU. Students can access electronic learning resources anytime and anywhere.

Digitisation of classrooms and schedules has been carried out to ensure efficient premise management and study planning (https://telpas.rtu.lv; https://nodarbibas.rtu.lv/ – screenshots of the interface are attached in “Screenshots of RTU IT systems”). Each RTU student and academic staff member can access their schedule, which provides information on the venue, time, instructor, room, title and type of lecture. In addition, for user’s convenience purposes, the system greatly facilitates lecture planning and scheduling, as well as optimises the use and efficiency of premises.

Electronic Staff Management and Record-keeping Systems, which cover the circulation of record-keeping and personnel documents at RTU (https://docs.rtu.lv/ – screenshots of the interface are attached in “Screenshots of RTU IT systems”), are also used to ensure the efficient administrative work. Electronic document coordination and document e-signing functionality have been introduced, thus reducing print-based document circulation and significantly increasing document circulation speed. Since autumn semester of 2019, students have been provided with electronically signed learning agreements. Since 2016, RTU graduates have been receiving electronically signed transcripts of records.

In terms of quality assurance, a digital student survey system is used, with the help of which the quality control of study courses and study programmes is implemented each semester. Based on the results of quality control, regular measures are taken to improve study programmes and the study process, in general.

For additional convenience of RTU students, academic and general staff members, RTU leases Microsoft Windows and Microsoft Office software, which provides all IT users with access to the latest Microsoft software. RTU students can use the licensed Windows operating system and the Microsoft Office productivity suite provided by RTU for study needs. All IT users have access to

Microsoft Office 365 cloud computing platform with one terabyte of storage space available to each user and access to a variety of additional collaboration and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic and general staff have access to the University's email system.

To support research activities, RTU has developed the Centralised Research Support System, which records all information on publications, patents, commercialisation applications, Doctoral Theses, RTU scientific journals, research staff, etc. The system provides access to information according to Open Access principle (https://science.rtu.lv). RTU students and academic staff also have centralised access to research software.

RTU has the high-speed fibre optic Internet and extensive wireless network infrastructure with over 400 access points, including the international *Eduroam* service. In addition, desk phones and mobile communications are provided for fast and easy communication.

To ensure a stable and secure operation of the information technology infrastructure, continuous monitoring of the IT infrastructure and systems is performed, resulting in proactive incident control. Data backup is also ensured.

The Information Systems Security Policy has been developed and implemented with the primary goal of ensuring the secure use of RTU information systems by establishing and maintaining a sufficient set of measures to reduce or prevent potential or resulting harm. Implementation of the Information Systems Security Policy envisages security checks, data transmission network monitoring, as well as preventive measures. Regular IT security and personal data protection training is organised for IT users. Automated security incident management and risk management have been implemented. Statistics demonstrate that the number of IT security incidents dropped significantly 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.

Due to ERDF funding granted to FEEE, from 2014 the studies take place in a new and modern building, equipped with an up-to-date building control sensor system, climate control systems, energy saving lighting, and other devices that also serve as monitoring and research tools. In parallel, the existing laboratories have been upgraded and new laboratories have been established.

University laboratory for power electronics:

- Study and Research Laboratory of Electrical Drives;
- Study and Research Laboratory of Automated Industrial Processes;
- Study and Research Laboratory of Computerised Control;
- Study and Research Laboratory of Microelectronics and Sensors;
- Study and Research Laboratory of Energy Efficiency;
- Study Laboratory of Electronic Devices;
- Study Laboratory of Theoretical Fundamentals of Electrical Engineering;
- Study Laboratory of Electrical Engineering and Electronics;
- Study and Research Laboratory of Semiconductor Converters;
- Laboratory of Industrial DC-Grid (AREUS DemoLab);
- Creative Student Lab;
- Electro-Mechatronics Scientific Research Laboratory.
- Laboratory of Relay Protection and Automation;
- Laboratory of Electric Supply Systems;
- Laboratory of Electrical Equipment for Power Stations and Substations;

- Electric Power Plant, Supply Network and System Laboratory;
- Laboratory of Electrical Equipment and Lighting.

These laboratories have all-new infrastructure – furniture, voltage switchboards and switchgear, black and white boards, projectors and other necessary equipment and facilities. Additionally, such learning procurement as an oscilloscope, a current sensor, some differential sensors, multimeters, solar power measuring device, electric power parameter analysers, power supply units, an auto-transformer, a portable optical parameter measuring instrument, etc. have been provided. Also, new workbenches for practical classes: a microelectronic workbench for design of electronic devices and "a lift drive" workbench in drive systems have been installed.

In the framework of FP7 AREUS Project, a unique laboratory has been established – a 600 V DC power supply network, equipped with an industrial 21kW robot KUKA Quantec Prime, 55 kW active rectifier, two drive workbenches that can simulate any robot's power consumption, supercondensor and Lithium-ion energy storage systems and other equipment.

A FESTO MPS mini-factory and an FMS unit, a compact water level control workstation FESTO Compact-Workstation, and a set of EMCO Concept Turn 105 / EMCO Concept Mill 105 equipment are available for research of industrial processes.

Signal measurements employ digital oscilloscopes. In 2017 a highly sensitive BNC port oscilloscope current probe Ultra mini CWT015 was purchased, allowing to measure the current that flows through transistor leads (legs).

Lighting parameter measurements employ an Avantes spectrometer, a SOLAR-100 solar power meter, a Konica Minolta LS-110 portable optical parameter meter, a Raynger ST60 ProPlus infrared thermometer.

Robotic system learning employs also an industrial KUKA Agilus with KRC4 controller, virtual programming software KUKA SIM, mobile Mistubishi robots, Festo Robotino platforms.

Electro-mechatronics laboratory has the latest equipment installed, with EGSTON COMPISO - Power Electronic Test Bench (up to 200kW) based on Power Hardware-In-the-Loop (P-HIL) unique for the Baltics, which lets students conduct real-time experiments for their theses, using Matlab Simulink, and modelling different scenarios for operation of AC or DC networks and their components (solar panel park, wind farms, storages, transformers, switches, etc.), develop new control algorithms power electronics converters, etc. This laboratory is also equipped with the Physical motion simulator based on KUKA KR 600 R2830 passenger, BEC Gondola control and safety system unique to the Nordic countries.

Energy saving parameters are defined using electricity analysers, set of power analysers, network analysers, Fluke network analysers, and similar devices.

AC and DC adjustable power supplies are used in development of different converters, as well as other kinds of power supplies: diesel generator SDMO DX 6000TE, solar panels, wind generator, hydrogen fuel cells, power supply units, a DC lab power supply, a DC electronic load, a DC lab power supply.

dSPACE platform for electric power control system development, modelling software Matlab/Simulink R14, simulation software PSIM Profesional 8.0, Synopsys Analog Simulation and Modeling Synopsys Advanced TCAD individua l licence, licence OrCAD PCB Design University Edition, software PSIM-JMAG, etc.

PCB (printed circuit boards) prototyping process employs a LPKF ProtoMat S64 PCB prototyping tool, a LPKF ContacRS PCB metallisation tool; a HAWK 3D axis microscope, a LPKF Multi Press – an automatic multilayer PCB press (for 4–8-layer board fabrication), as well as a coil (ballast) winding machine Jovil Manufacturing SMC-2 with auxiliary equipment.

Creative Student Lab has been founded with the support of JSC Latvenergo funding. It is located at 12-1 Āzenes Street, Room 219. In their free time students can work on their projects in the lab. In the laboratory, students have access to various tools, soldering stations, a programmable 6kW three-phase AC power supply Elektro-Automatik EA-ACP3P 520-16.8-6000-20U f45-450, 3D printers, materials, customized work places, allowing to transform their ideas to product prototypes.

In 2017, the equipment for research in smart networks, industrial robotics, Human Environmental Interactions was purchased, which include a physical motion simulation system (based on an industrial robot-manipulator with a lifting capacity over 500 kg), a robot-manipulator base (with integrated video projection equipment and control devices, connected to the system simulation computer using data exchange protocols (CAN, Ethercat, etc.)) and a physical electronic network emulator with integrated HIL system and power measuring equipment (system power capacity 200kW, at least 6 (with optional extension to 12) freely programmable channels for power flow control as a source in its loading mode, with integrated software support for simulation of electrical power networks, storages, drives, solar panels).

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.

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 organise connection and maintenance operation and to assess the condition of devices.

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.

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, and 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.

The equipment of the Laboratory of Power Plants, Networks and Systems includes computers with the power system calculation software in normal and emergency modes, as well as the power system analogue model. The laboratory offers an opportunity to acquire practical knowledge in modelling of power system modes, as well as offers the support to a wide range of courses and development of theses.

All equipment and laboratories mentioned above are successfully employed in the learning process, student research and development of the theses.

In order to ensure the process of studies all classrooms are equipped with multimedia hardware. A new computer room has been arranged.

Workplaces of the academic staff are equipped with modern personal or portable computers, as well as with printers, copiers and scanners.

3.3. Provide information on the system and procedures for the improvement and purchase of the methodological and informative provision. Description and assessment of the availability of the library and the databases to the students (including in digital environment) and their compliance with the needs of the study direction by specifying whether the opening times of the library are appropriate for the students, as well as the number/ area of the premises, their suitability for individual studies and research work, the services provided by the library, the available literature for the implementation of the study direction, the databases available for the students in the respective field, the statistical data on their use, the procedures for the replenishment of the library stock, as well as the procedures and options for the subscription to the databases.

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 1.4 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, significant investments were made in the development of the SL infrastructure by building additional premises (2240 m2). The total area of the SL premises is 6393 m2, of which 3417 m2 are reader service premises. There are 713 working places for SL users. The SL has four group rooms and six individual booths, a rare book reading room and a conference room. The SL is accessible for users with disabilities.

In order to improve the Scientific Library activities and to meet the information needs of academic and research staff, the Library Council has been established, which decides on replenishing the library collection with printed publications and subscribing to the necessary databases. The Library Council has approved the Compilation Policy of RTU Scientific Library Collection, which sets the basic principles of the collection development in accordance with the areas of RTU academic and research activities.

After the Scientific Library 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 head of a respective study programme and researchers, in compliance with the allocated funding. By contacting the Scientific Library 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/en/studies/scientific-library), an application form, contacting by phone 67089353, or visiting the Library at 5-105 Paula Valdena Street. The Scientific Library 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 organisation Electronic Information for Libraries (EIFL). The EIFL Licensing Programme offers libraries of state importance to subscribe to internationally recognised 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 Scientific Library newly-received literature bulletin in Latvian https://www.rtu.lv/lv/studijas/biblioteka/jaunieguvumi

At the request of the academic staff of the study direction “Power and Electrical Engineering, Electrical Technologies”, 174 new books were purchased by the Scientific Library amounting to 19106.82 EUR in the period of 2013-2020.

The list of Online *Database Subscribed* by the Scientific Library is summarized at (https://www.rtu.lv/en/studies/scientific-library/electronic-resources).

RTU Scientific Library also provides access to the databases funded by the Ministry of Education and Science of Latvia: ScienceDirect, SCOPUS (Elsevier), Web of Science.

IEEE Xplore Digital Library represents the most significant database for study programs in the field “Power and electrical engineering”. **IEEE Xplore Digital Library** offers the access to all full-text journals, conference proceedings, scientific volumes and standards of the Institute of Electrical and Electronics Engineers (IEEE). It covers the third part of the world’s literature about computers, networks and electronics:

- 195+ scientific journals and trade periodicals;
- 1900+ IEEE conference proceedings volumes;
- 9000+ IEEE standards.

Full texts of publications (over 5 million) are available from 1988, and for particular periodicals – from 1872.

ScienceDirect – a scientific, technical and medical article database supported by Elsevier- is also used. More than 2500 full-text journals are available, for instance, issues of Electric Power Systems Research, International Journal of Electrical Power & Energy Systems, The Electricity Journal from 2002 and full texts of 354 science books in different fields.

Applied Science &Technology Source EBSCOhost – access to 1200 full-text periodicals (applied mathematics, computer hardware, artificial intelligence, robotics, machine learning, aeronautics, energy, chemical technology, textile industry).

Latvian databases include LETA, Letonika, Latvian standard database (available only at the library).

Database use at RTU Scientific library has been growing since 2016. For instance, in 2019, lending of digital resources achieved 325,234.

New premises of the library allow an extended range of services for the users. Since the opening of the new premises the number of the library visitors has grown from 103825 to 691200. The central library of the Scientific Library is open for users Monday through Saturday (https://www.rtu.lv/writable/public_files/RTU_1_rtu_library.pdf). The 24-hour reading room is available.

Upon students request, during the end-of-semester exams in December, 2019 and January, 2020 the library users had 24-hour access to five floors lounges of the library. In the summer time, the Library is open each working day and works for reduced hours.

The library sources are housed in an open-access collection. Books and periodicals according to the field of study and the UDC indexes are located in the central building of the Scientific Library, 5 Paula Valdena Street, Riga. The last copies of the oldest publications corresponding to the RTU profile are kept in the library repository. They are always available to the users.

The librarian on duty helps visitors find their way around the collection. Bibliographers (information specialists) provide more detailed information and advice. The library has a branch librarian service. (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija in Latvian).

The library resource search is supported by the Primo Discovery search tool (https://www.rtu.lv/lv/studijas/biblioteka/vienota-informacijas-meklesana in Latvian). It allows searching the library catalogue (https://kopkatalogs.lv/F/H6B88N8SM6DDVT7B8RSX6CRCRAFRNUUYDS7ABX9MT1D115Y5MT-00754?func=option-update-lng&P_CON_LNG=ENG), the subscribed databases, as well as databases created by the RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes in Latvian) in one interface.

Searching for information in the electronic joint catalogue (https://kopkatalogs.lv/F), it is possible to simultaneously obtain information on the resources available in 12 Latvian libraries.

The manual “How to search for resources in the catalogue” has been drawn (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/ka-meklet-kataloga in Latvian).

Both the electronic catalogue and the RTU portal ORTUS allow remote reservation of library resources, as well as remote access to the databases. Since the introduction of RFID technology, users can use five self-service book-dispensing machines and check out books from the pick-up machines around the clock.

The library provides students, academic personnel and other stakeholders with various levels of individual consultations and group training in information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas in Latvian).

Publications not available in the library are delivered via an interlibrary loan or an international loan. Internet access is available throughout the library. The library has copying, scanning, printing, binding services and a self-service dining room.

Neskaidrību gadījumā ar ZB var sazināties: Jautā bibliotekāram (https://www.rtu.lv/lv/studijas/biblioteka/jauta-bibliotekaram in Latvian), izmantot uzziņu e-pastu vai zvanīt uz uzziņu tālruni (https://www.rtu.lv/writable/public_files/RTU_1_rtu_library.pdf)

3.4. Provide information on the procedures for attracting and/or employing the teaching staff (including the call for vacancies, employment, election procedure, etc.), and the assessment of their transparency.

The implementation of RTU personnel policy is stipulated in the Human Resources Development Plan, which focuses on three main goals within the professional development of the academic staff: renewal of the academic staff, by promoting academic work of Doctoral students, improvement of the professional competence of the existing academic staff and attraction of foreign academic staff. The action plan sets out, for each goal, the activities and sub-activities to be carried out, defines the results to be achieved, the responsible organizational units and the implementation schedule.

Elections of RTU academic staff are held in accordance with the requirements of the Law on Higher Education Institutions and Cabinet regulations based on the recommendations of the Council of Higher Education, in accordance with the Constitution of RTU and the regulations approved by the Senate "On the Procedure of Electing Professors and Associate Professors" and "On the Procedure Of Electing Assistant Professors, Lecturers and Assistants" (publicly available at https://www.rtu.lv/lv/universitate/vakances-rtu/personalatlases-dokumenti in Latvian, as well as included in the file of Annex 42-43 of the list of Internal regulations), as well as in compliance with other internal laws and regulations.

At the proposal of organizational units, the faculty council or the institute board shall consider and approve a reasoned proposal made by the head of a respective organizational unit for announcement of the competition for vacant academic positions, which expire in the respective academic year. The faculty council or the institute board shall submit the proposal under consideration to the RTU Personnel Department together with the job description and qualification requirements, including the workload (full-time or part-time).

Regarding academic positions for professors and associate professors, where the term of election expires in the respective academic year, periodic evaluation of scientific and pedagogical qualifications is performed in accordance with the Procedure for Election of a Candidate for the Position of Professor or Associate Professor and the Procedure for Assessing the Qualification of an Existing Professor or Associate Professor approved by the RTU Senate Meeting on 26 April 2021 (published at https://www.rtu.lv/writable/public_files/RTU_par_profesoru_un_asocieto_profesoru_periodisko_novertesanu_apstiprinasanu.pdf in Latvian; the English translation is in the file of Appendix 45 of the List of the governing regulatory enactments and regulations of the higher education institution/ college).

The Personnel Department informs the head of the structural unit of the professor or associate professor about the need to organize the evaluation of the professor or associate professor. The evaluation is performed by the Board of professors of the field in accordance with the Law on Higher Education Institutions, the Regulations of Councils of RTU professors and the Regulations on periodic evaluation of professors and associate professors approved by the RTU Senate. After the evaluation, the Council of the professors of the field submits an opinion on the result of the evaluation to the Rector and the Personnel Department. Taking into account the evaluation of the Board and the procedures and criteria set by the higher education institution, the employment contract with the associate professor or professor may be extended for a definite or indefinite term. If, as a result of the evaluation, the scientific and pedagogical qualification of a professor or associate professor meets the evaluation criteria set by the higher education institution, the employment relationship is continued. If, as a result of the evaluation, the qualification of a professor or associate professor does not meet the evaluation criteria set by the higher education institution:

- the relevant employment contract of the professor or associate professor is terminated;

- the department may decide to announce a new vacancy.

The Personnel Department announces a competition for academic staff positions at RTU website, the *Euraxess* vacancy portal and at least in one mass medium distributed throughout Latvia. The applicant shall personally submit or send by email the signed application documents no later than one month after the date of competition announcement.

The employment relationship shall be established by means of a written employment agreement between the Employer and the Employee at least two working days before the commencement of employment. The employment agreement shall be drawn up in duplicate. One copy shall be kept by the Personnel Department (in accordance with RTU File Nomenclature) and the other shall be issued to the Employee. Prior to entering into the employment agreement, the applicant is acquainted with RTU Rules of Procedure.

Employee's duties are defined in accordance with the Classification of Occupations of the Republic of Latvia and RTU Position Catalogue, Unified Work Remuneration Procedure at RTU (see the file of Annex 44 of the list of Internal Regulations), RTU Rules of Procedure and the requirements laid down in the job description, which is an integral part of the employment agreement. Job description shall be presented to and signed by the Employee. Job description shall be drawn up in duplicate; one copy shall be issued to the Employee and the other shall be kept according to RTU Case Nomenclature.

Before taking up the employment, the applicant shall present an identity document – passport or identity card, the foreigner shall additionally present a visa or residence permit, as well as a work permit if such a permit is required in accordance with regulatory enactments.

Visiting academic staff shall be employed in compliance with:

- Law on Higher Education Institutions (https://likumi.lv/doc.php?id=37967);
- Labour Law (https://likumi.lv/ta/id/26019-darba-likums);
- Immigration Law (https://likumi.lv/ta/id/68522-imigracijas-likums);
- Cabinet Regulations No 568 "Regulations Regarding the Procedure by which a Research Institution Concludes and Terminates Employment Agreements with a Foreign Researcher" as of 21 July 2008 (https://likumi.lv/doc.php?id=178749);
- Cabinet Regulations No 225 "Regulations Regarding the Amount of Financial Means Necessary for a Foreigner and the Determination of the Existence of Financial Means" as of 25 April 2017 (https://likumi.lv/doc.php?id=290808);
- Cabinet Regulations No. 25 "Implementing Regulations for the First, Second and Third Project Applications Selection Round of Specific Objective 8.2.2 "To Strengthen Academic Staff of Higher Education Institutions in the Areas of Strategic Specialization" of the Operational Programme "Growth and Employment"" as of 9 January 2018 (https://likumi.lv/doc.php?id=296513);
- RTU internal regulations “Procedure of Involvement and Employment of Visiting Academic Personnel at RTU” as of 26 November 2018 (see the file of Annex 25 of the list of Internal regulations);
- RTU internal regulations "Unified Work Remuneration Procedure at Riga Technical University" as of 27 April 2020 (amendments on 28 September 2020, 21 December 2020, 25 January 2021) (see the file of Annex 44 of the list of Internal regulations).

According to the results of the applicant selection competition, the employment agreement with the visiting academic staff is signed within a month, specifying an hourly rate. Job description is also provided, which includes specific job responsibilities (delivering lectures, designing study courses, lecture cycles, supervising study papers, etc.). The workload of the visiting academic staff member may include the provision of face-to-face work (delivering lectures, providing tutorials, conducting seminars, supervising graduation papers, etc.) and remote work if it complements the face-to-face work (video lectures, tutorials, supervision of graduation papers). If the work is to be carried out remotely, face-to-face visits (e.g., tutorials) should be provided at the organizational unit.

The visiting academic staff member shall enter into the employment agreement in compliance with the requirements of the Latvian regulatory enactments. During the term of the employment agreement, all assignable copyrights for the work created by the visiting academic staff member, including curricula, materials, and any other teaching aids developed by the visiting academic staff member, shall pass to the Employer. The visiting academic staff member, upon termination of the employment agreement, shall be obliged to transfer the work created within the framework of the employment agreement, including study materials, to RTU. Before terminating the employment agreement, the visiting academic staff member shall submit to the head of a respective organizational unit the reports and other documents stipulated in the employment agreement.

3.5. Specify whether there are common procedures for ensuring the qualification of the academic staff members and the work quality in place and provide the respective assessment thereof. Specify the options for all teaching staff members to improve their qualification (including the information on the involvement of the teaching staff in different activities, the incentives for their involvement, etc.). Provide the respective examples and specify the way the added value of the possibilities used for the implementation of the study process and the improvement of the study quality is evaluated.

At the end of 2018, the Centre for Academic Excellence (teaching and learning centre) was established at RTU in order to support RTU academic staff (in the areas of pedagogical, intercultural communication and self-development). The main tasks of the Centre for Academic Excellence are as follows:

- to organize various educational events, such as seminars, thematic series of events, guest lectures, conferences, discussions with the participation of the Latvian and foreign specialists;
- to coordinate experience exchange activities within faculties and other organizational units;
- to inform (including posting to ORTUS) the academic staff about the latest teaching and learning trends that are appropriate for RTU;
- to provide guidance to academic staff on the use of teaching and learning methods, as well as on the assessment of students' knowledge, skills and competence;
- to inform students about learning opportunities, such as platforms, systems, applications, effective methods and forms of learning that can be used both in the study process and individually.

Each semester, a core set of activities is offered taking into account the professional competence and needs of the academic staff, which are identified through a survey, in which the lecturers indicate the most important topics and areas in which they want to improve themselves. Student surveys data and information from student self-governments are also evaluated, to gain some topics which should be improved for lecturers from students' point of view. At the same time, proactive actions are being taken to assess the potential needs of academic staff.

The Centre for Academic Excellence organizes two methodological conferences a year. The conference organized in the autumn semester is dedicated to the modern content of the study courses, while the conference held in spring focuses on modern teaching and learning methods. Materials of all events are available on ORTUS within the study course "Materials of the Centre for Academic Excellence".

After each professional development event, participants complete assessment questionnaires, which enable organizers to improve the range of offered events. In order to promote the development of competences of the academic staff, the student surveys are analysed each semester, as well as discussions with the representatives of faculties, student self-governments and the instructors themselves take place.

Academic personnel have the opportunity to improve their English language skills by applying to the courses offered by the RTU Institute of Applied Linguistics or by the RTU Riga Business School, which are organized thanks to SOO 8.2.2 project funding.

With the emergency situation and lecturing switching to the remote mode, the CAE on the ORTUS portal prepared a site “Support in the provision of remote courses”. The site consists of six sections: General Information, Technical Assistance, Pedagogical Assistance, Experience Stories, Distance Exams and Mutual Support. Each section is regularly updated with relevant resources. Lecturers appreciate such a resource, and also suggest what other materials should be included.

Since March 2020, almost 80 webinars have taken place (both organized by CAE and international partners, in which RTU lecturers were invited to participate). Webinars organized by the CAE were recorded, with more than 400 participants participating online, and the recordings were viewed more than 650 times.

Educational events are also organized by the Career Support and Services Unit, providing regular seminars to RTU academic and general staff on the following issues:

- cultural diversity;
- work productivity (time planning, conflict resolution, communication culture, stress management etc.);
- critical thinking;
- how to approach students with disabilities.

For participation in seminars, employees receive professional development certificates issued by RTU Department of Further Education.

The themes of seminars and classes are offered taking into account the results of RTU staff surveys, as well as current trends at foreign universities. Information on seminars organized over the years is available at https://www.rtu.lv/en/studentservice/career-centre/projects-and-seminars/seminars-and-lectures.

RTU IT User Support Centre regularly organizes training on IT systems and the latest technology tools for RTU academic and general staff. Training is organized on the following topics:

- E-learning environment (Moodle) for beginners;
- E-learning environment (Moodle) for advanced users;
- MS Outlook email and calendar;
- Office365 Teams and OneDrive;
- Searching in subscribed databases;
- Record-keeping systems;
- Basic IT security issues working with RTU information systems.

Every year in January, the Student Parliament of RTU organizes the contest “Annual Award of the

Student Parliament of Riga Technical University”. During the event, faculty academic staff members chosen by the students are awarded the honorary titles “Most Active Instructor of the Year” and “Instructor of the Year”.

To recognize and appreciate RTU academic staff, since 2018, RTU has been organizing contests “Annual Academic Excellence Awards” and “Young Academic Staff Member of the Year” in cooperation with the foundation “Riga Technical University Development Fund” and Industry Service Partner Ltd. The aim of these events is not only to award the best academic staff members, but also to promote creativity in the academic environment.

The added value of the opportunities used by the teaching staff is updated in the election process, assessing the achievements of the teaching staff over a period of 6 years. The decision of the RTU Senate stipulates that in the 6-year period the lecturer must improve himself in the amount of at least 160 hours. It is also an incentive for teachers to attend different types of courses and engage in activities.

RTU ESF project SAM 8.2.2. “Strengthening of RTU Academic Staff in the Areas of Strategic Specialization” makes an important contribution to training of the academic staff. FEEE academic staff is being trained in the framework of the project, with involvement of foreign academic staff, post-graduate students and degree candidates at RTU.

The project activities are aimed at three issues:

(1) recruitment of post-graduate students to academic jobs at RTU,

(2) recruitment of foreign academic staff members to RTU,

(3) enhancement of the existing academic staff competencies, including on-the-job training of the academic staff in a commercial company, professional English language courses for the academic staff and specialized training for the academic staff.

One of the project activities is directly aimed at enhancement of the academic staff qualifications, i.e., improvement of the academic staff competencies, including on-the-job training of the academic staff in a commercial company, professional English language courses for the academic staff and specialized training for the academic staff.

The activity includes:

- Enhancement of the existing academic staff competencies. The project includes specialized training and qualification upgrading for the academic staff, which develop leadership in the academic staff as well as sector-specific cooperation competencies. In the activity framework the following members of the academic staff have taken a 200-hour on-the-job training at different electrotechnical companies in Latvia: O.Krievs, I.Steiks, R.Poriņš, L.Zemīte, I.Zicmane and J.Kozadajevs (more detailed information is given in the academic staff CVs);
- Professional English language training for the academic staff. The professional English training course was offered to the academic staff, who could evaluate their language skills at levels A and B, in order to enhance their language proficiency. . In the activity framework the following members of the academic staff have taken the English language training course: I.Zicmane, V.Bražis, A.Mutule, J.Kozadajevs, R.Petričenko, Ļ.Petričenko, A.Podgornovs, A.Utāns, M.Vorobjovs, D.Žalostība, L.Zemīte.
- Specialized training for the academic staff. In order to develop such skills as leadership and sector-oriented cooperation competencies in the academic staff, the Project agenda includes the cycle of workshops, discussions or conferences about different themes of the courses. For example, J.Maksimkina has taken part in the workshop about conflict resolution and generation equality. A.Potapovs has taken a variety of courses in time management,

emotional intelligence, protection of personal data.

3.6. Provide information on the number of the teaching staff members involved in the implementation of the relevant study programmes of the study direction, as well as the analysis and assessment of the academic and research workload. Provide the assessment of the incoming and outgoing mobility of the teaching staff over the reporting period, the mobility dynamics, and the issues which the higher education institution/ college must tackle with regard to the mobility of the teaching staff.

Implementation of the field of studies "Power and Electrical Engineering, Electrical Technologies" involves 97 members of the academic staff in total, including 89 elected to some RTU academic positions, in their turn 8 were recruited on a temporary basis. Professional qualification of the academic staff fully complies to the study field study programme requirements. 74 members of RTU elected academic staff hold PhD degrees, and 23 members – Master degrees. More detailed information about all the members of the academic staff involved is available in the Annex: The list and CVs of the Academic staff.

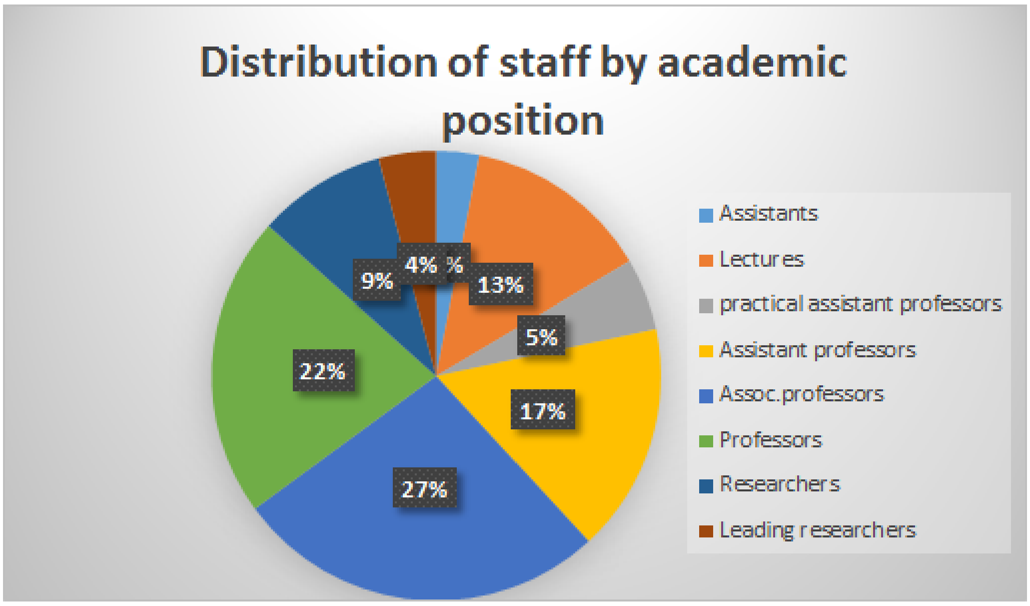

Figure. Distribution of academic staff by academic position.

Analysis of the data of RTU elected academic staff shows that each member of academic staff has acquired a PhD degree in the study field appropriate to the delivered study course, which is Engineering for the majority, though some members of the academic staff hold a PhD degree in Economics, Pedagogics, Social Science, etc., depending on the requirement of a delivered course.

Daily staff duties duplicate and all elected members of the academic staff have both academic and research workload, as well as administrative workload in certain cases. RTU does not put a strict line between academic and research workloads, their proportion is defined individually for each member of the academic staff while planning the employee workload at the department, as well as taking into account the post, participation in project implementation, professional qualifications and skills. The qualification of the academic staff in the study field is very high, and it is particularly important that the majority of the academic staff with a PhD degree are leading professors and researchers in their fields and have significant international experience. It is attested by the scientific achievements by the academic staff.

However, the fact that the members of the academic staff holding a Master degree for the moment mostly work under the guidance of professors and associate professors seems not less important. Most of them are post-graduate students or degree candidates.

With regard to the quality control of the study process, it is significant to develop competencies of the academic staff through mobility programmes, as well as to involve foreign lecturers. Mobility of the academic staff is evaluated as high and it has been realized in different forms. A lot of university teachers have enhanced their qualifications by taking part in international academic staff exchange programmes (for instance, ERASMUS+, COST mobility, and others). Throughout the reporting period, the academic staff and administrative personnel actively took part in international exchange programmes and delivered lectures abroad. More detailed information about all the academic staff of the study field is available in the Annex: The list and CVs of the Academic staff.

The following field-oriented guest lectures can be mentioned as instances of the inbound mobility within the study field:

- “Power industry of Ukraine: Situation, Problems, Prospects”, Ukraine
- “Power electronics - key enabling technology towards a CO2 neutral society”, Germany, RWTH Achen University
- “Finnish electrical system and universities collaboration opportunities”, Finland, Metropolia Power Engineering
- “Active Bypassing Techniques for Solar PV Modules”, Denmark, Aalborg University
- “An Introduction to Reliability of Power Electronic Components and Systems”, Denmark, Aalborg University
- “Industrial Internet of Energy Technologies”, Germany, Daimler AG
- “Model Predictive Control (MPC)”, Brazil, Federal University of Goias
- “Methods Applied to Power Electronics”, Estonia, Tallinn University of Technology
- “Pursuing High-Efficient PV Energy Solutions Based on Quasi-Z-Source Inverters: Benefits and Challenges”, Estonia, Tallinn University of Technology
- “Electromagnetic Modelling Approaches Towards Virtual Prototyping of WBG Power Electronics”, Switzerland, ETH Zurich
- “Development of interconnecting method for wind turbine generator system - parallel or series connection?”, Japan, Denki University
- “The Third Revolution in Measurement”, Pacific Northwest National Laboratory (PNNL)
- “Modern Propulsion Systems for Electric Vehicles”, Germany, RWTH, Aachen
- “Technologies and Trends in Energy Storage Systems”. TTU
- “Power Devices: Key Technology Driver for Future Power Electronic Systems” Germany, ECPE
- Spatial Motion Planning of Multibody Systems, prof. from Germany, *University* of *Duisburg-Essen*
- “Spatial Motion Planning of Multibody Systems”, prof. from Denmark, “Vestas Technology R&D”
- Mechanics and Robotics, Institute for Mechatronics and System Dynamics, University of *Duisburg-Essen*
- “Multilevel Technology in Power Electronics: Applications, Topologies, Modulation and Control”, Spain, Polytechnic University of Catalonia.
- About matrix converters, England, Nottingham University
- Visiting lecture about future challenges in energy sector; Greece
- "Electric circuit theory and applications"; Romania
- "The means for energy performance improvement of complex electric power systems and complexes”, Ukraine;
- Series of lectures “Smart Power Systems”, Bulgaria

- Series of lectures “State and prospects of development of the Energy of Ukraine”, Ukraine
- Course “Smart Energy”, Lithuania.

Regarding the inbound mobility, the visiting staff in the field of “Power and electrical engineering” should be also mentioned, who were recruited in terms of the project SAM 8.2.2. “*Strengthening of RTU Academic Staff* in the *Areas* of *Strategic Specialization*”, in elaboration of learning materials and study courses, and who work in the following HEIs: Lithuania, Kaunas University of Technology; Ukraine, Kharkov National Automobile and Highway University; Greece, Democritus University of Thrace.

In terms of the outgoing mobility, Professor Anastasija Žiravecka and Assistant Professor Svetlana Andrianova in 2013 and 2014 took part in ERSAMUS+ staff mobility programme and visited *University* of Ljubljana and the Technical University of Varna for exchange of good practice.

Professor Nadežda Kuņicina went to TU *Berlin* in Germany, in 2014 (lecturing), Kaunas University of Technology in Lithuania in 2018, and 2019, (experience exchange)

Professor Oskars Krievs in 21.11.2018 - 23.11.2018 did internship at the University of Duisburg-Essen in Germany, visiting the laboratory of robotics and taking part in the seminar on application of motion control software for industrial robotic manipulator, 16 (hours)

Iļja Galkins visited Tallinn University of Technology.

Anatolijs Zabašta – Belarusian State University (2014, experience exchange), Catholic University of Leuven (2017, 2018, experience exchange), Pisa University (2019, experience exchange)

Kristīna Bērziņa – Technical University of Varna.

Tatjana Lomane visited Technical University of Košice (Slovakia) in September, 2016 and in 11.09.17. – 16.09.17.(lecturing).

Assoc.prof. Anna Mutule in 31.10.2016 – 4.11.2016. visited KTH *Royal Institute of Technology* in Stockholm, took the training course "Topics on Distributed Energy Resources" in Sweden.

Mārcis Priedītis – experience exchange at the Technical *University* in *Graz.*

Inga Zicmane (8 hours), Kristīna Bērziņa (8 hours). Democritus University of Thrace (Greece). 17.09.-21.09.2018. ERASMUS+ Program, Mobility Agreement Staff Mobility for Teaching.

Kristīna Bērziņa, Inga Zicmane, Tatjana Lomane visited Technical University of Košice (lecturing) in 2019

Researcher Romāns Petričenko and assist.professor Ļubova Petričenko in 04.11.2019 – 04.12.2019 visited Kaunas University of Technology (Lithuania)

Assist.professor Ļubova Petričenko and researcher Romāns Petričenko in 04.01.2020 - 25.01.2020 visited Kaunas University of Technology (Lithuania);

Ļubova Petričenko - 06.04.2021 - 09.06.2021, Ondokuz Mayis University (Turkey) 08.02.2021 - 31.03.2021 etc.

In 2018 professor Pēteris Apse-Apsītis, researcher Ansis Avotiņš, lecturers Mārcis Priedītis and Armands Šenfelds visited Daimler AG in Germany for experience exchange.

Assoc. professor Jānis Zaķis in 2019 visited *Polytechnic University* of *Valencia* for experience exchange.

In 2020 the head of the study programme “Computerized Control of Electrical Technologies” and “Adaptronics” Professor L.Ribickis, Professor A.Žiravecka, Researcher A.Avotiņš, together with the final year post-graduate students visited *Aalborg* University.

Prof. Leonīds Ribickis, within the powers of his post, for exchange of expertise, as well as for building new contacts, from 2014 till 2019 visited the following universities: in 2014 – Moscow State Technical University, Chennai University, Delhi University, UAB Barcelona, Catalonia University, Polytechnic University of Valencia, University of Bordeaux, Paris Tech University, University of Technology of Compiègne, University of Florence, École polytechnique fédérale de Lausanne; in 2015 - Moratuwa University (Sri Lanka), Colombo University (Sri Lanka), University of Antwerp, Holon Institute of Technology, Wrocław University of Science and Technology; In 2016 - Czech University of. Life Sciences Prague, Lodz University of Technology, Royal Institute of Technology Sweden, University of Melbourne; in 2017 - Málaga University, University of Granada, la Lagunas University, University of Bergen, University of Porto, University of Ottawa, Polytechnique Montréal, Leidenes University, Aalborg University, Mohammed V University in Rabat, Budapest University of Technology and Economics; in 2018 - Kumamoto University, Tokyo University, Tokyo Denki University, Waseda University, Tallinn University of Technology, Palacký University, University of Madeira, Las Palmas de Gran Canaria University, Kyungpook National University, National Taiwan University of Science and Technology, Wu Feng University, University of Duisburg-Essen, University of Bucharest, LA Sapienza University, Turku University, Swiss Federal Institute of Technology, University of Bucharest; in 2019 - University of Trieste, University of Padua, Bergamo University, Polytechnic University of Turin, Oulu University, Albert Einstein University Mexico, Monterey Institute for Technology and Education (Mexico), Peru University, San Ignacio de Loyola University (Lima), Pontifical Catholic University of Peru, Catholic University of Santiago del Estero, University of Tsukuba (Japan), Shizuoka University (Japan), University of the Azores, Alto University, Brussels Open University, Vilnius Gediminas Technical University, Mykolas Romeris University (Lithuania).

3.7. Assessment of the support available for the students, including the support provided during the study process, as well as career and psychological support by specifying the support to be provided to specific student groups (for instance, students from abroad, part-time students, distance-learning students, students with special needs, etc.).

RTU Career Support and Services Department provides students with a wide range of career and psychological support services.

Career development support involves:

For prospective students:

- consultation on study programme selection;
- consultation on study selection and skills profiling;
- career choice seminars within RTU Open Days and upon request.

For current students:

- regular seminars and individual consultations on the development of career management skills, writing CVs and cover letters, job interview process;
- seminars on the development of entrepreneurial skills;
- project "RTU Golden Fund" to honour the best graduates and to promote new opportunities in the labour market;
- student summer camps for the development of career management and social skills and competences;

- online resource https://ekarjera.rtu.lv/;
- an annual career day aimed at informing students majoring in engineering, natural and social sciences about the best and leading companies in the respective fields and bringing them closer to potential partner companies for undertaking internship and employers.

Psychological support involves:

- individual consultations and support in case of difficulties with studies (time planning, lack of motivation, social anxiety, adaptation difficulties) and individual psychologist consultations on personal issues and difficulties (including crisis intervention).

Seminars and workshops on the following topics:

- adaptation events for first-year students - informative classes within the study course "Introduction to Study Field", seminars on the development of learning and communication skills;
- stress management methods;
- time planning methods;
- self-motivation;
- emotion management and development of emotional intelligence;
- public speaking skills.

Support is differentiated by the target groups (https://www.rtu.lv/en/studentservice/career-centre/psychological-support):

- prospective students (secondary school pupils, vocational school graduates, other prospective students): consultations concerning the studies are available, including skills diagnostics.
- first-year students: informative classes within the framework of the study course "Introduction to Study Field"; seminars on the development of learning skills; information letters on career and psychologist support opportunities; individual career and psychologist consultations; and other activities in cooperation with businesses and non-governmental organizations.
- all RTU students: individual career and psychologist consultations, seminars and classes, guest lectures, RTU Career Day.
- foreign students (Erasmus+ mobility and full-time): individual and career support consultations are available in English; wherever possible, seminars and classes are conducted in English, such as seminars on writing CVs and cover letters, time management.
- students with special needs: psychological and career support consultations are provided upon request; physical access to the room; opportunity to come with one's mentor or interpreter.
- graduates: career support consultations are provided if necessary; consultations on writing CVs and cover letters, job interview process, career opportunities.
- staff: consultations on work and study related issues are provided to RTU academic and general staff members, if necessary.

As a result of pandemic, the offer has become even more accessible, as counselling and also career classes can be offered remotely.

In 2014, the Student Services Centre was opened in Ķīpsala Campus. It ensures day-to-day support under the supervision of the Career Support and Services Department:

- provides answers to various questions that students may have;
- provides printing, copying and binding services;

- issues identification cards;
- draws up references and transcripts, if necessary.

Further information is available at: https://www.rtu.lv/en/studentservice/student-service.

In 2019, work was started on strengthening support for students with disabilities and in 2020 guidelines were issued with recommendations for effective communication and improvement of the study environment for people with disabilities and special needs.

RTU International Cooperation and Foreign Students Department has academic consultants who consult foreign students on studies and practical issues. Academic consultants keep track of the students' academic performance and attendance, as well as meet students on a regular basis to make sure their studies are successful, both in and outside the classroom. Shortly after the arrival of students, academic seminars are held, which are compulsory for all new students. Academic seminars are held approximately twice a week at the beginning of each semester, in line with the student influx. During these seminars, academic consultants introduce students to RTU internal rules, their responsibilities and rights, academic integrity, and various other practical aspects. In the future, it is planned to divide the students into groups according to the study programmes and to involve the heads of the study programmes in the seminars so that the students would get acquainted with the management of the programmes in due time. If during the semester a student is observed to face difficulties with the study process (attendance, academic arrears), the student is invited to an individual meeting with his/her academic consultant to discuss the best possible solutions to the problem. Each academic consultant has to arrange meetings with 2-5 students per week. After a month, students are invited to the meeting again to discuss their progress and make sure the situation has improved.

At RTU International Cooperation and Foreign Students Department, students have a contact person for facilitating the immigration process. The contact person organises immigration seminars and document examination at the beginning of the semester. The Department arranges an appointment for students with the Office of Citizenship and Migration Affairs of the Republic of Latvia.

RTU is a university pursuing excellence. On the way to this goal, for the second consecutive year the RTU Talent Program has been running, which involves young people from regional schools and all graduates of the Engineering High School (EHS) of Riga Technical University (RTU). These students are offered opportunity to participate in various support activities, workshops, as well as team-building activities. Upon student request, individual study plan is an option, allowing a student to finish the program faster, which means that the student will acquire the courses more intensively during the academic semester. If students show their willingness, they are engaged in research already in the first year of their studies. For additional support, each faculty assigns a coordinator for the students of the Talent Program, who can be addressed on various issues.

RTU FEEE Faculty Dean’s Office in cooperation with RTU FEEE student self-government functions as the information and service centre, aimed at improvement of student service at the faculty, as well as at raising the faculty and RTU profile as a whole. The centre provides the following services: copying, document print-out; key issuing (for classrooms and public lecture halls), first-aid kits, information for students and visitors, information management and provision (on the notice boards at the faculty, on the faculty home page, etc.).

Additionally, since 2017 RTU FEEE student self-government has implemented a special support programme for first year freshers. In the framework of the programme, a mentor from RTU FEEE self-government is assigned to each first-year Bachelor student of the study programme. The mentor answers the questions related to the study process, motivates to study (if a broader support is needed, representatives of RTU FEEE self-government organize work groups that help students to acquire the missed themes, etc.), meet with the academic staff and management of the study programme, if necessary. First year students welcome the self-government mentoring and the programme efficiency, it is attested by the fact that student number dynamics has changed – the rates of student dropout or sabbaticals due to difficulties in studies have decreased.

In cooperation with the companies in the industry, students are offered different scholarship competitions and thesis competitions. For example, companies JSC Latvenergo and JSC Augstsprieguma tīkls run thesis scholarship competitions in the areas of company interest. The company grants scholarship to students and provides materials and expert consultations. Furthermore, JSC Latvenergo in cooperation with Latvian Academy of Sciences on annual basis organizes thesis competition, when it awards the best theses. Therefore, to stimulate the industry and research development, to highlight outstanding achievements or life-long contribution to energy of young scientists, JSC „Latvenergo" and the Latvian Academy of Science (LAS) established the Annual Science Prize. This is one of the most significant events in the industry, which every year gathers advanced Latvian university teachers of engineering, researchers, industry-oriented experts and leaders, JSC Latvenergo specialists and representatives of LAS. A number of university teachers or their students have already received one of these prizes.

FEEE student self-government works hard and organizes various events oriented at student team-building, entertainment, sports, personal development and knowledge improvement, as well as at psychological support and assistance to foreign students in their integration in RTU study environment. In total, the student self-government of the Faculty of Electrical and environmental engineering and Student Parliament during the reporting period from 2013 to 2020 organized 115 events. Part of the events has already become a tradition; they are organized every year. "SPER GAISĀ X", "Race the: wind, light, power", "EEF (former faculty's acronym) Christmas", competitions "Rainfall", "Lauziens". It has already become a good tradition to hold the event on the occasion of the state holiday "EEF sadziedāšanas", which is now in its third year.

In 2013, the self-government organized nine events. For example, on 4. December, 2013, the event for RTU students "Race the wind" was organized. During the event, FEEE students could test the knowledge acquired at the university by fulfilling different "nagging" tasks and tests, to obtain all wind generator components and to prove finally that they were the best engineers and can build the most effective wind turbine.

In 2014, the self-government organized 15 events. In general, the events were oriented at team-building, educational and support activities, for example, on 6 November, 2014 the event "Study night" was held, which supposed to assist students in preparing for the end of the academic semester and *end*-of-*semester exams. Also, a variety of guest lectures was held in order to train students and to enhance their competencies. Furthermore, an interactive class was held, when* Atis Ķeņģis was delivering a lecture and debating on the subject of "What do studies stand for?". On 7 April, 2014, students had an opportunity to listen to the lecture delivered by RTU Vice-Rector for Research *Tālis* Juhna, when he spoke about potable water and its quality, about the water circulation in our life, and in the energy sector.

In 2015, the self-government organized 17 events. It held several team-building activities, a range of guest lectures and field trips to the companies. For example, at the guest lecture Mārtiņš Pelšs, the manager of "Agro Iecava" biogas plant, talked about operation of the biogas plant and on achievement of the set goals. The inspiring guest lecture "You can achieve more than you can imagine!" was delivered by Andrejs Gavrilovs. Besides, guest lectures about solar energy deployment were delivered with the following discussions and building (the most competitive light object). Same as in the previous years, the study night was held to support and assist students in preparing for the end-of-semester exams. Furthermore, a field trip to TES-2 was organized.

In 2016, the self-government organized 14 events. These included guest lectures, field trips, erudition contests and team-building activities. RTU students had an inspiring guest lecture delivered by "Blue Shock Bike" founder Artis Daugins. He shared his experience and told how to achieve the set goals, how to make ideas come to life and in general about the most favourable decisions for his career and wealth. A field trip to the leading global professional services company “Accenture” was organized on 23 November. The erudition contest “Tea-time at Einstein’s” offered students an opportunity to test the acquired knowledge. Team-building activities “EEF Rainfall”, “Full house of engineers”, “EEF days” allowed students to get to know their course mates better in a more informal atmosphere and to establish new contacts.

In 2017, FEEE self-government organized 15 events, when students could take part in a field trip to a company, listen to guest lectures and participate in team-building activities. In 2017 students used an opportunity to take part in FEEE self-government organized field trip s both to TES-2, and to Kegums HPP, informing about the principle of operation and the used technologies. During the visiting lecture ''Next generation applications with Microsoft.NET'' student could learn how .NET can help in development of adaptable, easy-to-maintain web-based applications. Team-building activities included “Freshers’ Camp SPER GAISĀ X10”, “ME’s vs PE’s Billiard”, “Hollywood in real life”.

In 2018, FEEE self-government organized 17 events. Students could listen to guest lectures, take part in a field trip to a company, and become a team and get to know other students. In 2018, guest lectures were delivered by Schneider Electric, which spoke about Schneider Electric plant background, its direct activities, support functions and different projects, as well as about career opportunities at the company. Also, a field trip to Schneider Electric was organized, where students could learn more about the latest developments in the world of energy, work at Schneider Electric and its latest ongoing projects. Team-building activities included such events as “Velo-orientation competition Gāziens (Rainfall)”, “Freshers’ camp SPER GAISĀ X11”, 101 “Lauziens” and others. Following the tradition of the previous years, the study night was organized to provide support to students and to assist in preparing for end-of-semester exams.

In 2019, FEEE student self-government organized 18 different events, where student could learn more about ERASMUS+ opportunities, take part in different sport games, meetings with specialists in power engineering and board game nights. During the events “Annual Rally of Power Engineers” and “Picknick of Energy Experts”, students could meet with power engineering activists of different generations, draw inspiration, establish new contacts and discuss topical issues related to power engineering. A guest lecture was delivered by the company SIEMENS. During the guest lecture, students had a chance to learn more about the international company Siemens activity domains, future plans and prospects, as well as broaden their knowledge about energy technologies. A lot of team-building activities were organized in 2019 to help students break the ice and integrate better in a new study environment and to encourage finding peers and making new contacts in a more informal atmosphere, as for instance, at such events as “Velo-orientation competition Gāziens (Rainfall)”, “SPER GAISĀ X12”, “Rector’s cup in table football and novuss”. As a team-building for students and staff, on the occasion of the Latvian state holiday a patriotic activity “EEF Sadziedāšanās” was held, where people could sing Latvian songs and enjoy *Kliņģeris* (a *traditional* Latvian *cake shaped* into a large pretzel).

In 2020, FEEE self-government organized only six events. A lot of activities had to be postponed or delayed due to Covid-19 restrictions, still the student self-government as much as possible were trying to organize some events, following all Cabinet regulations and legal requirements. To date year 2020 featured various team-building activities and on-line contests, allowing students to express themselves. For example, before the imposition of the state of emergency, same as in the previous years, the “ME’s vs PE’s Billiard Tournament” was held, to promote cooperation between RTU faculties. The on-line contest “Fidget’s challenge” was organized to encourage students to continue doing individual sports exercises even during the state of emergency.

II - Description of the Study Direction (4. Scientific Research and Artistic Creation)

4.1. Description and assessment of the directions of scientific research and/or artistic creation in the study direction, their compliance with the aims of the higher education institution/ college and the study direction, and the development level of scientific research and artistic creation (provide a separate description of the role of the doctoral study programmes, if applicable).

Apart from the academic work, academic staff of RTU actively participate in research. Professors and associate professors are re-evaluated and re-elected every six years. Candidates have to meet certain criteria with regard to their scientific activities, i.e., number of publications or patents, number of supervised theses, etc. (RTU Senate Decision No. 594 “On RTU Regulations on the Procedure for Election of Professors and Associated Professors” after approval of the new revision, approved on 30.11.2015.). The authority to supervise theses can be awarded if a member of the academic staff has an expert status in a certain field of science (RTU Senate Decision No. 602 “On Amendments to Riga Technical University Regulations for Post-graduate Studies”, approved on 26.09.2016), which is possible only if the criterion for the number of publications/patents has been met. Expert status is awarded by the Latvian Council of Science. Expert database is published in the National research information system (NRIS; http://sciencelatvia.lv).

Every year the Rector and the Faculty deans sign agreements where each faculty undertakes to achieve the main stated performance parameters, with many of them being based on research outcomes, for example, number of publications/patents, granted funds from research projects, etc. The parameters influence the funding that the faculty receives from performance-based financing.

FEEE academic staff have been very successful in elaboration and implementation of scientific project proposals (including EU Horizon framework programme, and other international projects). In the latest international ranking of Latvian research institutions made by Technopolis for the period 2013-2018, FEEE was ranked 4, taking a place among 16 top high-ranking research institutions in Latvia. In the mentioned period the total FEEE research budget exceeded 18,000,000 EUR and 25% of it was funding from EU research programmes.

The main areas of research in the field of study “Power and Electrical Engineering, Electrical Technologies”:

- Power electronics technologies for lighting systems, electrical drives, use of renewable energy resources and power flow control;
- Automation and robotics of production;
- Smart transportation control systems;
- Control, optimisation and automation of power generation and electricity supply;
- Development of innovative electrical machinery, apparatus, and devices.

The mentioned areas of research are fully in line with the specifics of the field of study, and the research outcomes in these areas can be integrated in the study courses of the study programme.

The study programmes included in the field of study fully comply to the strategic goal of RTU Faculty of Electrical and Environmental Engineering (until 2020 the title was the Faculty of Power and Electrical Engineering) for 2014 – 2020 – to become an internationally recognized Latvian leading study, research and innovation institution in the fields of energy, electrical technologies and environmental science before 2020, ensuring high-quality study process, internationally recognized research and sustainable innovation, commercialization and knowledge transfer in the national economy.

RTU implements a lot of support mechanisms for involvement of the academic staff in research, of which the two most important to be mentioned are RTU Research support fund and Research platforms. The goal of RTU Research Support Fund (RTU Senate Decision No. 585 "Regulation on RTU Research Support Fund", approved on 15.12.2014.) is to provide financial support to different research related activities, for example, finance research equipment maintenance, protect and license intellectual property, cover the costs of PhD studies, publish scientific journals, visit and organize scientific conferences, support researchers in establishment of new advancer research laboratories. The Research Support Fund is a research activity support tool, which stimulates the development of strategic fields of research. In 2013, at RTU level six research platforms were founded for RTU dominating strategic research fields as a tool for promotion cross-disciplinary and cross-faculty researchers' cooperation in fields of industrial and social relevance. These platforms include: "Energy and environment", "Cities and development", "Information and communication technologies", "Transportation", "Materials, processes and technologies", "Safety and security". Each platform is assigned a certain coordinator, and together they form the Coordinator Board being in charge of implementation of the activities within the platforms. The Board is accountable to the Office of Vice-Rector for Research (RTU Senate Decision No. 600 "On Approval of the Regulation for Riga Technical University Research Platform Coordinators" of 23 May, 2016). Similar to the faculties, the platforms have their own research programme (RTU Senate Decision No. 590 "On Authorization of RTU Research Council to Approve RTU Research Programme"; "Riga Technical University Research programme for 2016–2020" of 27 May, 2015), annual action plan and financing by the Science support fund. Internal project tenders are organized on the annual basis, allocating for this purpose 90 –120 thous. EUR to the winning projects. The compulsory requirement to projects is 20 % co-financing from an industrial sector and participation of more than one faculty. In the period from 2016 to 2018 this way 33 projects received funding in the total amount of almost 275 thous. EUR. The framework of the research platforms supposes regular seminars for better transfer of expertise, field trips to companies aimed at promotion of networking opportunities and cooperation with industry experts, as well as other relevant activities.

The effectiveness of these mechanisms is seen by the growth of SCOPUS indexed publications from 2013 to 2020. The total number of publications at the university increased from around 440 publications a year in 2013 to 750 publications in 2019. SCOPUS publications output per scientist (in full-time equivalents (FTE)) increased from around 0.9 in 2013 to around 1.5 publications/FTE in 2019 (data received from Elsevier "SciVal" database on 17 June, 2019).

The number of SCOPUS indexed publications written by the involved academic staff and the ratio of cited publications is given in the diagram.

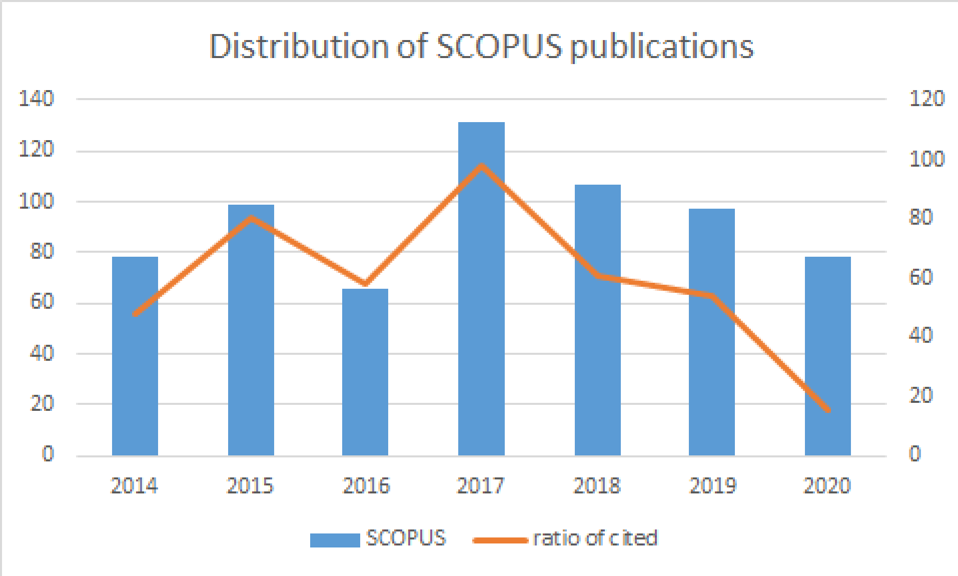

Figure. Distribution of SCOPUS publications written by the academic staff by year.

Ph.D Study Program "Computerised Control of Electrical Technologies"

Ph.D Study Program "Computerised Control of Electrical Technologies" is the only program in Latvia providing training of highly qualified international level experts (Ph.D holders) in the sub-fields "Power Electronics", "Electrical Technologies and Automation", as well as "Electrical Machines and Equipment" of the field "Electrical Technology, Electronics, Information and Communication", by delivering theoretical and practical knowledge, which is needed for performing independent research work and teaching, thus providing the intellectual potential and restoration needed for the national economic development. The content and implementation of the study program is based on the laws and regulations in force in the Republic of Latvia, the principles of Ph.D education recommended by the European Association of Universities, EQUAL Guidelines on Ph.D studies of May 2016, in compliance with the goals of strategic development of the RTU and the Faculty of Electrical Engineering and Environment Engineering and UN Sustainable development goals in higher education. On average, minimum one or two Doctors of Science out of the students in the program defend their Ph.D Thesis.

Study programs on similar topics are implemented in the higher education institutions in the Baltic countries, however, the offer of the RTU is characterised by scientific research in the fields targeted at development of solutions for issues topical for both the national economy of Latvia and the European Union, for example, power electronics transformers for use of renewable energy resources, as well as control of electricity and its quality in power networks, introduction of support robotics in industrial automation, etc. Ph.D studies are offered both in Latvian and English by attracting students from various countries. The extensive involvement of the Faculty researchers in implementation of international projects allowing Ph.D students to participate in development of scientific research issues covered there should be seen as indispensable advantage of the Ph.D study program at the RTU Faculty of Electrical Engineering and Environment Engineering.

The study program is focused on research in the sub-fields of power electronics, electrical technologies and automation, as well as electrical machines and equipment in order to be able to solve the scientific research and innovation tasks appropriate for the field topics, thus contributing to the international competitiveness of the Latvian industry. The variety of the topics of defended Ph.D Thesis reveals the broad range of interests of students securing creative diversity of the teaching work. Within the scope of the study program research is performed within the science fields where interdisciplinary issues related to power electronics and smart automated control systems are studied. The above research fields are unique for the study program, therefore its integration with other study programs implemented in the RTU or other universities is not a feasible option.

Ph.D Study Program "Smart Electrical Engineering"

Ph.D Study Program "Smart Electrical Engineering" is the only program in Latvia providing training of Doctors of Science in the sub-field "Electrical Engineering" of the field "Electrical Technology, Electronics, Information and Communication", by delivering theoretical and practical knowledge, which is needed for performing independent research work and teaching, thus providing the intellectual potential and restoration needed for the national economic development. The content and implementation of the study program is based on the laws and regulations in force in the Republic of Latvia, the principles of Ph.D education recommended by the European Association of Universities, EQUAL Guidelines on Ph.D studies of May 2016, in compliance with the goals of strategic development of the RTU and the Faculty of Electrical Engineering and Environment Engineering and UN Sustainable development goals in higher education. The uniqueness of the study program is based on performing research in the fields related to various environment creation aspects. Minimum one Doctor of Science defends the Ph.D Thesis out of 1-2 Ph.D students starting studies every year.

Study programs under a similar title are implemented in the higher education institutions in the Baltic countries, however, the offer of the RTU is characterised by scientific research in the fields targeted at development of solutions for issues topical for both the national economy of Latvia and the European Union, for example, provision of the European gas networks, optimisation of the power system development planning and energy production, trade and distribution, etc. Ph.D studies are offered both in Latvian and English by attracting students from various countries. The extensive involvement of the Faculty researchers in implementation of international projects allowing Ph.D students to participate in development of scientific research issues covered there should be seen as indispensable advantage of the Ph.D study program at the RTU Faculty of Electrical Engineering and Environment Engineering.

The study program is targeted at research in the field of electrical engineering and electrical technology to be able to solve the scientific research and innovation tasks of the field contributing to the international competitiveness of the Latvian industry. Therefore the topics of the theory tasks and practical assignments of the study program are related to the industry topicalities. The variety of topics reveals the broad range of interests of individual providing the informative and creative diversity of the teaching work. Within the scope of the study program research is performed within the science fields where interdisciplinary issues related to smart energy control, automation, optimisation, operation and element synthesis, etc. are studied. These areas of research attest the uniqueness of the study program and therefore its integration with other study programs implemented in the RTU or other universities is not a feasible option.

4.2. The relation between scientific research and/or artistic creation and the study process, including the description and assessment of the use of the outcomes in the study process.

RTU Research Programme for 2016–2020 (available in the file: RTU Pētniecības programma 2016.-2020. gadam.pdf) states the following goals of the Faculty (FEEE):

1. Increased international visibility of research;

2. Increased effect of innovation and research on development of relevant fields of research;
3. Increased economic and social role of research;
4. Development of research infrastructure.

RTU FEEE vision is to become an internationally recognized Latvian leading study, research and innovation institution in the fields of energy, electrical technologies and environmental science before 2020. FEEE has defined four main strategic fields on which long-term research goals are based:

- To increase international visibility of research and enhance the quality of publications, upgrade the environment to an innovative thinking space;
- To reduce the fragmentation of research fields at the institutes and promote cooperation between the institutes, cooperate within the framework of RTU research platforms;
- To improve the economic and social role of research via participation in project competitions of EU research and innovation programme “Horizon 2020” and other international support programmes;
- To develop the research infrastructure, by establishing new laboratories and using more UseScience efficiently, specifying in it not only equipment, but also services and qualifications, which FEEE can provide.

All mentioned research goals are focused on boosting successful research, its linkages and integration in academic studies, as well as start-up career assistance to the existing researchers when they start a career at the profession.

Cross-disciplinary role of research, including the synergy between science and research of RTU institutes and faculties, is ensured via involvement in work of RTU Research Platforms, which aim at cross-faculty, cross-disciplinary research in the fields relevant to the national economy and society. The research platforms are a social coordination mechanism, supposed to analyse needs of companies and different state institutions in order to define potential fields of research in compliance to RTU competencies, organize relevant internal project tenders, applications for international projects, cooperation with companies and state institutions. RTU FEEE institutes participate in FEEE coordinated RTU research platform “Energy and Environment”.

The integration of scientific research in the study process is ensured using possible knowledge transfer principles and continuous improvement of competence that becomes apparent through integration of research outcomes in study courses and the study process, student engagement in research, familiarization of students with relevant research results, by giving them an opportunity to do research individually and in cooperation (group work). The linkage of science and research in the study process is also ensured by means of visiting lecturers and workshops, through active participation of students in international conferences and seminars, international scientific publications and participation in international cooperation research projects, thus developing their research skills throughout the course of their studies, and supporting students in becoming young researchers at the same time.

Students of the study programmes of the field of study “Power and Electrical Engineering, Electrical Technologies” take active part in the development of spin-offs (for example, the student of the PhD programme “Computerized Control of Electrical Technologies" Artūrs Paugurs with the company "CozyCell"), where researchers and graduates continue successful acquisition of both scientific and economically successful results, which have an impact on the national economy, society and culture. Such activities contribute to sustainability of study programmes, engaging students in research work, and post-graduate studies, and engaging doctoral students in further scientific work once they obtain their degrees at FEEE and other scientific institutions. For integration of scientific research results in the study process please see Section 4.5. about engagement of students in scientific research.

In RTU FEEE development framework the Science Commission was formed to promote science development at the faculty, including support of scientific research results integration in the study courses, thus providing the study courses with continuing growth of up-to-date research outcomes.

The efficiency of scientific research and study process linkage is evident by RTU FEEE scientific activity and SWOT analysis results:

Internal RTU FEEE strengths:

- Renewed study and research infrastructure;
- The quality of studies and research is ensured by experienced, professional and loyal academic staff;
- Growing number of awarded PhD degrees over the past years due to a successful process of the academic staff rejuvenation;
- Good research performance parameters (number of publications and citing, international projects, contract works, etc.) at the national and international level, despite little (at international level) state funding to science;
- Active international cooperation in the field of studies and scientific research;
- Development of new fields of research, induced by opening of new study programmes and updating of the existing ones;
- Quality improvement of diplomas through engagement of students in development of research projects;
- Implementation of a variety of study programmes in English.

RTU FEEE external opportunities:

- High demand for energy, electrical and environment engineering specialists in Latvia and abroad;
- Globally increasing relevance of scientific research in the fields of energy, electrical engineering and environment;
- Updating of diploma themes in cooperation with international projects and industry-oriented companies, including innovative companies;
- Leverage additional funding and extension of international cooperation through participation in the national and European programmes and projects (State Research Programmes, LCS funded projects, "Horizon 2020" etc.);
- Cooperation with the companies in the industry in implementation of market-oriented research;
- Availability of national research centre infrastructure for scientific research activities, including work on graduation or PhD theses;

Enrolment of more students for studies in the study programmes.

4.3. Description and assessment of the international cooperation in the field of scientific research and/or artistic creation by specifying any joint projects, researches, etc. Specify those study programmes, which benefit from this cooperation. Specify the future plans for the development of international cooperation in the field of scientific research and/or artistic creation.

The most important forms of scientific and research work include participation in international scientific research projects, research commissioned by the state or the business sectors, featuring scientific publications, patents and participation and referencing in international and local conferences. The academic staff of the field of study “Power and Electrical Engineering, Electrical Technologies” actively participate in international scientific projects as apparent from a large number of such projects and academic staff publications with external co-authors. Successful international cooperation is confirmed also by high ranks of FEEE in the latest international ranking of Latvian scientific institutions, same as the fact that FEEE funding from the EU research programmes in the reporting period was 25% of all the research budget.

The major international projects of EU and other international programmes in the field “Power and Electrical Engineering, Electrical Technologies” during the reporting period are as follows:

EU Research Programme Projects

- Horizon 2020 project “TSO-DSO-Consumer INTERFACE architecture to provide innovative grid services for an efficient power system”, 2019 – in progress, Manager Antans Sauhats;
- Horizon 2020 project with CERN ARIES "Accelerator Research and Innovation for European Science and Society", Manager Pēteris Apse-Apsītis, 2017– in progress).
- Horizon 2020 project “Sun coupled innovative Heat pumps (SunHorizon)”, 2018- in progress, Manager Antans Sauhats, EUR 155’000;
- Horizon 2020 project “Securing The European Gas Network (SecureGas)”, 2019- 2021. Manager Laila Zemīte, EUR 266’875
- Horizon 2020 project “Building and district thermal retrofit and management solutions (THERMOSS)”, 2018. - 2020., Manager Antans Sauhats, EUR 183’750;
- Horizon 2020 project (No. 646116) "RealValue: Realising Value From Electricity Markets With Local Smart Electric Thermal Storage Technology", 2015 – 2018. EUR 632'318.
- FP7 project “Automation and Robotics for European Sustainable manufacturing (AREUS)”, 2013 – 2016., EUR 601'732. Manager Leonīds Ribickis;
- FP7 project “Pan European Grid Advanced Simulation and state Estimation (PEGASE)”, 2008–2013, EUR 329’296, Manager A. Mutule;
- FP7 project “Intelligent coordination of operation and emergency control of EU and Russian power (ICOEUR)”, 2008. – 2014., EUR 95'640, Manager Antans Sauhats;
- FP7 project “Led-based intelligent street lighting for energy saving (LITES)”, 2009- 2014, EUR 370'548, Manager Leonīds Ribickis;
- FP7 project “Development of training network for improving education in energy efficiency (TEMPUS)”, 2012 - 2015, EUR 175'618, Manager Leonīds Ribickis;
- FP7 project “Production and Energy System Automation Intelligent - Built environment and urban infrastructure for sustainable and friendly cities - Arrowhead (ARTEMIS)”, 2013- 2016, EUR 109,263, Manager A. Ļevčenkovs

Other international projects

- Nordic Energy Research project "Fast, flexible and secure decarbonisation of the Baltic states – possible progress in the next Ten years", 2020-2021 Manager Diāna Žalostība, EUR 39’213;
- EC Joint Research Centre project " Technical Support for Risk Assessment of Power Transmission Network - LOT 2: Expertise from the perspective of electricity system of gas-electricity network for reference system: Republic of LATVIA", 2017, Manager Antans Sauhats, EUR 29’350
- EC Joint Research Centre project “Technical Support for Risk Assessment of Gas Transmission Network. LOT 2: Expertise from the perspective of Gas system of Gas-Electricity network for Reference System: Republic of LATVIA”, 2017, Manager Laila Zemīte, EUR 31’000

- COST TU1104, „Smart energy regions”, 2012−2016 Manager Anastasija Žiravecka.
- EC ARTEMIS Call 2012 Arrowhead, 2013−2016, EUR 100'000. Managers Anatolijs Zabašta, Nadežda Kuņicina.
- Erasmus+ project “Establishing smart energy system curriculum in Russian and Vietnamese universities (ESSENCE)”.
- Erasmus+ project “Applied curricula in *space exploration* and *intelligent robotic systems* (APPLE)”, (Project Manager A. Zabašta, 2016–2019).
- “Improvement of Master level education in the field of physical sciences in Belarusian universities (Physics)”, (Project Managers A. Zabašta, N. Kuņicina, 2015–2018).

For successful participation in international research consortiums, local research work is also necessary, in order to accumulate research developments and strengthen cooperation with the business sector. During the reporting period, in the field “Power and Electrical Engineering, Electrical Technologies” a large number of research projects financed by national or EU structural funds, with the following below to be highlighted:

Most recent ERDF projects

- ERDF project “Research and Development of Electrical, Information and Material Technologies for Low-Speed Rehabilitation Vehicles for Disabled People”, (Funding: 610 652,81 EUR, Project Manager I. Galkins, 01.03.2017–29.02.2020).
- ERAF project “*Development of Energy-Saving* Elevator Using Regenerated *Power Accumulation System*”, (Project Manager V. Bražis, 29.01.2018–28.01.2021).
- ERAF project “*New control methods* for *energy* and ecological efficiency *increase* of greenhouse *plant lighting systems* (uMol)”, (Funding: 600 000,00 EUR, Project Manager A. Avotiņš, 01.03.2017–29.02.2020).
- ERAF project “Dynamic system of energy consumption control and data acquisition (DEPUIS)”, (Project Manager P. Apse-Apsītis, 2017–2020).

Projects financed by the national research programmes

- Project of the State Research Programme “Energy” “Sustainable Development and Integration of the Latvian Energy System in Europe” Manager Antans Sauhats, EUR 472,440;
- Project of the State research programme “Energy” “Trends, challenges and solutions of Latvian natural gas infrastructure development (LAGAS)”, Manager Laila Zemīte, EUR 472’440;
- Project of the State research programme “Energy” “Innovative smart grid technologies and their optimisation (INGRIDO)”, Manager Aleksandrs Dolgicers, EUR 472’440;
- Project of the State research programme “Energy” “Innovative solutions and recommendations for increasing of local and renewable energy resources in Latvia (RTUAER)”, Manager Leonīds Ribickis, EUR 467’320;
- State research programme “Energy efficient and low-carbon solutions for a secure, sustainable and climate variability reducing energy supply” ("LATENERGI"), programme Manager Leonīds Ribickis, coordinator Oskars Krievs, 2014-2018, 2’250’000 EUR
- Project Nr. 1 of the State research programm "LATENERGI" “Innovative power electronic technologies for increasing energy efficiency of industrial and household sectors in Latvia, future power supply grids and harvesting of renewable resources”, 2014 – 2018, EUR 405’000 Project Manager L. Ribickis.
- Project Nr. 2 of the State research programm "LATENERGI" “*Power* system *development planning* and energy *production*, sale and *distribution* optimisation”, 2014 -2018, EUR 450'000, Manager Prof. A. Sauhat.
- National research programme in next generation information and communication

technologies (ICT) - NexIT “Application of sensor grid and signal processing in national economy”, 2014–2017, Project Manager N. Kuņicina.

Most recent LSC (*Latvian Council* of *Science*) fundamental and applied research projects

- Grant of the Latvian Academy of Sciences “New integrated buck-boost multilevel inverter for renewable energy applications”, (Project Manager J. Zaķis, 2014–2017).
- Z 12.0467, Nr. 416/2012 “Study of the DC converter of a source of full resistance”, PVS ID 1727, 01.02.2013.–31.12.2015, (funding EUR 53 853. Manager Jānis Zaķis);
- Management and Operation of an Intelligent Power System (I-POWER), 2018-2021. Project Manager A. Sauhats

Most recent RTU cooperation projects

- “Development of computed system of individual’s personality evaluation (DPNS)”, (Project Manager P. Apse-Apsītis, 03.05.2017–04.05.2020).
- “Development and study of pseudo-bionic feedbacks and technical diagnostics systems of prosthetic and rehabilitation equipment”, (Project Manager L. Ribickis, 15.02.2016–14.02.2019).
- “The textile material reducing infrared radiation of thermal spectrum for protection of military uniform clothing”, (Project Manager P. Apse-Apsītis, 02.01.2017–31.12.2017).
- “Project in collaboration with Latvian Centre of Competence of Electric and Optical Equipment Production (LEO KC) and AERONES”, (Project Manager A. Avotiņš, 01.09.2016–31.12.2018).
- ZI-2014/9 “Self-diagnostics and optimisation of smart prosthetics using vibration feedbacks”, PVS ID 1882, (Manager Iļja Galkins, 01.12.2014 - 30.11.2015, total funding EUR 12 977,00).

Involvement of the teaching staff of the direction “Energy, Electrical Engineering and Electrical Technologies” in the above referred scientific research projects improve their qualification and promote cooperation with foreign colleagues, allowing supplementing the content of their courses with the recent science and technology trends in the fields of electrical engineering and electrical technology. All the Master and Ph.D level programs of the direction benefit most from this cooperation, moreover, because also some Master level students and all Ph.D students are involved in the implementation of these projects. Almost all the equipment prototypes and computer models of power networks developed within projects are used in one or several Master and Ph.D Thesis.

As regards further plans in international cooperation of scientific research, several projects are scheduled to be submitted in programs, like Horizon 2020, “Horizon Europe”, “Nordic Energy Research” and “Baltic Nordic Research”. In the applications, the list of cooperation partners includes foreign universities and companies, like TalTech, VTT Finland, Joint Research Centre, GuardTime, Conexus Baltic Grid, KTH Royal Institute of Technology, Klaipeda University, Deloite, etc. It is envisaged to improve the Bachelor and Master study programs “Smart Electrical Engineering” in the result of cooperation. At the Faculty of Electrical

Engineering and Environment Engineering there is a physical movement emulator with a virtual reality cabin, which is unique in the North Europe, and in this regard it is planned to submit scientific research projects in the field of movement control and simulation jointly with the University of Duisburg-Essen and the National Technical University of Athens. It is envisaged to improve the Bachelor and Master study programs “Adaptronics” in the result of cooperation. New power system emulator Egston Compiso with the capacity of 200kW has been installed and in this regard it is planned to submit project applications and to expand cooperation in the field of power electronics with “RWTH Aacken”, “Uni Stuttgart”, “Aalborg University”, Fraunhofer Institute, as well as the companies “Daimler AG” and “ABB”, resulting in improvement of the Bachelor, Master and Ph.D study programs “Computerised Control of Electrical Technologies”.

4.4. Specify the way how the higher education institution/ college promotes the involvement of the teaching staff in scientific research and/or artistic creation. Provide the description and assessment of the activities carried out by the academic staff in the field of scientific research and/or artistic creation relevant to the study direction by providing examples and the summary of the quantitative data on the activities in the field of scientific research and/or artistic creation relevant to the study direction over the reporting period, for instance, the publications, participation in conferences, activities in the field of artistic creation, participation in projects by the academic staff members, etc., by listing the aforementioned according to the relevance.

It is a requirement of RTU that academic staff are actively involved in research apart from their involvement in the study process. Professors and associate professors are re-evaluated and re-elected every six years. Candidates are obliged to comply with certain criteria in terms of scientific research, i.e., number of publications or patents, supervised Doctoral candidates, etc. (Decision of RTU Senate No. 649 “On approval of the RTU Regulations “On the Procedure for Election of a Candidate for the Position of Professor or Associate Professor and the Procedure for Assessing the Qualification of an Existing Professor or Associate Professor” in a new edition” as of 26 April 2021). In order to be allowed to supervise Doctoral students, the academic staff have to be approved experts in their fields, which is possible only if criteria regarding the number of publications/patents are met (decision of RTU Senate No. 602 “On Amendments to RTU Regulation on Doctorate” as of 26 September 2016). Approval process for the experts is organised by the Latvian Council of Science. The database of the experts is published on the National Research Information System (NRIS; http://sciencelatvia.lv).

Every year, the Rector and faculty deans sign agreements by which each faculty undertakes to achieve certain key performance indicators, many of which are based on research output, e.g., the number of publications/patents, obtained research project funding, etc. Achievement of these indicators has an impact on financing received by the faculty from the so-called performance-based funds.

RTU Research Support Fund (Decision of RTU Senate No. 585 “RTU Regulation of Research Support Fund” as of 15 December 2014) aims at providing financial support for various research related activities, such as support for maintenance of research equipment, protection and licensing of intellectual property, covering of expenses related to the Doctoral study process, publishing of scientific journals, participation and organization of scientific conferences, support to researchers in establishing new laboratories in a prospective research field. The Research Support Fund is an instrument to support research activities, which foster the development of the strategically important research fields.

Six research platforms in the main strategic research areas of RTU were established in 2013 as an instrument for fostering inter-disciplinary and inter-faculty cooperation of researchers in the areas of importance for industry and society. These platforms are as follows: “Energy and Environment”, “Cities and Development”, “Information and Communication Technologies”, “Transport”, “Materials, Processes and Technologies”, “Security and Defence. Each platform has a dedicated coordinator, and they comprise the Council of Coordinators responsible for implementing the activities within platforms. The Council is supervised by the Office of Vice-Rector for Research (Decision of RTU Senate No. 600 “On Approval of the Regulation of the Council of Coordinators of Research Platforms at Riga Technical University” as of 23 May 2016). Similar to the faculties, the platforms have the

Research Program (Decision of RTU Senate No. 590 “On Authorization to Approve RTU Research Program by RTU Scientific Council” as of 27 May 2015; “Research Program of Technical University 2016–2020”), annual action plan and dedicated funding from the Research Support Fund. Internal project calls within the platforms are organized every year, allocating 90–120 thousand EUR in total to six projects selected on a competitive basis. A mandatory requirement for the projects is a minimum 20% industry co-financing and participation of more than one faculty. In the period of 2016–2020, 16 projects were supported and nearly 300,000 EUR of funding was allocated to the projects. Regular series of seminars and visits to companies are also organized by the research platforms to stimulate networking and cooperation with industry.

Efficiency of these mechanisms can be illustrated by growth of SCOPUS indexed publications in the period of 2013–2019. The total number of the publications increased from approximately 440 publications per year in 2013 to 865 in 2018. Number of SCOPUS publications per researcher (expressed in full-time-equivalent (FTE)) increased from circa 0.9 in 2013 to circa 1.5 publications/FTE per year in 2018 (the data were obtained from Elsevier “SciVal” database on 17 June 2019).

According to RTU regulations, the academic staff must be involved in scientific research activities. In the field “Power and Electrical Engineering, Electrical Technologies”, the academic staff has developed **1256 publications**, included in the international cited databases. **819 publications** are included **in SCOPUS database** and **292** of them are cited publications indexed in this database.

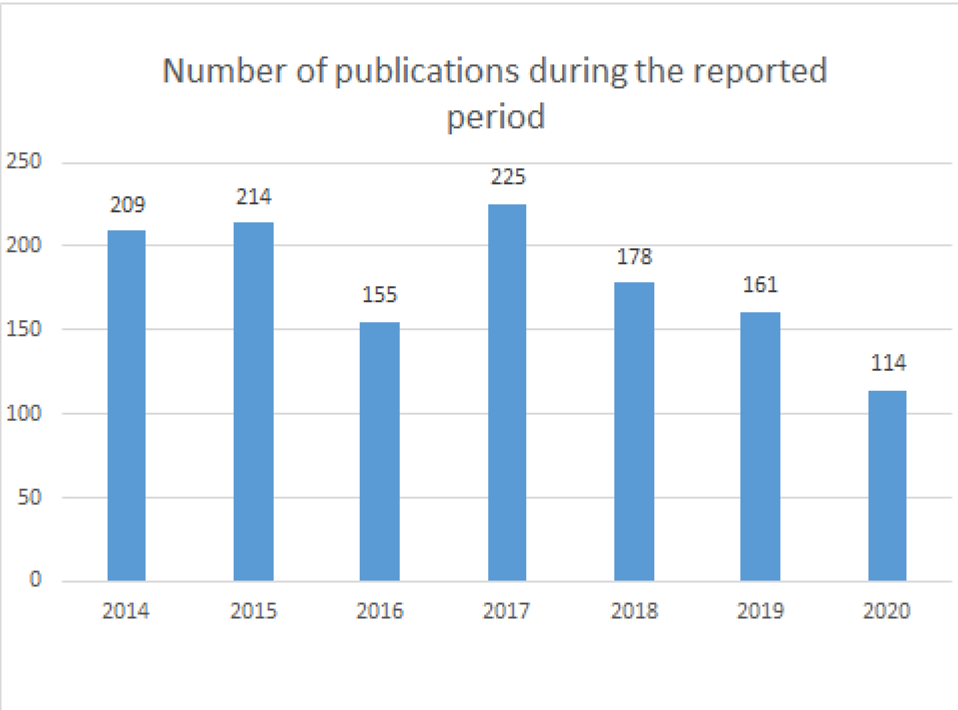

Figure: Number of publications in the reporting period

It may be concluded from the data that research outputs are very successful, it is evident by high number of publications and projects during the reporting period. The figure shows the decrease in the number of publications during the last 3 years which is due to the fact that the number of publications in scientific journals is growing and substantially faster than the number of conference reports.

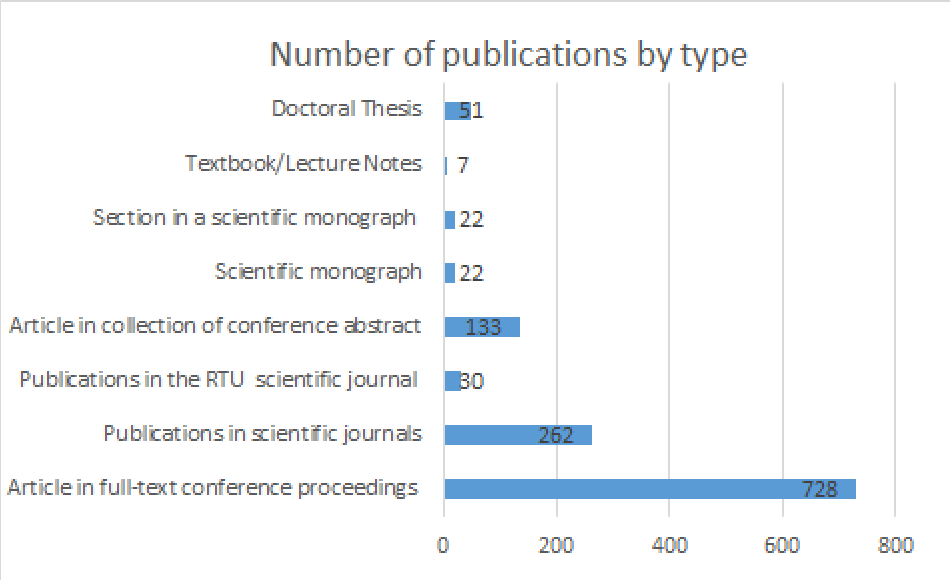

Figure: Number of publications by type

Two thirds or 728 publications of all publications are full-text articles in conference proceedings, as is appliable to electrical engineering, electronics and ICT in the rest of the world. The next popular way of publication represents scientific journals - 262 publications and their specific weight is during the last 3 years has grown significantly. This confirms active participation of the academic staff in scientific conferences and projects and demonstrates that academic work performed by the academic staff meet the current trends in the represented sector. Mostly all publications are indexed in SCOPUS database 819 publications). Of them 485 publications are also found in WoS.

A lot of members of the academic staff of the field “Power and Electrical Engineering, Electrical Technologies” are also postgraduate students. During the reporting period from academic year 2013/2014 to 2020/2021, 51 theses were defended in RTU Doctoral Councils P-14 and P–5 in the field of study “Power and Electrical Engineering, Electrical Technologies” (for more information see Part III of the PhD programmes “Energy and Electrical Engineering” and “Computerized Control of Electrical Technologies” description report).

In parallel to academic work the academic staff of the field actively participate in realisation of research projects. FEEE academic staff succeeded much in preparation of applications and implementation of research projects (including EU Horizon framework programme and other international programmes), which is also confirmed by the latest international ranking of Latvian research institutions, high FEEE rank (took a place among 16 top high-ranking research institutions in Latvia). More detailed information about the academic staff involved in research projects is available in CVs of the members of the academic staff.

Involvement of the academic staff of the field “Power and electrical engineering” is also promoted through organization of different international conferences:

- Every autumn International Scientific Conference on Power and Electrical Engineering of Riga Technical University (RTUCON) is organized;
- Since 2017 in cooperation with VGTU, Lithuania, the international scientific seminar "Workshop on Advances in Information, Electronic and Electrical Engineering (AIEEE) has been organized;
- On 17.09.2018 – 21.09.2018 the international conference “European Conference on Power Electronics and Applications” (EPE ECCE 2018) was organized, with more than 700 participants from 42 countries.
- On 11.05.2015 – 13.05.2015 “Power Engineering, Energy and Electrical Drives” POW-

ERENG’2015), 120 participants from over 33 countries and 67 universities.

4.5. Specify how the involvement of the students in scientific research and/or artistic creation activities is promoted. Provide the assessment and description of the involvement of the students of all-level study programmes in the relevant study direction in scientific research and/or artistic creation activities by giving examples of the opportunities offered to and used by the students.

RTU maintains mechanisms for involvement of students within all education cycles and study programmes in research. For example, the following important activities on the university scale can be mentioned:

- Centralized courses/ summer schools dedicated to research tools and methodology;
- Support funds for research projects (Master studies, PhD studies);
- Availability of research infrastructure, including software provision and data bases;
- Scientific Technical Student Conference;
- Various tutorials.

Various activities are implemented aimed at enhancing the PhD studies and ensuring career opportunities for young researchers in post-doc period.

Doctoral grants are provided to PhD students on a competitive basis. International calls are made to attract to post-doctoral projects. In addition, the internal Research Excellence Grant for young scientists was established in 2018 as a new initiative, providing 270 000 EUR for a 3-year period based on international competition (conditions are similar to EC ERC grant with international call and evaluation performed by external, i.e., foreign well-recognised researchers). The grant allows young and talented researchers to establish their own research groups and make research career at RTU. Internal project calls provide additional funding for publishing articles in SCOPUS/WoS indexed editions, and internal projects within 6 research platforms stimulate involvement of PhD and Master students in multi-disciplinary and inter-faculty research projects in cooperation with the industry. The Research Support Fund (10% of the research base funding is allocated to this fund) provides support to PhD students (attending conferences, publishing papers and thesis, etc.).

Employment of PhD students and post-doctoral researchers at RTU went up from 0 FTE in the period of 2013-2016 to 88 FTE (PhD students) and 97 FTE (Post-doctoral researchers) in 2018. 17 post-doctoral 3-year long projects with total funding of 2.28 million EUR were launched in 2017. The funding covered salaries, costs of materials and mobility, as well as support for further development of research skills (circa 134,000 EUR are allocated to one project).

16 post-doctoral 3-year long projects were launched in 2018 and 12 post-doctoral 3-year long projects were launched in 2019 with total funding of 3.7 million EUR. 18 post-doctoral 3-year long projects with a total funding of 2.4 million EUR were launched in 2020. In 2021, at least 10 projects should be launched. The post-doctoral projects allow attracting new researchers to RTU from abroad and other Latvian research institutions and provide academic career opportunities to PhD students who graduated from RTU.

Internal project calls within the six research platforms, which are organised every year, have criteria regarding the involvement of students in the project, giving an additional score if students at the Bachelor, Master or Doctoral level are involved in the project.

The Design Factory (DF) of RTU (see additional information about the DF below) organises the study course "Vertically Integrated Project" (VIP), during which interdisciplinary student teams develop a challenging long-term research project under the guidance of experienced researchers. The course is implemented in cooperation with researchers from the Georgia Institute of Technology (the USA). Within the course, cross-disciplinary student teams are assembled, bringing together students from at least three different study programmes, and ranging from first-year Bachelor students to Doctoral students, as well as involving pupils from the Engineering High School (EHS) of RTU (see additional information about the EHS below). During the course, students participate in research work under supervision of RTU researchers, working together with students of other study programmes and gaining experience in research as well as in team and project work. At the end of the course, each team presents its progress and demonstrates the results obtained. For example, during spring semester of 2019, the call for VIP courses was announced for three topics:

- sensor systems and networks (group leader Prof. Jurģis Poriņš);
- wastewater treatment (group leader Prof. Tālis Juhna);
- energy efficient houses (group leader Leading Researcher Jānis Zaķis).

The course is registered as a free elective study course and two credit points are assigned to the student in the semester.

The Engineering High School of Riga Technical University is the first general secondary education establishment in Latvia that has been founded within the framework of a university. It is the place where the most talented Latvian pupils can acquire the study courses in exact and natural sciences at an advanced level to get prepared for the engineering studies. At the EHS, special attention is paid to the integration of engineering studies and scientific research activities into the study process. As a mandatory condition, students should choose a place of internship at one of RTU faculties, to get an idea what to do at certain faculties and try themselves in research work.

The establishment of DF Labs (http://rtudf.rtu.lv) for design and prototyping is a success story. Idea of having the Lab at RTU was inspired by a positive example of Aalto University in Finland. Its task is to provide expertise and shared infrastructure for developing prototypes of new products and technologies, based on ideas of students and researchers. RTU DF also works with industry, start-ups and spin-offs and has established a very good reputation. We could observe that it considerably improved the involvement of students at all study levels in research and innovation activities and promoted cooperation of RTU with industry.

In order to characterise the opportunities used by the students of the study direction “Power Industry, Electrical Engineering, and Electrical Technologies” to get involved in science in FEEE the following examples could be mentioned:

- At the programme “Adaptronics”, two graduates of EHS are studying, who were recruited as scientific assistants in FEEE. They are involved in Vertically integrated research projects (VIP);
- During the study process, the most successful and proactive students are involved in research projects recruiting them as research assistants or researchers. There are multiple such students each year sometimes even in bachelors level, but mostly masters level.
- Practically all doctoral students are recruited both as research personal and as members of the academic staff.

The integration of scientific research with the study process is ensured using the available knowledge transfer principles and continuing improvement of competencies, which is reflected in integration of research outcomes in the study courses and study process, involvement of students in research, familiarization of students with relevant research results, an opportunity to do research individually or in a group (group work). The interconnection of science and research in the study process is ensured also through visiting lecturers and practical workshops, active participation of students in international conferences and seminars.

4.6. Provide a brief description and assessment of the forms of innovation (for instance, product, process, marketing, and organisational innovation) generally used in the study direction subject to the assessment, by giving the respective examples and assessing their impact on the study process.

RTU is a modern, internationally recognized research and technology university, which especially highlights such goals as innovation and valorisation, or technology transfer in the scope of its goals. Overall modernisation and best global knowledge transfer practices provide dynamic and sustainable development of FEEE and allows its graduates to compete at international level. In the field of study “Power and electrical engineering” innovative forms of study programmes are introduced in a wide range of fields and levels.

As a mandatory condition, in 2017 RTU Senate adopted the decision that all study programmes must include the study course “Design of Innovative Products and Entrepreneurship”, and it is included in the study programmes of the field of study “Power and Electrical Engineering, Electrical Technologies”. The goal of the study course is to create comprehensive knowledge about design of new products, technology transfer, entrepreneurship, as well as innovation and commercialisation of its results, promote the skills to make use of acquired knowledge, competence and methods in practice and professional development, when starting commercial activities or founding companies, as well as managing team work.

In order to develop innovative thinking, creative competences and entrepreneurial skills of the students, RTU is implementing the project “Innovation Grants to Students”. Students of all levels are offered to take part in different activities and to enhance their entrepreneurial skills through cooperation with the business sector, develop early-stage business ideas in research intensive sectors, receive tuition scholarship and support grant. Seven activities are carried out within the programme “RTU Innovation Grants to Students”:

Cooperation platform “DEMOLA LATVIA” supposes to develop innovative solution concepts for definite ideas/challenges faced by the companies through cooperation of students, academic and research staff from different universities with the sector-related companies. For problem solving purposes, cross-disciplinary and cross-cultural student teams have been formed to be added with young experts in different fields, so that already during the studies students could develop the skill to cooperate with representatives of the economic sector. Search for new solutions stimulates design mindsets, provides cross-cultural experience and awareness about development of the economic sector and elaboration and implementation of new concepts.

“Ideation activities” stimulate generation of new business ideas, team building, networking and development of new products. The process is based on generation of ideas, fast decision making (in limited time and space conditions) and expert evaluation.

- The goal of Hackathon, which lasts for 24–48 hours, is to build new teams and to elaborate new technological solutions. Initially, everyone who has a business idea, presents it to other participants. Then the participants choose the idea they will work on during further 48 hours and “from scratch” make a real product prototype. Hackathon is the place of meeting for professionals of different level and specialties.

- Festival “ICEBREAKERS” is the basis for exchange of ideas, networking, generation of new ideas, inspiration, exchange of expertise, as well as public discussion and evaluation of the previous season activities.
- Corporate events, opened for comers from all Latvian universities. Their active engagement, outreach and effective networking, provide building of new teams, knowledge transfer and update, as well as stimulates higher grasp, awareness and understanding of society about the programme opportunities. Winning scholarships are planned.

“Product Development Project” (PDP) is a learning module where student teams create prototypes through systematisation and enhancement of knowledge in new product development, technology transfer, commercialisation of innovations and their results. The task of the activity is to develop students’ competence in development of new products and technology transfer, raise entrepreneurial skills and apply them in practice, stimulating in parallel the development of general novelty and planning skills, as well as to build understanding about modern business models. PDP also plans involvement of potential supporting organizations in the study process and possible commercialisation of resulted module products. To succeed in application a student or a team should have a ready and presentable Alpha prototype. A company’s or organisation’s confirmation of project continuation is taken as an additional criterion.

“Vertically Integrated Project” brings together students of different special fields, allowing them to develop a large-scale R&D projects, in parallel, strengthening and broadening research activities of the academic staff. The goal of activities is to provide an opportunity for students of different study programmes and levels cooperate in a long-term research project – Master degree and PhD students supervise work of Bachelor degree students in design and research project, which could become a part of a Master or PhD research work. Students acquire credit points or receive scholarship, but the academic staff can use team work results. The teams are cross-disciplinary– students of all faculties are involved– and vertically integrated – each academic term students represent different study levels, from Bachelor to PhD studies. All Bachelor degree students can take part in the project up to three years, but all Master degree and PhD students can take part all period of their studies. The team work is supervised by a professor, but led by senior students. The team must continuously work on development of a prototype, as well as data collection and processing, using a research technique. Quality control and assistance in design and fabrication of a prototype is provided by RTU Design Factory.

“RTU IDEALAB” – a pre-incubator ensures assistance to new or existing business ideas of RTU students, stimulating new start-ups, providing support to development and initial testing of business ideas. Both individual students and a team with at least one RTU student can submit their ideas for pre-incubation. “RTU IdeaLAB” is implemented at two levels. First of all, the training is given, focused on validation and testing of ideas, improvement of team work, identification of the general goal. After the general course of training, the teams present their solutions. 20 teams receive support in implementation of ideas – training, mentoring, individual couching, opportunities of product development at RTU Design Factory and access to the support fund of more than 2,500 Euro for one team. Finally, the teams present the results of the season, and a drawn-up idea development roadmap (attraction of investments, the next support tool, involvement of an industrial partner, etc.).

“Industrial Doctor of Science” supposes developing a research thesis *tailored* to the company interests and needs. Acquisition of scientific approaches during education and training of PhD students usually is based on problem solving strategies used in academic setting, which does not have evident relationship with industry and its needs. The goal of this activity is to provide financial support to young scientists, who develop their theses on company development topics and whose scientific findings are necessary for development of companies. The university, in cooperation with companies, educates Doctors of Science in the fields to be initiated by the companies. A PhD student works at the university, but is intensively involved in a company's R&D activities. The chosen topic is based on the university scientific excellence and strategic vision of the company on development of technology.

"University Incubator" supports teams that work on company problem solving, elaborating products applicable in practice. The incubator offers the teams expert consultations (for viability test of business ideas, development of business plans, market research, organization of work groups, technological expertise of business ideas and establishment of *concept development teams*), equipped work places, training, services of external experts, technological expertise and financial assistance to development of business ideas.

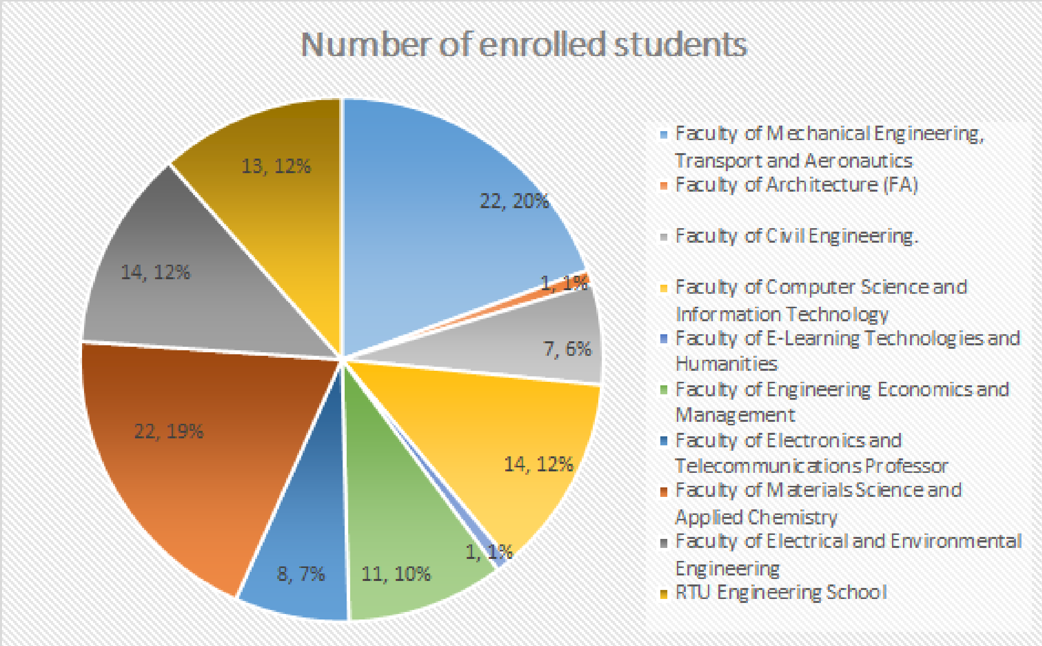

Figure. RTU innovation grants to students per number of enrolled students in 2019

Students actively use the opportunities of activities in terms of "Innovation Grants to Students". In 2019, 14 FEEE students enrolled in the project.

Students of the study programmes in the field of study "Power and Electrical Engineering., Electrical Technologies" actively participate in spin-offs (for example, in 2016, the student of the PhD study programme "Computerized Control of Electrical Technologies" Artūrs Paugurs with the company "CozyCell" (wireless mobile phone chargers), in 2015 - the companies SolarDot (small sized, mobile phone charging stations, using solar energy) and Lesla Latvia – (wireless charging devices, developer of robotics solutions and small electric vehicles)), when researchers and graduates continue successful development of both scientifically and economically beneficial results that benefit the national economy, society and culture. Such activities contribute to sustainability of the study programmes, through involvement of students in scientific activities, engagement of students in research work, in further PhD studies, as well as motivation of PhD students to continue their research activities after award of PhD degree at FEEE and other scientific institutions.

Central Baltic Start-up Springboard, the student innovation-oriented start-up springboard project, was implemented successfully (Project Manager: L. Ribickis, EUR 175 739.00, 01.11.2015 - 31.01.2018).

II - Description of the Study Direction (5. Cooperation and Internationalisation)

5.1. Provide the assessment as to how the cooperation with different institutions from Latvia and abroad (higher education institutions/ colleges, employers, employers' organisations, municipalities, non-governmental organisations, scientific institutes, etc.) within the study direction contributes to the achievement of the aims and learning outcomes of the study direction. Specify the criteria by which the cooperation partners suitable for the study direction and the relevant study programmes are selected and how the cooperation is organised by describing the cooperation with employers. In addition, specify the mechanism for the attraction of the employers.

The choice of partners is based on the current practices of the field of study and expert cooperation with foreign institutions through studies, science, project development, associations, etc.

The goal of the study field "Power and Electrical Engineering, Electrical Technologies", as well as the set outcomes can be achieved only in cooperation, through involvement of different institutions in it. FEEE, since its inception, has been successfully cooperating with companies, organizations and state authorities. Year by year this cooperation is being strengthened and new forms of cooperation are appearing, along with growing mutual interest in reaching successful results. Cooperation with different professional organizations occurs both in form of joint conferences and seminars, and scientific cooperation, through associations, consultations about economic sector trends and necessary improvements in curricula.

The main areas of cooperation and activities within the fields of study are as follows:

- Providing and improving the study process and quality, including updating the curriculum and forecasts of future demand for specialists;
- Providing student professional development by offering places of internship and jobs;
- Supervising and reviewing studies and theses, suggesting topics of theses (by formulating problems of companies to be solved, to let students develop the solutions for end-use sectors);
- Commissioned research and testing of scientific research outcomes, technology upgrade and optimisation tasks for students;
- Involving professionals (company experts) in the study process;
- Organizing and implementing other outside-studies activities, including company grants and support to students, as well as learning field tours, career days (see Item 5.3.);
- Representing interests of the university and economic sector at state and international organizations;

Participation in industrial associations contributes to creation of close contacts with employers – Latvian Electrical Engineering and Electronics Industry Association (LETERA), with FEEE institute of Industrial Electronics and Electrical Engineering implementing the programmes "Computerized Control of Electrical Technologies" and "Adaptronics", as a member of Latvian Association of Energy Engineers and *Latvian* Association of *Power Engineers and Energy* Constructors (LEEA), with FEEE dean Prof. O.Krievs as a board member, Latvian Energy Efficiency Association (LATEA), with one of the members of the academic staff Ansis Avotiņš as a board member and Association of Machine Building and Metal Processing Industry (MASOC). Cooperation with the Latvian Association of Energy Auditors and *Latvian Association* for *Heating Companies* also occurs. The requirements to graduate qualification, free job positions and other issues are discussed on a regular basis. Close interpersonal relationships between the staff of the department and the management of associations have been established.

Typical cooperation with companies during the studies include guest lectures, internship opportunities, solving topical emergency situations in the framework of the study courses and development of theses. Company employee qualification training and contract research are also conducted. The most significant partners in the study field “Power and Electrical Engineering, Electrical Technologies” include JSC “Augstsprieguma tīkls”, JSC “Latvenergo”, JSC “Lattelecom”, JSC “Sadales tīkls”, municipal enterprise "Rīgas Ūdens", Ltd „EK Sistēmas”, Ltd „Arcus Elektronika”, Ltd „VEF KT”, Ltd „Energy Line”, Ltd „ABB Latvia”, Ltd „Siemens Latvia”, Ltd „Danfoss Latvia”, Ltd "Vizulo" etc. Among international companies the stress is put on cooperation with Daimler AG, “Metercom”, “LYRACOM”, “VEADES”, “IHAAB Marketing”, Ltd “BEC”, “Darmstadt GSI” (research centre, JSC “Viru Limmid”, etc.

Particularly such enterprises as Ltd „EK Sistēmas”, JSC „Latvenergo”, Ltd „ABB Latvia” and others that donated for upgrading and modernisation of study laboratories and are interested into involvement of new specialists should be mentioned. Ltd „ABB Latvia” donated modern manuals and frequency converters for modernisation of electric drive control laboratory. Also „ Ltd ABB” provided a 50% discount on purchase of an ABB robot, for cross-disciplinary uses in student training programmes of the faculties and institutes RTU FEEE IEEI, RTU FCSIT, and RTU TMF, as well as very often apply different discounts up to 75% on the purchase of different electrical engineering materials and equipment, necessary for enhancement of the study process and needs of scientific research.

The Latvian Electrical Engineering and Electronics Industry Association (LETERA) (also MASOC, LEEA, Latvian Energy Efficiency Association (LATEA)), regularly points at the lack of electrical engineering specialists and their interest of the industry in qualification of the programme specialists. Associations have also initiated actualization of the field related professional standard “Electrical Engineer” and elaboration of the standard “Chief Electrical Engineer”, which is being in progress at the moment.

Typical cooperation with state and municipal institutions during the studies include topical problem solving in terms of the study courses and development of theses, as well as cooperation projects. Such partners as the Ministry of Education and Science, the Ministry of Economics, the Investment and Development Agency of Latvia (LIAA), Latvian National Accreditation Bureau, Central Statistical Bureau, State Development Finance Institution “ALTUM”, The *State* Construction *Control Bureau* of Latvia, Piaseczno municipality, Bordeaux municipality, Saulkrasti municipality council, Madona municipality, Kuldiga municipality and Kandava municipality may be mentioned.

Cooperation within the field of study also occurs with other Latvian HEIs, which are implementing similar programmes - The Latvia University of Life Sciences and Technologies and Latvian Maritime Academy. The IEEI academic staff is actively involved in cooperation within joint research projects. Joint research projects are also carried out together with the *Institute* of *Solid*-State *Physics of the University of Latvia*, LAS *Institute* of *Physical* Energetics (IPE).

Also, cooperation within the field occurs with the *European* Power *Electronics and Drives Association* (EPE), *ARTEMIS* Industry Association *Embedded* & Cyber-Physical *Systems*, Latvia *Technology* Park and *Latvian Electronic Equipment Testing Centre* (LEITC).

In addition, cooperation with foreign embassies and state councils (promotion of international cooperation in environmental science, involvement of guest lecturers, organization of joint topical events (seminars, activities for students and potential students, cooperation in initiation of new projects)) is practised – as, for instance, cooperation with the Embassy of the USA in Latvia, Embassy of Denmark in Latvia, Embassy of Kazakhstan in Latvia, Embassy of Uzbekistan in Latvia, Embassy of Norway in Latvia, Embassy of Germany in Latvia, British Council in Latvia, the *Goethe I*nstitute in Riga, the French Institute in Latvia and Nordic Council of Ministers.

In autumn 2012, the Institute of Industrial Electronics and Electrical Engineering together with 13 other partner-universities and 9 different states started implementing the quality improvement project Tempus for development of education in energy efficiency. This project was specific because in the framework of Tempus IV programme it was the first joint project being coordinated by a Latvian university, which certainly proves the quality of the study programme "Computerized Control of Electrical Technologies". The project supposed implementation of partner university learning tools and laboratory work using the best practices of RTU and other partner EU universities. Within the TEMPUS project "ENERGY" a lot of text books were written:

- Power Electronics. Contributors: Leonids Ribickis, Joan Peuteman, Ilja Galkins, Ivars Rankis, Dries Vanoost, Anastasia Zhiravetska. Editor/proofreading: Anastasia Zhiravetska. Project: Development of Training Network for Improving Education in Energy Saving (ENERGY) number: 530379-TEMPUS-1-2012-1-LV-TEMPUS-JP - RTU Press, Riga, 2015. ISBN 978-0034-10-602-6, 277 pp.
- Energy Saving Technologies. Contributors: Leonids Ribickis, Paweł Żukowski, Ion V. Ion, Tomasz N. Kołtunowicz, Renaat De Craemer, Anastasia Zhiravetska, Anatolijs Zabasta, Ansis Avotins, Joan Peuteman, Leslie-Robert Adrian, Jordan Radosavljević, Viesturs Brazhis, Nebojša Arsić, Nadezhda Kunicina. Editors: Anastasia Zhiravetska, Nadezhda Kunicina. Project: Development of Training Network for Improving Education in Energy Saving (ENERGY) number: 530379-TEMPUS-1-2012-1-LV-TEMPUS-JP - RTU Press, Riga, 2015. ISBN 978-9934-10605-7, 239 pp.
- Effective Lighting, Contributors: L.Ribickis, I.Galkins, G.Tamulaitis, A.Pashayev, B Tagiyev, K.Allahverdiyev, I.Uteshevs, A.Suzdalenko, A.Avotins, O.Tetrvenoks. - RTU Press, Riga, 2015. 275 lpp.
- Hydrogen Energy. Contributors: A.Andreiciks, I.Steiks, M.Belpaeme, V.Bashtovoi – RTU Press, 2015. 94.pp.

Successful cooperation has developed with the staff of relevant faculties at Tallinn University of Technology, which ensures both student exchange, improvement of academic staff qualifications, and student and academic staff exchange.

Since 2012, successful cooperation with German RWTH Aachen University has been developing, where students of the study programme "Computerized Control of Electrical Technologies" can start studies using ERASMUS exchange opportunities, as well as successfully defend Bachelor or Master theses.

The cooperation agreement has been signed between RTU and Wayne State University (USA), supposing implementation of joint study programmes.

Students of the study field are sometimes sent to foreign technical universities for internship – to Aalborg University in Denmark, ETH, Zurich in Switzerland, Trondheim *University* of Science and Technology in Norway and other. Members of the academic staff of the department regularly communicate with the academic staff of relevant special fields from Lithuanian and Estonian technical universities.

Professor L. Ribickis is a member of European PEMC (Power Electronic and Motion Control) Council and coordinates cooperation with the representatives of this special field at different European universities.

The full list of partner universities is available in the Annex "Collaborative universities"

No	Partner institution (agreement signed)	Subject of the agreement	Term of the agreement
1.	Aalborg University	Electronics and automation	30.09.2021
2.	Graz University of Technology	Electricity and energy; Building and civil engineering	30.09.2021
3.	Kaunas University of Technology	Electricity and energy; Electronics and automation; Environmental sciences; Chemistry; Engineering and engineering trades; Chemical engineering and processes	30.09.2021
4.	KTH Royal Institute of Technologies	Engineering and engineering trades	30.09.2021.
5.	KU Leuven	Mathematics and statistics; Information and Communication Technologies (ICTs); Medical diagnostic and treatment technology; Engineering and engineering trades; Literature and linguistics	30.09.2021
6.	Norwegian University of Science and Technology (NTNU)	Engineering and engineering trades	30.09.2021
7.	RWTH Aachen University	Electricity and energy; Mechanics and metal trades; Textiles (clothes, footwear and leather); Architecture and town planning	30.09.2021.
8.	Tallinn University of Technology (TalTech)	Business and administration; Building and civil engineering; Management and administration; Electronics and automation; Mechanics and metal trades	30.09.2021
9.	University of Duisburg-Essen	Mechanics and metal trades	30.09.2021.
10.	Vilnius Gediminas Technical University	Building and civil engineering; Information and Communication Technologies (ICTs); Electronics and automation; Business and administration; Earth sciences; Environmental protection; Electricity and energy technology; Motor vehicles, ships and aircraft; Architecture and town planning	30.09.2021

5.2. Specify the system or mechanisms, which are used to attract the students and the teaching staff from abroad and provide a description of the dynamics of the number of the attracted students and the teaching staff.

To attract foreign students to RTU, two communication target groups are mainly addressed:

- the internal: management team; general staff, academic staff; existing students;
- the external: prospective foreign students (foreign students studying in Latvia, foreign pupils and students, parents of foreign pupils and students); foreign graduates; mass media; opinion leaders; educational institutions; student recruitment education agencies; diplomatic and consular missions of the Republic of Latvia.

The communication strategy uses several types of information channels, choosing the most appropriate for each target audience – paid advertising channels, earned and owned ones. Marketing communication is an essential part of addressing foreign audience using all the traditional marketing tools – advertising in media and other channels, event marketing, direct marketing, digital marketing etc. The main marketing tool used to reach foreign audience is participation in various educational exhibitions and seminars organised by educational agencies in target markets. Continuity in the provision of information and promotion of studies is ensured by the long-term partner universities and educational agencies.

Public relations tools (press releases, media events, face-to-face meetings, interviews, opinion polls, etc.) and RTU social media channels (Facebook, WeChat, WhatsApp, YouTube, etc.) are used in corporate communication. RTU internal channels (ORTUS portal, email, etc.), information seminars and special events are used for internal communication.

Every May, Summer Doctoral Schools are organized in the framework of the study field “Power and Electrical Engineering, Electrical Technologies”. The Doctoral School provided the platform for guest lectures delivered by a number of internationally recognized scientists and experts in electrical engineering:

- In 2020, “Active Bypassing Techniques for Solar PV Modules”, Aalborg University, Denmark
- In 2020, “An Introduction to Reliability of Power Electronic Components and Systems”, Aalborg University, Denmark.
- In 2019, “Industrial Internet of Energy Technologies”, Daimler AG.
- In 2019, Model Predictive Control (MPC) Methods Applied to Power Electronics Federal University of Goias (Brazil)
- “Pursuing High-Efficient PV Energy Solutions Based on Quasi-Z-Source Inverters: Benefits and Challenges” Tallinn University of Technology, Estonia
- In 2018, "Electromagnetic Modelling Approaches Towards Virtual Prototyping of WBG Power Electronics”, ETH, Zurich,
- In 2018, “Development of interconnecting method for wind turbine generator system - parallel or series connection?” Tokyo Denki University, Japan.
- In 2017, “The Third Revolution in Measurement”, PNNL, IEEE
- In 2017, “Modern Propulsion Systems for Electric Vehicles”, RWTH, Aachen.
- In 2016, “Technologies and Trends in Energy Storage Systems”, TTU, Tallinn.

RTU foreign student enrolment rates are summarized starting with academic year 2012/2013, indicating whether the student is pursuing undergraduate or graduate degree. The number includes only the students enrolled in the first year.

The number of applications processed is much higher than the number of students actually enrolled. For example, in academic year 2015/2016, 626 applications were received from prospective students, while 349 students commenced their studies; however, in academic year 2016/2017, 670 applications were received, but 445 students were enrolled; in academic year

2017/2018, 1813 applications were received, but 632 students were enrolled; in academic year 2018/2019, 2627 applications were received, but 774 students were enrolled; in academic year 2019/2020, 3340 applications were received, but 870 students were enrolled.

Foreign students at the study programmes within the study field

		2013/14		2014/15		2015/16		2016/17		2017/18		2018/19		2019/20	
Bachelor studies	DIEN	6	26%	11	20%	1	2%	3	9%	2	6%	5	8%	12	18%
	MOB	15	65%	18	33%	25	58%	19	54%	10	28%	11	19%	15	22%
Master studies	DIEN	2	9%	15	27%	8	19%	9	26%	17	47%	19	32%	13	19%
	MOB			8	15%	8	19%	2	6%	7	19%	22	37%	24	36%
PhD studies	DIEN			3	5%									1	1%
	MOB					1	2%	2	6%			2	3%	2	3%
TOTAL		**23**	100 (%)	**55**	100 (%)	**43**	100 (%)	**35**	100 (%)	**36**	100 (%)	**59**	100 (%)	**67**	100 (%)

The mobility of incoming foreign students within the Erasmus+ exchange program is positive during the reporting period. The distribution of incoming students by European country is demonstrated in Annex 14 the figure “Breakdown of incoming students by country”.

Information on the involvement of foreign lecturers is provided in Section 3.6 of the report.

5.3. In the event that the study programme entails a traineeship, provide a description of the traineeship options offered to the students, as well as the provision, and work organisation. Specify whether the higher education institution/ college provides assistance in finding traineeships.

Annex "Description of the Organisation of the Traineeship of the Students" provides the Senate resolution on the Internship management procedure at RTU, which was revised in 2019. It states that the internship coordinator at an organizational unit helps students find the internship place. If additional assistance is required, students can contact the Career Support and Services Unit, where a career consultant and project manager assist students in finding and addressing companies where to undergo internship, as well as promote the development of career management skills through a variety of activities that can ensure the achievement of successful results during the internship. Once a year, the Career Support and Services Unit organizes RTU Career Day, where students also have the opportunity to meet face-to-face with company representatives and discuss future opportunities. More information about the event and participants of the previous years is available at https://www.rtu.lv/lv/studentuserviss/karjeras-centrs-ssc/karjeras-diena (in Latvian). In 2021, due to the pandemic, the event is planned as virtual.

An additional resource developed in 2015 is a website that invites companies to post vacancies that are relevant to RTU students (https://ekarjera.rtu.lv/). Students have the opportunity to log in with the University username and keep abreast of current internships and job opportunities in their field.

RTU Development Fund provides additional support for practical skills promotion (https://www.rtu.lv/en/developmentfund). Hundreds of practical skills competitions are offered during the year, which are organized in cooperation with companies.

Each year, the University concludes cooperation agreements with companies and organizations (template in English is in the file of Annex 37 of the list of Internal regulations), where the parties agree on provision of internship places to students.

Regulation of the organization of internship is provided in Annex 12.

5.4. In the event that joint study programmes are implemented in the study direction, provide the justification of the creation of the joint study programmes and a description and assessment of the selection of the partnering higher education institutions by including information on the principles and the procedures for the creation and implementation of these joint study programmes. In the event that no joint study programmes are implemented in the study direction, provide a description and assessment of the plans of the higher education institution/ college for the creation of such study programmes within the study direction.

The development and implementation of joint study programmes are governed by "Procedure for the Application, Elaboration and Amendment of the Study Programmes" (see the file of Annex 6 of the list of Internal regulations). The choice of partner higher education institutions is the responsibility of the initiator of the joint study programme development, in agreement with the Study Field Committee and RTU Vice-Rector for Academic Affairs.

So far, no joint programmes are implemented within the study field.

II - Description of the Study Direction (6. Implementation of the Recommendations Received During the Previous Assessment Procedures)

6.1. Assessment of the fulfilment of the plan regarding the implementation of the recommendations provided by the experts during the previous accreditation of the study direction, as well as the assessment of the impact of the given recommendations on the study quality or the improvement of the study process within the study direction and the relevant study programmes.

Following the recommendations provided by experts during the previous accreditation of the study field “Power, Electrical Engineering and Electrical Technologies”, the subsequent improvements have been made to improve study quality and the study process:

- Increased volume of training courses and the number of programmes carried out in the English language;
- Significantly improved study infrastructure (new building for the Faculty of Electrical and Environmental Engineering is built and refurbished laboratory equipment);
- Developed local and international cooperation with higher education institutions and research

institutes;
- Increased full-time equivalent (FTE) of the assistant research personnel;
- Improved support for student mobility.

More detailed information on the above points can be found in the corresponding section of the study programmes of the respective field.

The study programme “Computerised Control of Electrical Technologies” in the field of Power, Electrical Engineering and Electrical Technologies has been implemented for 20 years with a variety of improvements. In turn, the Bachelor and Master study programmes “Adaptronics” are new, interdisciplinary programmes in electrical technologies and automobiles, as well as in the power electronics subsector with improved adaptive systems and information technologies that can be applied to the development of modern automation technologies. They have been developed according to a sample of several German study programmes, to provide opportunities for students to use robotics and artificial intelligence in automatic management systems supporting the current industry. The study programme “Smart Electrical Energy” offers a Master and PhD level education in the electrical engineering, electronics, information, and communications technology sectors, electrical energy, electricity supply, and electrical machinery and equipment, and enables students to obtain professional qualifications in the fields of electricity, electricity supply, electrical machinery, and equipment.

The professional Master study programme “Smart Power” is entirely new, but the PhD programme of the corresponding name has been modernized, under the previous name “Power and Electrical Engineering”.

With the involvement of professional associations in the sector, LEEA (Latvian Association of Power Engineers and Energy Constructors) and LETERA (Latvian Electrical Engineering and Electronics Industry Association) work is ongoing to update the professional standard “Electrical Engineer” corresponding to the study field and to develop the standard “Leading Electrical Engineer”, which has not yet been completed. Similarly, the qualification structure of the power engineering sector includes new professional standards “Electrical Technology and Automotive Engineer” and “Leading Electrical Technology and Automotive Engineer” to be obtained within the study programmes “Computerised Control of Electrical Technologies” and “Adaptronics”. Changes to the study programmes of the field “Power, Electrical Engineering and Electrical Technology”, closing of outdated programmes and development of new programmes are undertaken to adapt to the technological developments of the sector, as well as to respond to changes in the qualification structure of the power engineering sector.

During the period of 2020-2025, the programmes “Computerised Control of Electrical Technologies” and “Adaptronics” are intended to be combined into one programme in the study field “Power, Electrical Engineering and Electrical Technology” at all levels of study focused on electrical and automotive technology, electrical machinery and equipment, as well as on the sub-sectors of power electronics. The programme is intended to be implemented once the development of professional standards “Engineer of Electrical Technology and Automatics” and “Leading Engineer of Power Engineering and Automatics” is completed.

A new professional Bachelor study programme “Smart Power Engineering” is being developed, which will replace the academic Bachelor study programme “Power and Electrical Engineering”.

Consequently, the recommendation on the reduction of the number of study programmes provided by experts in previous accreditation will also be followed. As a result, when the development of professional standards relevant to the study field and the corresponding adaptation of study programmes will be finished, both the electrical technology and automotive sub-sector and the electric power sub-sector will have only one study programme at each level: at the professional Bachelor, professional Master, and PhD levels.

The implementation of the recommendations provided by experts in the accreditation of the study field is also summarised in the table in Annex Implementation of expert recommendations.

6.2. Implementation of the recommendations given by the experts during the evaluation of the changes to the relevant study programmes in the respective study direction or licensed study programmes over the reporting period or recommendations received during the procedure for the inclusion of the study programme in the accreditation form of the study direction (if applicable).

During the reporting period, Accreditation Certificate No. 54 as of 29 May 2013 was issued. To improve the study process and the quality of education from academic year 2015/2016, the academic study programme “Computerised Control of Electrical Technologies” was replaced with the professional Bachelor study programme “Adaptronics”. The most important changes are related to the distribution of free electives according to three specialisations, the addition of internship to the study programme, the increase of credits to 180 CP, and the increase of duration of studies to 4.5 years for full-time studies (Accreditation Certificate No. 365).

To improve the content of the programmes, in 2017 significant changes were made to the professional Master study programme “Computerised Control of Electrical Technologies” and the professional Bachelor study programme “Computerised Control of Electrical Technologies”.

Following the needs of the national economy and employers' recommendations, two licences were received in 2020 for professional Master study programmes “Adaptronics” and “Smart Power”. More detailed information is provided in the study programme descriptions.

In 2021, major changes were made to the professional Bachelor study programmes “Adaptronics” and “Computerised Control of Electrical Technologies”.

In May 2021, significant changes to professional Master study programmes “Adaptronics” and “Smart Power Engineering” will be submitted for approval to RTU Senate.

In the result of the previous accreditation of study field “Power, Electrical Engineering and Electrical Technologies” on the 27th of May 2013. the following recommendations were received from the experts:

- *Consider merging similar study programs;*
- *The size of study course modules must be increased in order to reduce the proportion of 2 credit point courses;*
- *Master’s level study courses taught in English must be set as a priority;*
- *Bachelor’s level academic personnel must be provided with assistants in order to be able to spend more time on research work;*
- *Support for student mobility has to be strengthened;*
- *Local cooperation with higher education and research institutions has to be widened;*
- *The enrolment criteria have to be intensified due to high student dropout.*

Existence of similar programs

Within the previous accreditation of the study field, 12 study programs were accredited. Even though currently 15 study programs are implemented in the study field, a significant number of those are not to be continued and will be closed. Only 7 study programs are being promoted for the next accreditation, thus a claim can be made that the recommendation on merging similar programs is fulfilled.

In the period of 2021-2025, it is planned to consider combining the programmes “Computerized Control of Electrical Technologies” and “Adaptronics” into one programme in the study field “Power, Electrical Engineering and Electrical Technology” at each level of study, which will be focused on the sub-sectors of electrical and automation technology, electrical machines and equipment, as well as power electronics. It will be done once the development of professional standards “Engineer of Electrical Technology and Automatics” and “Leading Engineer of Power Engineering and Automatics” is completed and their content is known to the stakeholders.

Course modules and proportion of two credit point courses

Even though there still is a large number of 2 credit pint courses in the study programs, multiple course modules and large courses have been introduced, e.g. the course “*Innovative Product Development and Entrepreneurship – 6CP”*, or course modules devoted to electrical machines and drives, as well as to design, optimization and control of electric grids. Thus, the recommendation on reducing the proportion of courses with two credit points is established.

Master’s level study courses taught in English

Since the previous accreditation, two new master’s level study programs have been licensed in the study field – “Adaptronics” and “Smart power systems”, which are to be implemented in Latvian and English languages. The master’s program “Computerized Control of Electrical Technologies” is to be implemented in English in the nearest future as well. All the courses of those programs are available in English so the recommendation on setting the master’s level study courses taught in English as a priority is established.

Increasing the number of assisting personnel

The ESF project SAM 8.2.2. “Strengthening of RTU Academic Staff in the Areas of Strategic Specialization” has played a significant role in increasing the number of assisting personnel. Within the project, the following PhD students were employed as assistants at the faculty of Electrical and environmental engineering for one year with 0,5FTA within the period 2019. – 2021:

- Artūrs Brēķis (06.2020. – 06.2021.);
- Dmitrijs Boreiko (10.2019. – 10. 2020.);
- Ivars Zālītis (10.2019. – 10.2020.);
- Kristaps Vītols (08.2020. – 08.2021.)

Outside the mentioned project the Bachelor’s level academic personnel of the study field “Power, Electrical Engineering and Electrical Technologies” is widely assisted by the PhD students under their supervision even though not always being officially employed as assistants. The FTE of assistants officially employed in the period starting from 2014. has been within the range of 0,8 – 1,6.

Support for student mobility

The support for student mobility in the study field “Power, Electrical Engineering and Electrical Technologies” has been improved resulting in increased student mobility – especially the incoming student mobility. Recognition of study courses covered during mobility takes place according to the “Amendments to the Organisation Procedure of Erasmus+ Student Mobility” (Resolution of RTU Vice-Rector for Academic Affairs No. 01000-1.1/240 as of 29 October 2014) and “Regulation on the

Recognition of the Courses Completed at Other Universities and RTU Study Programmes" (Resolution of RTU Vice-Rector for Academic Affairs No 02000-1.1/29 as of 4 April 2016). The recognition of ERASMUS+ mobility is carried out by the head of the study programme on the basis of the Transcript of Records submitted by the student after the ERASMUS+ mobility and a pre-signed application for the recognition of study courses. In order to make the recognition of courses more successful, the student carefully chooses the most appropriate partner school for the curriculum and the area before applying for ERASMUS+. The selected study courses are coordinated with the Erasmus+ coordinator and are approved by the head of the study programme.

Local cooperation with higher education and research institutions

Since the previous accreditation the local and international collaboration of academic personnel of the study field "Power, Electrical Engineering and Electrical Technologies" has been greatly improved co claim can be made that the recommendation on widening the local cooperation is fulfilled.

Detailed information on the most significant collaboration partners can be found in the chapter II.5. "Cooperation and Internationalization" of the self-assessment report as well as in program descriptions within the report.

Enrolment criteria

The admission process and procedure of students' matriculation in the study field "Power, Electrical Engineering and Electrical Technologies" is stipulated in the RTU Admission Regulations, which are elaborated based on the Law on Higher Education Institutions and Regulations of the Cabinet of Ministers No 846 issued 10 Oct 2006 ''Regulations on Requirements, Criteria and Procedures for Enrolment in Study Programmes'', as well as the specific requirements of study programmes and the industry. The RTU Admission Regulations are approved by the RTU Senate and published on November 1 each year. In order to enlist in study programs of the field for State finances, the level in the centralised math exam after the secondary school has to be at least 12%, so the recommendation on intensifying the enrolment criteria is established.

Annexes

I. Information on the Higher Education Institution/ College		
List of the governing regulatory enactments and regulations of the higher education institution/ college	List of the main internal normative acts and regulations.zip	Galveno normativo aktu saraksts.zip
Information on the implementation of the study direction in the branches of the higher education institution/ college (if applicable)		
Management structure of the higher education institution/ college	RTU_Management_Structure.pdf	RTU_parvaldibas_struktura.pdf
II. Description of the Study Direction - 1. Management of the Study Direction		
Plan for the development of the study direction (if applicable)	Annex “Development Plan of the Study Field.docx	Pielikums Studiju virziena attīstības plāns 2020. – 2025. gadam.docx
Management structure of the study direction	RTU_Study_Direction_Management_Structure.pdf	RTU_studiju_virziena_parvaldibas_struktura.pdf
II. Description of the Study Direction - 3. Resources and Provision of the Study Direction		
Basic information on the teaching staff involved in the implementation of the study direction	Mācībspēku saraksts virzienam_ENG_ jauns-1.xlsx	Mācībspēku saraksts virzienam_LV jauns.xlsx
Biographies of the teaching staff members (in Europass Curriculum Vitae format)	CV_ENG_septembris.zip	CV_LV_septembris.zip
Summary of the statistical data on the incoming and outgoing mobility of the teaching staff over the reporting period	Pielikums_mācībspēku ienākošā un izejošā mobilitāte_ENG_v2.docx	Pielikums_mācībspēku ienākošā un izejošā mobilitāte virzienam_v2.docx
II. Description of the Study Direction - 4. Scientific Research and Artistic Creation		
List of the publications, patents, and artistic creations of the teaching staff over the reporting period	List of publications of academic staff 2014-2020 (1).xlsx	Virzienam publikacijas 2014-2020 (1).xlsx
II. Description of the Study Direction - 5. Cooperation and Internationalisation		
List of cooperation agreements	Collaborative universities.docx	Sadarbības augstskolas.docx
Statistical data on the teaching staff and the students from abroad	14.pielikums_Statistika_arzemnieki mobilitāte ENG virzienam.xlsx	14.pielikums_Statistika_arzemnieki_LV_mobilitāte virzienam.xlsx
Statistical data on the mobility of students (by specifying the study programmes)	12.pielikums_Erasmus_EN Virzienam.docx	12.pielikums_Erasmus_LV_Virzienam.docx
Description of the organisation of the traineeship of the students	Internship_Management_Procedure.pdf	Prakses_organizesanas_kartiba.pdf
Information on the agreements and other documents confirming the traineeship of the students in companies	Pielikums.10_Sadarbības līgumi (1).zip	Pielikums.10_Sadarbības līgumi (1).zip
II. Description of the Study Direction - 6. Implementation of the Recommendations Received During the Previous Assessment Procedures		
Overview of the implementation of the provided recommendations	Pielikums Rekomendāciju ieviešana_EN.docx	Pielikums Rekomendāciju ieviešana_LV.docx
Description of the Study Programme - Other mandatory attachments		
Confirmation signed by the rector, director or the head of the study programme or the study direction of the higher education institution/ college which states that the official language proficiency of the teaching staff involved in the implementation of the relevant study programmes of the study direction complies with the regulations on the level of the official language knowledge and the procedures for testing official language proficiency for performing professional duties and office duties.	Apliecinājums - Valsts valodas prasme.edoc	Apliecinājums - Valsts valodas prasme.edoc
III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	5.pielik_RECO studenti statistika_Eng.docx	
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard		
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme		
Curriculum of the study programme (for each type and form of the implementation of the study programme)		
Descriptions of the study courses/ modules		REDO kursu aprakstiLV.zip
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	Pielikums_14_Doktora_diploma_paraugs.docx	Pielikums_14_Diploms.zip
Description of the Study Programme - Other mandatory attachments		
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		
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		
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.		

If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education		
Sample (or samples) of the study agreement		
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.		
Description of the Study Direction - Other mandatory attachments		
Electronically signed application form for assessment of a study direction	01000-2.2.1-e_212.edoc	01000-2.2.1-e_212.edoc

Other annexes

Name of document	Document
ESG_standartu_integresanas_raksturojums.pdf	ESG_standartu_integresanas_raksturojums.pdf
ESG_standards_integration_description.pdf	ESG_standards_integration_description.pdf
RTU IT sistemu saskarnes.zip	RTU IT sistemu saskarnes.zip
Screenshots of RTU IT systems.zip	Screenshots of RTU IT systems.zip
Zinātniskās laboratorijas	14.pielikums_zinatniski pētnieciskās laboratorijas.DOCX
Studiju virziena komisijas sastāvs	Studiju virziena komisijas sastāvs.docx

Computerised Control of Electrical Technologies (51522)

Study field	*Power Industry, Electrical Engineering, and Electrical Technologies*
ProcedureStudyProgram.Name	*Computerised Control of Electrical Technologies*
Education classification code	*51522*
Type of the study programme	*Doctoral study programme*
Name of the study programme director	*Leonīds*
Surname of the study programme director	*Ribickis*
E-mail of the study programme director	*Leonids.Ribickis@rtu.lv*
Title of the study programme director	*habilitētais doktors*
Phone of the study programme director	
Goal of the study programme	*The aim of Doctoral studies is to train high-qualified specialists in the area of computerised control of electrical technologies objects, who can solve tasks of scientific novelty, and to prepare lecturers for high schools and researchers for scientific institutions.*
Tasks of the study programme	*1 – to provide knowledge to PhD students about tasks and methods of research for complex computer controlled electrical technical objects and systems;* *2 – to provide knowledge to PhD students about methods of technical innovations;* *3 – to provide knowledge to PhD students and skills for pedagogical work;* *4 – to strengthen the knowledge of foreign languages to the level necessary for international scientific discourse;* *5 – to promote implementation of internationally important research and dissemination of research results.*
Results of the study programme	*PhD studies result in the obtaining of knowledge for further scientific and pedagogical work, which in terms of competences and skills can be characterized as follows:* *- able to apply theoretical knowledge for the solution of scientific problems;* *- able to organize and implement pedagogical activities;* *- able to design and develop innovative systems of computer control for electrotechnical equipment used in different branches of economy;* *- able to design and develop innovative electronic devices, semiconductor devices of a power converter, electric propulsion systems and robotic equipment;* *- able to conduct internationally significant research, implement dissemination of research results through international publications and conferences;* *- able to apply knowledge of foreign language at the level of international scientific discourse.*
Final examination upon the completion of the study programme	*PhD Thesis (dissertation).*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*192*
Admission requirements (in English)	*master degree of engineering or comparable education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D.) in Electrical Engineering, Electronics, Information and Communication Technologies*
Qualification to be obtained (in english)	—

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 4 years - english

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*english*
Amount (CP)	*192*
Admission requirements (in English)	*master degree of engineering or comparable education. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D.) in Electrical Engineering, Electronics, Information and Communication Technologies*
Qualification to be obtained (in english)	—

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

The study programme is intended to be implemented in the form of full-time studies in Latvian, as it has been implemented until now, and in the form of full-time studies in English. The duration of the study programme is 4 years and its volume is 192 CP. The degree to be obtained until 2020 was the Doctor of Engineering Sciences, but according to changes to the Cabinet regulations, as of 2020 the degree to obtained is Doctor of Sciences (PhD).

In 31 May 2021, by Decision of RTU Senate No 650, the study programme was updated, envisioning implementation of the study programme in English.

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

Table 1 presents the data on the student number dynamics at the RTU PhD study programme “Computerised Control of Electrical Technologies”.

Table 1. Student number dynamics at the RTU PhD study programme “Computerised Control of Electrical Technologies”

Year	Enrolled PhD students	Defended	Total at the programme
2013/2014	5	5	30
2014/2015	8	3	31
2015/2016	9	2	36
2016/2017	7	3	32
2017/2018	0	1	27
2018/2019	7	3	32
2019/2020	5	3	24

2020/2021	4	1	28

By analysing the data included in the table, it can be concluded that overall, the number of PhD candidates in the study programme is at approximately one level, around 30 students, while the number of PhD students enrolled varies significantly each year, from 4 to 9. The average number of defended dissertations is 3 per year.

The amount of the PH.D student's scholarship and other opportunities and amount of funding of studies, which depend on the year of admission, for example, opportunities of receiving various grants or an opportunity to employ a Ph.D student by using project funding can be mentioned as a major affecting factor. Another encouraging factor is an opportunity to receive the ESF financial support for Ph.D students, which has decreased during the last years.

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

During PhD studies, an individual cooperation with the scientific adviser-Professor is provided to the PhD students for mastering compulsory, field-specific and free elective study courses on aspects of application of principles of computer control of electrical technologies in different branches of economy. In the second phase of the study process, only scientific studies are carried out on an individual subject related to computer control of electrical technologies and this phase is completed with the development and defence of dissertation in the Doctoral Council P-14, and obtaining PhD degree.

The aim of the study programme is to educate and train highly qualified specialists and researchers in the fields of electrical engineering, electrophysics, computer control of electrical technologies, electrical propulsion, power electronics, robotics and motion control, capable of generating new knowledge, developing new electrical equipment and their control methods, and being able to experimentally test and introduce them for valorisation. The second aim to be mentioned is the training of the young scientist for universities and scientific research institutions.

The main tasks are to provide PhD students with knowledge of research, development, modelling, experimental marketing, testing and valorisation of new electrotechnical equipment and technologies; to develop skills in pedagogical activities; to strengthen knowledge of a specialised technical foreign language at international level; to develop skills in implementation of international projects and to disseminate results of their research on local and international level.

Specialists with a Master degree in engineering sciences can enrol in the PhD study programme. The admission of candidates takes place on the basis of a ranking, which includes the number of publications and the average mark of the Master diploma. The knowledge of English is tested for applicants to studies in English.

Upon completion of their studies, students earn Doctoral degree in sciences (PhD). To earn the degree, students need to pass all study courses of the study programme, elaborate and defend a PhD Thesis.

The duration of studies is 4 years, the volume is 192 CP.

The acquisition of the study programme is completed with the presentation of the PhD Thesis (dissertation) at the Doctoral Council.

The elaborated research paper (dissertation) is submitted to the Doctoral Council P-14, which first sends the paper for approval to the State Scientific Qualification Committee, and after receiving a positive evaluation appoint reviewers and organize Viva Voce Examination. PhD degree is awarded after positive vote of the members of the Council.

The study programme educates and trains researchers for high-tech companies, research institutions related to the sector of electrical engineering, academic staff for universities and higher education institutions, and highly qualified engineering professionals for all branches of the economy.

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master's and doctoral study programmes, 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 volume of the PhD study programme is 192 CP, 150 of which are research work, which includes the elaboration and defence of a PhD Thesis. The choice, scope and content of the PhD study courses were designed to enable PhD students to study new world trends in technology and the principles of its design and control, and to base their research work on the application of these new ideas.

During their studies, PhD students will learn about the types of electrical technologies, conduct research on their principles of operation, analyse computer control approaches to technologies, develop new technologies or approaches to their control, propose improvements to existing technologies, perform technical and economic calculations, present their research at conferences and scientific journals, exchange experience and knowledge with researchers and PhD students from other countries and universities.

In line with industry trends and recommendations for improving the content of the study programme, the content of study courses and the programme are regularly improved. For example, the content of the study course "Intelligent Electronic Equipment" is regularly improved by using the latest developments in the design and element base of control systems for electrical devices, which gives PhD students knowledge of the latest solutions in digital control systems based on traditional and fuzzy logic, as well as artificial neural networks that build adaptive and self-learning systems in the context of the basic principles of artificial intelligence.

The structure of the study programme and all formal requirements comply with the requirements of the national norms and regulations and the resolutions of RTU Senate.

If the student has not acquired knowledge in compliance with the requirements stipulated by the Law on Environment protection and the Law on Civil Defence at a lower level study program, within the scope of the Ph.D program students can choose the study courses “Civil defence” of 1 CP (ICA301) and Environment and Climate Roadmap of 1 CP (VAS038), if such disciplines were not included in the preceding study program, and students of the program in English can choose to study the Latvian language in the study course “Latvian language for foreign students” amounting to 1 CP.

As a result of their PhD studies, PhD students acquire the knowledge and competences that meet the requirements of a PhD degree and allow them to start the corresponding scientific and research activities. The structure of the study programme is shown in Annex 11.

The programme is completed with the defence of the PhD Thesis (dissertation) at the meeting of the Doctoral Council P-14.

Rules for the completion of PhD studies

1.1. PhD studies at RTU are completed if successful grades have been obtained in all study course examinations included in the study plan and the PhD Thesis has been submitted for Viva Voce Examination of the PhD degree to the relevant Doctoral Council, as well as a public presentation has been carried out.

1.2. If a candidate for a scientific degree has independently developed a PhD Thesis and the results of his/her previous education or professional experience have been recognised in accordance with the procedure established by RTU as corresponding to the requirements of a particular PhD study programme, then they have the right to submit the PhD Thesis for Viva Voce Examination.

1.3. A PhD student is considered as a candidate for a degree in sciences if, after successful completion of the PhD study programme, the PhD student has submitted a PhD Thesis to the Doctoral Council or has held a preliminary Viva Voce Examination of a draft of the PhD Thesis at a meeting of the Doctoral Council or at a meeting of structural unit attended by the chair of the Doctoral Council or a field expert designated by the chair, and has received a recommendation to submit the thesis to the Doctoral Council for consideration.

1.4. A PhD student is exmatriculated from RTU for failure to complete the PhD study programme if, after successful completion of the PhD study programme, a preliminary Viva Voce Examination of a draft of the PhD Thesis has not been conducted at a meeting of the Doctoral Council or at a meeting of the structural unit attended by the chair of the Doctoral Council or a field expert designated by the chair, and a recommendation to submit the thesis for consideration by the Doctoral Council has not been received.

1.5. The PhD degree is awarded after the successful Viva Voce Examination of the PhD Thesis at the Doctoral Council.

The elaborated research paper (dissertation) is submitted to the Doctoral Council, which first sends the paper for approval to the State Scientific Qualification Committee, and after receiving a positive evaluation appoint reviewers and organize Viva Voce Examination. PhD degree is awarded after positive vote of the members of the Council.

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended

outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

The PhD study programme “Computerised Control of Electrical Technologies” has defined 6 learning outcomes:

- ability to apply theoretical knowledge to the solution of scientific problems;
- ability to organise and carry out pedagogical work;
- ability to design and develop innovative technical computer-controlled systems for electrical equipment in various branches of the economy;
- ability to design and develop innovative electronic equipment, semiconductor devices of a power converter, electric propulsion systems and robotic automated manufacturing systems;
- ability to conduct internationally relevant research, disseminate results in international publications and conference presentations;
- ability to apply knowledge of foreign languages at international scientific level.

The aims set in the descriptions of study courses are closely linked to the learning outcomes of the study programme. The content of the study courses is fully relevant to the learning outcomes. The syllabi of the study courses are regularly reviewed and improved, which helps to monitor and update the content, teaching methods and learning outcomes.

The main research areas of this study programme are:

Power electronic converters and their control systems;

Development of control systems with artificial neural networks and fuzzy logic controllers;

New electric propulsion systems and motion control;

Development of expert systems in electrotechnological processes;

Development and research of alternative energy conversion systems;

Development and research of semiconductor reactive power compensation devices and active filters;

Electrophysics and theoretical electrical engineering;

Multi-criteria analysis of logistic decisions for energy systems;

Installation of a positioning system for solar photovoltaic inverters;

Use of power electronics and electric propulsion systems in electric vehicles;

Development of a bidirectional power flow controller with sinusoidal grid currents for electric transport;

Research on electromagnetic compatibility of power electronic converters;

Development and research of supercapacitor energy storage systems;

Power tool propulsion manufacturing technologies and their optimisation, etc.

Most of these areas are being developed through local and international research projects. In order to achieve research aims, students at other levels - bachelor and master - with diploma papers with specific aims and objectives are involved in both projects and these research areas.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

Various methods and modes of teaching are used in the study process, their choice is conditioned by specifics of every study course. Much attention is paid to the analysis and summary of research literature, research papers and conference proceedings, as well as to autonomous work in the laboratory using computer equipment, dealing with computer modelling. At the end of each semester, students draw up a report on the accomplished activities within each study course, they report on their scientific research work. Every year, PhD students have to report on their progress.

The training process (lectures, practical and laboratory classes) will be based on new technologies such as modelling computer programs, computer projectors, micro-control kits, unified digital and analogue control plates, and other types of technology. Some technological equipment and computer programs were self-created, and some of them were purchased. The study programme is implemented through project tasks, their public presentation and assessment. Students are involved in various research projects.

Descriptions of study courses will be available at RTU website, in the Study Programme Register. Their description is based on the principles of Bloom's taxonomy, namely, including not only an annotation and a short description of the study course, but also providing information on the aims and tasks of the study course expressed in competencies and skills, defining the learning outcomes to be achieved and their assessment, as well as prerequisites for acquiring the study course.

Assessment of student learning outcomes is carried out in accordance with the “Regulation on the Assessment of Learning Outcomes” (approved at the Meeting of RTU Senate on 27 May 2017, Minutes No 610), which is available on Studies Regulations page of RTU web page (https://www.rtu.lv/writable/public_files/RTU_studiju_rezultatu_vertesanas_nolikums.pdf (in Latvian) English translation is Annex 04 in the zip folder "List of Internal regulations"). Pedagogical methods used in the implementation of study courses, as well as assessment forms and methods are selected by the instructors responsible for the study courses in compliance with course curriculum and specifics of the programme, as well as student needs. A member of academic staff should inform students about particular assessment criteria at the fist lecture/practical class.

The main advantage of the summative assessment system is that the final grade is made up of several components. Therefore, the students may contribute to their final grade working during semester. Criteria for assessment of the study courses and individual/home tasks are published on ORTUS e-study system beforehand. During semester, the assessment for each home task, test, report, presentation and any other task is ascribed certain weight in the final grade. Exam grade may not exceed 50% of the final grade. Academic staff may take into consideration and also assess student attendance. Assessment structure for the study course is determined by the academic staff themselves, abiding the resolution of RTU Senate that the exam grade may not contribute more than 50% to the final grade. Selecting assessment criteria and methods for evaluation of student achievements, specifics of each study programme and learning outcomes are taken into consideration.

The members of academic staff shall inform the students on the specific assessment criteria of the study course at the first lecture, they are also published in the e-page of the study course.

The student-focused education principles are considered during the whole implementation of the study process:

1. Involvement of students in the study process and content improvement. RTU has developed procedures providing for the student feedback on the quality of the study process (surveys, regular meetings of students with the program director and leading teaching staff, etc.). Thus, students have an opportunity to affect the study process. Students in the program are regularly involved in the program quality assessment, participate in the work of decision making bodies and advisory bodies.
2. Study outcomes. The assessment of the study courses of the program and the number of credits is related to study outcomes. The study outcomes of each study course are notified to students. Professors relate the course outcomes to the study program outcomes, as well as substantiate the necessity of acquisition of the information of the relevant course for mastering the profession of an electrical engineer.
3. Mobility. Within the study program "Adaptronics" mobility resources are used to improve the teaching process of the university, as the student-focused education is based on a powerful teaching process. Teaching staff of foreign universities is involved in the program implementation, thus benefiting not only students, but also the teaching staff involved in the program implementation by taking over the best practice.
4. Social dimension. When students study within this program, their study process is sufficiently flexible, providing an opportunity for students to combine studies with work starting from the second or third study year. Students of the day department also have an opportunity to change the form of studies to remote studies in order to combine studies and work. The fact that the premises of the RTU library are available to students round the clock and also on weekends should be mentioned as another advantage.
5. Teaching methods. Various teaching methods are applied in the program implementation process. For example, study projects are developed, there are group works, the peer-to-peer method is applied in some study courses. Students can receive individual consultations from the academic staff in personal meetings or by communicating in the e-environment.
6. Study environment. During the program implementation there is cooperation between librarians and the academic staff aimed to improve the teaching and learning process. Both students and the teaching staff involved in the program have access to premises with relevant equipment appropriate for research and the learning process.
7. Development of the academic staff competences. The academic staff involved in the program have regular opportunities for improvement of their methodological and teaching skills. The process of development of the academic staff competences includes also discussions on application of the teaching and learning methods, including innovative teaching methods. For instance, within the scope of ERASMUS+ and NordPlus projects workshops on innovative teaching methods were organised with participation of colleagues from Latvia, Lithuania, Estonia and Finland.
8. Extracurricular activities of students. The program management supports the work of the students' self-government, thus allowing students improving their independence, providing opportunities for implementation of ideas, as well as to study additionally outside the scope of lectures.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of

the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

Table 2 shows the data on defended PhD Theses within the study programme Computerised Control of Electrical Technologies. All Theses are written on up-to-date and topical themes, in collaboration with experts from industry and research institutions. The results of the PhD Theses elaborated within the study programme Computerised Control of Electrical Technologies are practically applied, or at least validated, in the industry or are developed upon the industry's demand. The results of the Doctoral Theses are highly evaluated by foreign as well as local experts and reviewers.

Table 2. Themes of the PhD Theses and year of defence

New PhD holder	Date of Viva Voce Examination	Scientific adviser	Research theme
P. Apse-Apsītis	12.02.13.	L.Ribickis, Dr.habil.sc.ing., prof.	Research of the Wireless Monitoring and Control Systems for Electro-Technological Devices
V. Karevs	03.07.13.	M.Mezītis Dr.sc.ing., prof.	Railway Automation and Telematics Systems' Monitoring and Diagnostic Methods' Research and Development
A. Suzdaļenko	28.11.13.	I.Galkins Dr.sc.ing., prof.	Research and Development of Control Means for Intelligent Household Electrical Grids
A. Mors-Jaroslavcevs	18.12.13.	A. Ļevčenkovs Dr. sc.ing.	Modeling the Intelligent Electrical Transport Control Systems with Immune Algorithms
D. Meike	18.12.13.	L.Ribickis Dr.habil.sc.ing., prof.	Increasing Energy Efficiency of Robotized Production Systems in Automobile Manufacturing

A. Zabašta	15.07.14.	N.Kuņicina Dr. sc.ing., prof.	Development of Computer Control Methods and Approaches for Critical Infrastructure Interdependencies Analysis
A. Potapovs	05.11.14.	A.Ļevčenkovs Dr .sc.ing.	Research and Development of Integrated Smart Devices for Adaptive Control of Railway Transport
G. Ašmanis	30.12.14.	L.Ribickis Dr.habil.sc.ing., prof.	Measurement and Modelling of EMI Filters High Frequency Parasitic Parameters
O. Tetervenoks	13.05.15.	I.Galkins Dr.sc.ing., prof.	Direct Current Regulation and Compensation of Non-linearity for Improvement LED Lighting Quality
J. Maksimkina	17.12.15.	I.Raņķis Dr.habil.sc.ing., prof.	Investigation of the Dynamic Modes of High Power Induction Motors, Taking into Account the Skin Effect
U. Sirmelis	07.01.16.	J.Zaķis; Dr.sc.ing., asoc.prof prof. L.Latkovskis Dr. sc.ing.	Urban Electric Transport System Modelling for the Selection of Optimal Energy Storage Parameters
L. Robert Adrian	20.06.16.	L.Ribickis Dr.habil.sc.ing., prof	Research and Development of Obstacle Avoidance Systems for Mobile Robotics
A. Hermanis	25.11.16.	M.Greitāns; Dr. sc.ing., prof O.Krievs Dr. sc.ing., prof	Shape Sensing Based on Embedded Sensors for Mobile Cyber-Physical Systems
G. Zaļeskis	29.09.17.	I.Raņķis Dr.habil.sc.ing., prof	Research of the Automation Tasks of the Wind Generators in the Low-power Microgrids
A. Ašmanis	04.11.18.	L.Ribickis Dr.habil.sc.ing., prof	Surface-Mount Component 3D Modelling in Frequency Range 150 khz-100 mhz
A. Riepnieks	07.12.18.	L.Ribickis Dr.habil.sc.ing., prof	Parameter Estimation and Signal Modelling for Phasor Measurement Units

K. Kroičs	07.12.18.	L.Latkovskis; Dr.sc.ing., V.Bražis Dr.sc.ing., prof	Development of Supercapacitor Based Devices for Electric Drive Retrofit
V. Veckalns	28.05.19.	L.Ribickis Dr.habil.sc.ing., prof	Studies of Colour Flow in Top Quark Pair Decays at 13 TeV at the CMS Experiment of the CERN LHC
Š. Jassema Gatana	09.12.19.	A.Podgornovs Dr. sc.ing., prof	A New Design of M.V – Vacuum Circuit Breaker – With Auxiliary Units Damping Techniques for Soft Interrupter Applications
J. Mārks	19.12.19.	S.Vītoliņa Dr. sc.ing., prof	Vibration Model for the Detection of Mechanical Faults Within Windings and Magnetic Core of Power Transformers
R. Saltanovs	29.12.20.	I.Galkins Dr. sc.ing., prof	Increased Efficiency of Wireless Energy Transfer to Vehicle System

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

RTU Office of Vice-Rector for Academic Affairs regularly conducts student surveys on the ORTUS portal (during autumn and spring semester). The results of these surveys are available to the head of the study programme, as well as to the instructor of each study course. The head of the study programme and the instructor of the study course evaluate the results and make the necessary improvements. It can be concluded from the surveys carried out that students positively evaluate the study process and teaching methods used.

The survey results are available at the ORTUS portal.

The overall opinion of students and graduates regarding the studies at RTU is reflected by the fact that the university has been the most recommended university by employers in Latvia for the last eight years. This annual research is performed by the Latvian Confederation of Employers (LDDK) in cooperation with the career and education portal prakse.lv.

Analysis of the references of students and graduates regarding the study process allows viewing the situation within the context and implement improvements in both organisation of studies and the teaching approach in the program as a whole and in individual subjects taught by various professors.

The results of the surveys of students, graduates and employers are used for reviewing and improving the study content and process jointly with teaching staff.

Student participation in the improvement of the study process is already being implemented and will take place in several ways. First of all, students will be regularly surveyed in ORTUS e-learning environment where, according to the results of the survey, the head of the study programme can assess the results and make the necessary improvements. Secondly, one of the themes for the graduate papers may be the upgrading of a new or existing laboratory workspace, particularly when it relates to the needs of businesses and new technologies, as well as the development of methodological material for teaching, or, for example, the addition of material with new computer models, electrical circuits, their descriptions, etc. Thirdly, students, also through the Student Self-government of the Faculty, organise various activities, field trips to production companies, competitions in the field of civil engineering, participate in exhibitions and discussions.

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

Students regularly have traineeship at foreign technical universities. Cooperation has been launched with several foreign universities, where, through the ERASMUS+ exchange programme, students successfully start training and successfully develop PhD Theses. It can be concluded that interest in mobility opportunities is high, and the level of students' knowledge is sufficient with the level of knowledge, skills and competencies of study courses implemented by other internationally recognized higher education institutions. During mobility, the students study and pass tests and exams at the best European universities, such as RWTH Aachen or the University of Duisburg-Essen in Germany.

Recognition of study courses covered during mobility takes place according to the “Amendments to the Organisation Procedure of Erasmus+ Student Mobility” (Resolution of RTU Vice-Rector for Academic Affairs No. 01000-1.1/240 as of 29 October 2014) and “Regulation on the Recognition of the Courses Completed at Other Universities and RTU Study Programmes” (Resolution of RTU Vice-Rector for Academic Affairs No 02000-1.1/29 as of 4 April 2016). The recognition of ERASMUS+ mobility is carried out by the head of the study programme on the basis of the Transcript of Records submitted by the student after the ERASMUS+ mobility and a pre-signed application for the recognition of study courses.

In order to make the recognition of courses more successful, the student carefully chooses the most appropriate partner school for the curriculum and the area before applying for ERASMUS+. The study courses, which are coordinated with the Erasmus+ coordinator in the form of an application, are approved by the head of the study programme.

During the recognition process, the evaluation of courses acquired during ERASMUS+ programme is not converted to a 10-point grading scale, but the successfully covered ones are marked as “recognised” instead of an assessment of courses of partner higher education institution, thereby recognising the credit points obtained. If the application for recognition of courses calls for amendments to the study programme and the student has been successful during ERASMUS+ programme, an order of RTU Vice-Rector for Academic Affairs is issued regarding individual amendments to the study programme which are then prepared.

In 2016, 1st year PhD student Priedītis Mārcis spent one semester at Tallinn University of Technology, Estonia, and every year in January almost all PhD students and their scientific advisers participate in Tallinn University of Technology Doctoral School with presentations and exchange of scientific ideas and experience. In turn, IEEE hosts PhD students from TalTech at the Doctoral School organised by the Institute every May.

Erasmus mobility at doctoral study programme Computerised Control of Electrical Technologies REDO

No	Name, surname	Country	Erasmus University	Period
1.	M. Priedītis	Estonia	Tallinn University of Technology	01.02.2016 - 18.06.2016
2.	M. Stunda	Belgium	Free University of Brussels	2020

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

The state budget subsidy to the students of PhD study programme “Computerised Control of Electrical Technologies” amounts to EUR 177, 678,97 or EUR 13, 215.13 per student.

Table 3. Funding of the PhD study programme “Computerised Control of Electrical Technologies”

	State budget subsidy	Tuition fees of local students	Tuition fees of foreign students	Total funding of the study programme	Costs per 1 student, EUR
2019/2020	177 678,97	-	-	177 678,97	13 215,13
2018/2019	158,539.29	-	-	158,539.29	12,689.04
2017/2018	152,162.81	-	-	152,162.81	12,121.97
2016/2017	127,701.07	-	-	127,701.07	11,598.06
2015/2016	132,817.71	-	-	132,817.71	11,598.06
2014/2015	154,174.47	2,027.59		156,202.06	11,598.06
2013/2014	141,763.00	4,055.00		145,818.00	11,598.00

In order to improve the resource base, additional financing from contractual work conducted by the faculty units is attracted.

The tuition fee of the program is defined by considering the market situation in the industry and with the goal to maintain competitiveness. In order to ensure financial stability by admitting students who pay for their studies at a tuition fee which does not cover the costs per student, the teaching staff of the program actively engage in scientific research by receiving a substantial part of their remuneration in projects.

16 members of the Institute of Industrial Electronics and Electrical Technology of the Faculty of Electrical and Environmental Engineering – professors and associate professors take part in the implementation of the study programme.

In addition to the academic staff of the Faculty of Electrical and Environmental Engineering, general staff are involved in the management of the study programme that undertake study support processes, such as the organisation of study process, the management of public and international relations, student records, technical support of study programmes, work related to the implementation of the study programme. Their duties also include the organisation of business correspondence, the circulation of information, including cooperation organisations in Latvia and abroad, the coordination of telephone calls, e-mails, and correspondence, planning the work schedule of the manager, administration of appointments. They may also carry out simple financial records, analysis, assessment, and control of documentation, as well as drawing up various types of activity related reports on behalf of the manager and solving problems or non-standard situations.

Successful cooperation has been developed with the staff of the relevant faculty of Tallinn University of Technology, which ensures the improvement of the professional skills of employees and the exchange of students and employees.

In Latvia, study programmes in Power, Electrical Engineering and Electronics are implemented at Latvia University of Life Sciences and Technologies and the Latvian Maritime Academy, and the academic staff of the Faculty of Electrical and Environmental Engineering and Power Institute are actively involved in these programmes, creating joint scientific projects. The joint projects are also implemented with the Institute of Solid-State Physics of the University of Latvia, the Institute of Physical Energetics of the Latvian Academy of Sciences, RTU Faculty of Mechanical Engineering, Transport and Aeronautics, as well as Faculty of Computer Science and Information Technology.

With ERDF funding to the field of Power, Electrical Engineering and Electronics, since 2014 the study process has been implemented in a new and modern building with an up-to-date building management system with embedded sensors, climate control systems, energy-efficient lighting, etc., which also serve as a means of research. In parallel, existing and new laboratories have been upgraded:

- Power Electronics Training Laboratory;
- Electrical Propulsion Training and Research Laboratory;
- Manufacturing Automation Training and Research Laboratory;
- Computer Management Training and Research Laboratory;
- Microelectronics and Sensor Training and Research Laboratory;
- Energy Efficiency Training and Research Laboratory;
- Electronic Equipment Training Laboratory;
- Electrical Engineering Fundamentals Laboratory;
- Electrical Engineering and Electronics Training Laboratory;
- Research Laboratory of Semiconductor Converters;
- Industrial DC System Laboratory (AREUS Demo Lab);

- Student Creative Laboratory.

These laboratories have a brand-new infrastructure – furniture, network voltage links, blackboards, projectors, etc. In addition, the following training facilities have also been purchased: oscilloscope (RigolDS1052D, total number: 10 pcs), oscilloscope (Rigol DS4012, total number: 2 pcs), power measurement keys (Rigol RP1001C, 7 pcs), differential keys (RigolRP1025D, total number: 2 pcs), multimeters (u1233a, total number: 16 pcs), solar meter (solar-100), power parameter analysers (CIR-E3, number: 14 pcs), power units (EX752M - PSU, total number: 8 pcs), power units (QL355TP - PSU, PROG, TIPLE, 35V, 5A, 5V, 5V, 1A), total number: 2 pcs, power units (TTI - CPX400s - PSU, total number: 2 pcs), two power units (EA-PS 2042-20b - PSU), transformer (VELLEMAN sr-1000), accumulator-screwdriver/drill-machine (Festool), portable optical meter (Konica MINOLTA LS110)). New test benches have also been created for students' practical work: microelectronics, electron devices, propulsion system “lift drive” bench.

Within the FP7 project framework AREUS, a unique laboratory has been set up: a 600 V DC power supply network consisting of an industrial 21 kW robot KUKA Quantec Prime, a 55 kW active rectifier, two power benches capable of emulating electricity consumption of any robot, super condenser, and lithium-ion energy storage systems and other equipment. The Faculty of Electrical and Environmental Engineering has a compact solar storage system at its disposal; the storage system is with lithium-ion batteries and a charge-level control system; local, interlinked autonomous power supply systems with 3.6 kW wind generators and 6.6 kW solar panels; inverter electricity for grid transfer or lithium-ion storage systems for energy storage. In parallel, special programmable DC power units have also been purchased, which are capable of simulating solar panels or hydrogen systems with a power of 2 · 15 kW, 2 · 5 kW, 2 · 3 kW, fuel cell research set Ballard Nexa with a power of 2 1.2 kW and 8 kW.

For industrial process studies, the FESTO mini plant MPS and FMS complex, the compact water-level control work station FESTO Compact-Workstation, EMCO Concept Turn 105/EMCO Concept Mill 105 equipment kit are available.

Digital oscilloscope YOKOGAWA DLM6054-F-HE-L16/P4, oscilloscope (Rigol DS1052D – 10 pcs; Rigol DS4012 – 2 pcs), digital oscilloscope TEXTRONIX, Fluke, Rigol, etc. are available for signal measurement. In 2017, a fine BNC-type oscilloscope power key Ultra mini CWT015 was purchased to measure the current running through the legs of a transistor.

For the measurement of lighting parameters, the Avantes spectrometer, the solar meter (SOLAR-100), the portable optical meter (Konica Minolta LS-110), the infrared temperature meter Raynger ST60 ProPlus are available.

To determine energy performance parameters, electricity parameter analysers (CIR-E3 – 14 pcs), power analyser set N4L PPA5530-3 Phase (5 pcs), network analysers AR5 and AR5L, Fluke network analysers, etc. are used.

Variable AC and DC power sources, as well as other sources are used for the development of various converters, such as diesel generator SDMO DX 6000TE, solar panels, wind generator, hydrogen fuel cells, power units (EX752M – PSU, 8 pcs), direct voltage laboratory power unit (EA-PSI 9360-120 3U), direct voltage electronic load (EA-ELR 9150-30 3U) and electronic load for DC Electro Automatic ea-el3400-2, direct voltage laboratory supply unit (EA-PS 8032-10 T).

Electronic Technology Management System Development Platform dSPACE, Matlab/Simulink R14 modeling programme, simulation programme PSIM Profesional 8.0, Synopsys Analog Simulation and Modeling Synopsys Advanced TCAD individual license, license OrCAD PCB Design University Edition, software PSIM-JMAG, etc. are also available.

Prototyping equipment for PCB plates is used such as LPKF ProtoMat S64 PCB prototyping equipment, LPKF ContacRS PCB metalizing plant, HAWK 3D axis microscope, automatic multi-layer PCB press (4-8 slice plate development) LPKF multi-press; and electrical coil (throttle) rolling stand are available with Jovil Manufacturing SMC-2 equipment.

In 2017, owing to the financial support of Latvenergo JSC shareholder, equipment was supplemented in Latvenergo Student Creative ILboratory by purchasing a programmable 6 kW three-phase AC power unit, electro-automatic EA-ACP3P 520-16.8-6000-20U f 45-450.

In 2020, the Ergonomic Electrical Technology Research Laboratory joined the Institute. The Laboratory promotes interdisciplinary research, integrating the developments of materials science, electrical engineering, electronics and anthropometrics in ergonomic applications. Creating innovative and completive environment, it is possible to attract young researchers offering them opportunity to develop their PhD Theses for promotion of new research, creation of new products and services to promote sustainable development of Latvia in cooperation with the industry. In the process of studies, students have opportunity to conduct research in the fields of anthropometry and ergonometry using the equipment available at the laboratory (Vitus Smart XXL 3D scanner, traditional measuring equipment used in anthropometrics, twin-axis goniometer for measuring movement amplitude, relevant software).

All the equipment and laboratories mentioned above have been successfully used in the study process, students' research, and in the development of graduation papers.

The infrastructure and technical support available for the implementation of the study programme, thanks to a high level of digitization, provide an opportunity to increase the competitiveness, quality, and efficiency of the University, as well as the availability of information, by integrating information technology (IT) solutions into the University's administrative, study and research work processes, providing students, administrative and academic staff with modern, reliable, secure and integrated IT infrastructure and high quality IT services.

To ensure easy and efficient identification of IT users, an IT user identity management system has been introduced; as a result, each IT user has a unique electronic identity that is valid in all information systems. In addition to the aforementioned, a user session management system is ensured in IT systems, which means that there is no need for IT users to re-authenticate when logging in to RTU information systems. It gives the experience of using a unified integrated information system without having to memorize different identification data and re-enter them, implementing different IT application scenarios.

All IT users are provided access to the centralised portal ORTUS (https://ortus.rtu.lv), which functions as a single digital gateway, combining information from all RTU information system components and providing users with an easy-to-use way of accessing the directory of all IT services in one place.

The Centralised Study Management System is used for efficient administration of the study process, which ensures digital provision of the study life cycle, incl. Electronic Register of Study Programmes (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub), drawing up learning agreements and enrolment of students in study programmes, Register of Study Courses (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub), designing student's individual study plans, drawing up orders, implementing study courses and study process, registering grades, recognising study courses, awarding qualifications, administering payments, hostel information, gathering information to issue diploma supplements, etc. This system is one of the main cornerstones in the administration of RTU study process.

To ensure effective implementation of the study process, Moodle e-learning system is used, where all relevant information is compiled in an automated way (study courses, users, groups, access rights, etc.). This system ensures student-instructor communication. The academic staff members place various electronic materials, assessment tests, homework assignments, information on a particular study course, etc. in the system. Students can also view their financial information on the ORTUS portal, as well as make request for documents (references, transcripts of records, copies of a learning agreement, etc.).

Since 2007, more than 130,000 unique study course sites have been generated in the e-learning environment of RTU. Students can access electronic learning resources anytime and anywhere.

Digitisation of classrooms and schedules has been carried out to ensure efficient premise management and study planning (https://telpas.rtu.lv; https://nodarbibas.rtu.lv/). Each RTU student and academic staff member can access their schedule, which provides information on the venue, time, instructor, room, title and type of lecture. In addition, for user's convenience purposes, the system greatly facilitates lecture planning and scheduling, as well as optimises the use and efficiency of premises.

Electronic Staff Management and Record-keeping Systems, which cover the circulation of record-keeping and personnel documents at RTU (https://docs.rtu.lv/), are also used to ensure the efficient administrative work. Electronic document coordination and document e-signing functionality have been introduced, thus reducing print-based document circulation and significantly increasing document circulation speed. Since autumn semester of 2019, students have been provided with electronically signed learning agreements. Since 2016, RTU graduates have been receiving electronically signed transcripts of records.

In terms of quality assurance, a digital student survey system is used, with the help of which the quality control of study courses and study programmes is implemented each semester. Based on the results of quality control, regular measures are taken to improve study programmes and the study process, in general.

For additional convenience of RTU students, academic and general staff members, RTU leases Microsoft Windows and Microsoft Office software, which provides all IT users with access to the latest Microsoft software. RTU students can use the licensed Windows operating system and the Microsoft Office productivity suite provided by RTU for study needs. All IT users have access to Microsoft Office 365 cloud computing platform with one terabyte of storage space available to each user and access to a variety of additional collaboration and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic and general staff have access to the University's email system.

To support research activities, RTU has developed the Centralised Research Support System, which records all information on publications, patents, commercialisation applications, Doctoral Theses, RTU scientific journals, research staff, etc. The system provides access to information according to Open Access principle (https://science.rtu.lv). RTU students and academic staff also have centralised access to research software.

RTU has the high-speed fibre optic Internet and extensive wireless network infrastructure with over 400 access points, including the international *Eduroam* service. In addition, desk phones and mobile communications are provided for fast and easy communication.

To ensure a stable and secure operation of the information technology infrastructure, continuous monitoring of the IT infrastructure and systems is performed, resulting in proactive incident control. Data backup is also ensured.

The Information Systems Security Policy has been developed and implemented with the primary goal of ensuring the secure use of RTU information systems by establishing and maintaining a sufficient set of measures to reduce or prevent potential or resulting harm. Implementation of the Information Systems Security Policy envisages security checks, data transmission network monitoring, as well as preventive measures. Regular IT security and personal data protection training is organised for IT users. Automated security incident management and risk management have been implemented. Statistics demonstrate that the number of IT security incidents dropped significantly 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.

The University library plays a major role in providing methodological and information support to the students. The Scientific Library of RTU (https://www.rtu.lv/en/studies/scientific-library) is an academic library of state significance, which has obtained its status as a result of library accreditation. The Scientific Library of RTU provides the necessary information for RTU study process and research activities, performs library, bibliographic and information services for RTU students, teaching staff, and employees. The Library's collection includes 1.4 million printed documents and e-resources in the databases relevant to RTU fields.

In 2016, significant investment was made in the development of the library infrastructure, with the construction of an additional 2240 m2 of space for the Central Library. The total area of the library premises is 6393 m2, of which 3417 m2 are for reader services. There are 713 workstations for library users. The library has four group rooms and six individual cubicles, a Western reading room and a conference room. The library is accessible to users with reduced mobility.

To improve the work of the Scientific Library of RTU and to ensure the availability of information needed for study and research work, the Library Council has been established, which decides on the replenishment of the library's collection with printed publications and subscriptions to the necessary databases. The Library Council has approved the "*RTU SL Collection Completion Policy*", which defines the basic principles of collection formation and development in accordance with the fields of RTU study and scientific activities.

When RTU provides funding for the library, the funding for information resources for each study programme is calculated. The collection is replenished according to the recommendations of the heads of study programme, researchers, and the allocated funding. The desired titles can be ordered by contacting the Library's Collection Development Department, ordering on the Library's website, filling in the order form, filling in the application form, by phone 67089353 or by visiting the Library at Paula Valdena 5-105. The Scientific Library offers a guide to ordering titles and e-resources, which brings together the websites of various publishers and bookshops in Latvia and abroad.

Database subscription contracts are concluded both directly with the supplier and through the "Cultural Information Systems Centre" state agency, which is the Latvian national representative of the international non-profit organisation EIFL (Electronic Information for Libraries, http://www.eifl.net/). The EIFL Licensing Programme offers national libraries subscriptions to internationally recognised databases at significantly reduced subscription fees not offered to individual subscribers, thus saving financial resources of the libraries.

The database subscriptions maintained by RTU Scientific Library

(https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/abonetas-datubazes):

- ProQuest Ebook Central, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, EBSCOhost eBook Academic Collection, Wiley Online Library, SpringerLink, The International Monetary Fund.
- Databases financed by the Ministry of Education and Science available to RTU Scientific Library: ScienceDirect, SCOPUS (Elsevier), Web of Science.
- Latvian databases: LETA, Letonika, the Database of Latvian Standards (available on the premises of the Library).

Database usage at the Scientific Library of RTU has been growing since 2016. E-resource loans have increased from 75,391 to 525,194 items.

The new library premises have allowed to extend the range of services. Since the opening of the new premises in 2018, the number of visits to the library has increased from 103,825 to 235,600. The Scientific Library of RTU is open to everyone. The Central Library is open to users from Monday to Saturday. There is a 24/7 reading room. During the summer period, the Central Library is open every weekday with reduced opening hours. (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3).

The library sources are housed in an open-access collection. The last copies of the oldest publications corresponding to the RTU profile are kept in the library repository. They are always available to the users.

The librarian on duty helps visitors find their way around the collection. Bibliographers (information specialists) provide more detailed information and advice. The library has a branch librarian service. (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija).

The library resource search is supported by the Primo Discovery search tool (https://www.rtu.lv/lv/studijas/biblioteka/vienota-informacijas-meklesana). It allows searching the library catalogue (https://kopkatalogs.lv/F/?func=find-b-0&local_base=rtu01), the subscribed databases, as well as databases created by the RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes) in one interface. Searching for information in the electronic joint catalogue (https://kopkatalogs.lv/F), it is possible to simultaneously obtain information on the resources available in 12 Latvian libraries. Both the electronic catalogue and the RTU portal ORTUS allow remote reservation of library resources, as well as remote access to the databases. Since the introduction of RFID technology, users can use five self-service book-dispensing machines and check out books from the pick-up machines around the clock.

The library provides students, academic personnel and other stakeholders with various levels of individual consultations and group training in information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas).

Publications not available in the library are delivered via an interlibrary loan or an international loan. Internet access is available throughout the library. The library has copying, scanning, printing, binding services and a self-service dining room.

During the reporting period 158 textbooks and 15 electronic books totally amounting to 173 study materials were purchased for the program acquisition.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

Cooperation of the Institute of Industrial Electronics and Electrical Engineering with other scientific institutions and higher education institutions ensures the involvement of PhD students in scientific work within the framework of this cooperation, the Institute’s study and scientific resource base. For example, IEEE has cooperation agreement with EON-RWTH Aachen Research centre, the University of Duisburg-Essen and Mechanics Institute laboratory, as well as cooperation agreement with CERN signed in 2012, as a result of this cooperation V. Veckalns defended his PhD Thesis.

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

The implementation of the study programme is ensured by the academic staff of RTU FEEE IEEE – professors and associate professors, each of whom is an expert in their field.

Academic staff from partner universities abroad are invited to participate in the implementation of the study programme, as well as industry professionals provide classes that are orientated more towards practical tasks. Partners from Tallinn University of Technology, RWTH Aachen University, the University of Duisburg-Essen provide onsite and online lectures and practical/laboratory classes.

Both academic teaching staff and teaching staff possessing work experience in the industry participate in implementation of the program. The results of the students’ survey reveal the high evaluation of the teaching staff. Table 4 below presents information about changes of the teaching staff involved in the program implementation per their positions.

The academic staff conforms to the requirements of implementation of the study subjects. This is confirmed by both the description indices and CV’s, the scientific and methodological developments by the teaching staff, their participation in international scientific and methodological conferences organised by Latvia and RTU, management of their scientific directions. Generally, the data confirm the qualification of the teaching staff and that this qualification can provide high quality supervision of Ph.D students and their research projects. In parallel, some professors work in industrial companies, therefore the practical work skills and competences are transferred to the study program, and research is developed in compliance with modern industry requirements.

Table 4. Changes in the composition of the teaching staff 2013 – 2020

	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020
Professor	7	9	8	8	8	9	13
Acting Professor	1	1	2	2			

Associated professor	4	4	2	3	4	4	8
Acting Associated professor	2	3	3	4	3	1	
Assistant professor	4	7	8	9	6	10	11
Assistant professor (practical)	2	2	1	1	1	1	1
Acting Assistant professor						1	
Total	20	26	14	27	22	26	32

Involved teaching staff actively uses the opportunities presented by international cooperation mobility programs. Mobility of teaching staff, international scientific cooperation within the scope of projects, as well as publications provide changes of the program content and application of teaching methods in compliance with the modern global trends, thus helping to achieve defined study outcomes and goals.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

Overall, the qualification of all the teaching staff comply with the conditions of implementation of the study program and the requirements of laws and regulations, as well as ensures attainment of the program goals and study outcomes, which is attested by their qualifications and CV's.

Professor Leonīds Ribickis holds a Doctoral degree in engineering. Alongside his academic, scientific and organisational activities, he is actively involved in Latvian and global scientific organisations, contributing to the development and improvement of the power and electrical engineering sector. He has more than 40 years of experience in higher education: study process management, scientific research, project management. Leonīds Ribickis is an academician of the Latvian Academy of Sciences and an expert in the field of engineering and technology - electrical engineering, electronics, information and communication technologies, as well as a member of RTU Senate and the Council of RTU Faculty of Electrical and Environmental Engineering, Chairman of RTU Promotion Council in Electrical Engineering, Chairman of RTU Council of Professors in Electrical Engineering. He has co-authored more than 600 publications, including 21 monographs and 77 patents on the following topics: electrical engineering, electronics, electrical drives, technological process and motion control, industrial robot equipment; semiconductor power converters, power electronics equipment and their control systems; energy efficiency of electrical equipment, smart

DC networks; electric transport and e-mobility; electromechanical converters, AC and special electrical machines; alternative energy systems. He supervises Bachelor, Master and Doctoral Theses in subjects related to electric drive systems, industrial electronics and control systems for power electronic converters. He managed and executed more than 50 international and national projects related to scientific research.

Professor I. Raņķis carries out scientific work in the field of design and optimisation of DC electrical drives for electric trains, industrial and public electric transport. I. Raņķis has worked with both full-time and part-time students, as well as delivered study courses to foreign students in English. He has also been a guest lecturer at Tallinn University of Technology and a trainee at the Royal University of Technology in Stockholm. He has supervised the internship of young lecturers of electrical engineering subjects at Vilnius Gediminas University and Riga Technical University. Raņķis has been active as a scientific adviser of students' qualification papers, i.e., engineering projects (50), Bachelor Papers (30), Master Theses (40). Prof. I. Raņķis has supervised 9 Doctoral Theses in engineering.

Professor I. Raņķis is active in the field of science. His research interests include the development and study of energy storage systems in active cooperation with various enterprises, the study of pulse regulation systems for AC electrical systems, and the study of the efficiency of the application of non-linear inductances.

In general, Prof. I. Raņķis purposefully improves his qualification, actively cooperates with young engineering specialists, is able to confidently help students overcome study difficulties and problems and promotes students' professional growth. He is a very effective member of the student learning system.

Professor Oskars Krievs holds a Doctoral degree in the field of power electronics and has 20 years of academic experience in electrical engineering and power electronics. During this period, O. Krievs has led or participated in 16 scientific projects, including two international ones. Since 2020, O. Krievs has been the Dean of the Faculty of Electrical and Environmental Engineering at RTU, and from 2011 to 2020 - Dean of the Faculty of Power and Electrical Engineering at RTU. Currently O. Krievs delivers 3 study courses in the field of electrical engineering, but in total he has developed or participated in the development of more than 10 study courses. To improve his qualifications, O. Krievs has participated in 36 international scientific conferences, as well as undertaken internships at the Polytechnic University of Turin (2007), University of Duisburg-Essen (2018) and Ltd. EK Sistēmas (2020). In 2019, O. Krievs received the award of the Latvian Academy of Sciences for the most significant achievements in science, and in 2017 - the annual award of the Latvian Academy of Sciences and JSC Latvenergo for significant contribution to the field of power engineering. Since 2019, O. Krievs has been a member of the Latvian Association of Power Engineers and Energy Constructors.

Leading Researcher Anatolijs Zabašta holds a Doctoral Degree in the field of computerised control of electrical technologies. He has 9 years of professional experience as a lecturer, project manager, researcher and leading researcher. He is a coordinator of several ERASMUS+ CBHE projects and leader and participant of various other projects. A. Zabašta improves his knowledge by participating in RTU and other international scientific conferences, seminars, RTU professional advancement courses and courses organised by other universities. A. Zabašta is the co-author of more than 100 scientific publications, scientific monographs and textbooks.

Anastasija Žiravecka, Dr.sc.ing., Professor. She publicly presented her Doctoral Thesis in 1999 at Riga Technical University. She has worked as an Assistant Professor, Associate Professor since 2005, and as Professor since 2014 at the Institute of Industrial Electronics and Electrical Engineering. Author of more than 90 scientific publications and textbooks related to electrical drives and their control, power electronics, energy saving. Participated in and managed local and international research and training projects - TEMPUS, ERASMUS+, ERDF. In 2014/2015 she participated and coordinated the development of the new professional Bachelor study programme "Adaptronics", in 2019/2020 she coordinated the development and licensing of the new professional Master study programme "Adaptronics". In addition, she publicly presented her Master Thesis in English Philology in 1998. She participates in, as well as coordinates the work with foreign students.

Associate Professor **Gundars Ašmanis** has a Doctoral degree in electrical engineering. He has more than 12 years of experience working as a Radio Engineer, Quality System Manager, Leading Researcher and Technical Director at an internationally accredited electromagnetic compatibility testing laboratory of the Latvian Electronic Equipment Testing Center. He has more than 12 years of experience working at Riga Technical University as a Research Assistant, Lecturer, Associate Professor, Researcher. He spent six months at the European Space Agency (ESA ESTEC) in the Electromagnetic Compatibility Testing Division, developing and testing power filters for the Columbus International Space Station scientific module. Gundars Ašmanis' qualification is appropriate for the implementation of the study course.

Associate Professor Ingars Steiks holds a Doctoral degree in electrical engineering. He has accumulated scientific experience as a Research Assistant, Researcher, Senior Researcher, Assistant Professor and Associate Professor over the past 15 years. Knowledge is actively developed both in international research projects and in the academic staff strengthening programme in the field of electrical engineering. The thematic areas include both power converter development and industrial automation, i.e., hardware and software. The development of research skills is further enhanced by the regular supervision of graduation papers at all levels of study.

Associate Professor and Leading Researcher Jānis Zaķis has a PhD degree in electrical engineering. He has more than 15 years of experience in the field of higher education: participation in the study process, research and international project management. As the leading researcher and scientific project manager, he has participated in the elaboration of project applications, project management and implementation, the elaboration of scientific articles for conferences and journals. He regularly attends international conferences and seminars on relevant research topics, reviews scientific articles and projects, is a member of conference and scientific journal editorial board. J. Zaķis regularly develops his knowledge by attending teaching qualification courses, as well as various seminars organized at RTU. The knowledge and skills acquired in the field of research are integrated into the content of lectures, thus ensuring the topicality of study courses. The achievement of high-quality study results is ensured by both academic knowledge and scientific activities performed by J. Zaķis.

Professor Nadežda Kuņicina holds a Doctoral degree in electrical engineering and has been elected Professor of Electrical Engineering, Electronics, Information and Communication Technologies (Electrical Engineering and Automation). She holds the Expert status of the Latvian Council of Science in Social Sciences - Educational Sciences until 6 January 2024 and in Engineering and Technology - Electrical Engineering, Electronics, Information and Communication Technology until 3 September 2023. Professor Nadežda Kuņicina conducts research in the field of electrical engineering, mainly related to improving the efficiency of electricity use in industrial electronics and electric vehicles. Nadežda Kuņicina has participated in the development of study programmes, such as Erasmus plus KA 2 Applied Curricula in Space Exploration and Intelligent Robotics Systems - APPLE (2017-20); Electrical Energy Markets and Engineering Education - ELEMEND (2017-21); Innovative Approach towards a Master Program on Smart Cities Technologies - SMARTCITY

(2018-21); Development of Practically-Oriented Student-Centred Education in the Field of Modelling of Cyber-Physical Systems - CybPhys (2019-22), Knowledge Triangle for a Low Carbon Economy - KALCEA (2020-23). Within the projects, academic objects and methodological tools have been developed on the following topics: innovation in information and communication technologies; introduction to the specialisation in design of energy-efficient technologies; metrology and mathematical modelling; Internet of Things and smart electrical technologies; energy saving in electrical equipment; electrical processes and equipment in biotechnology; thermal energy, fundamentals of control theory; energy efficient technologies; fundamentals of industrial computer networks; automation theory; automation elements; non-traditional non-contact electromechanical converters; non-traditional energy converter systems and storage; methods of analysis and calculation of electronic circuits. Nadežda Kuņicina develops study materials within the following study courses: “Fundamentals of Industrial Computer Networks”, “Computerization of Mathematical Tasks in Electrical Engineering”, “Elements of Automation”, “Industrial Safety”, “Control Fundamentals of Critical Infrastructures”, “Design of Adaptive Systems”, “Linear and Non-linear Systems”.

Professor **Kārlis Ketners** studied at the Faculty of Electrical Engineering of Leningrad Electrical Engineering Institute from 1956 to 1962. He received a diploma of an electrician-engineer in the specialty of electrification of industrial enterprises and equipment. From 1962 to 1966, after graduating, he worked as a Design Engineer at Riga Semiconductor Factory. From 1966 to 1970, he received a Doctoral degree from Leningrad Electrical Engineering Institute. He bcame a Candidate of Technical Sciences with the Doctoral Thesis “Structural Modeling of Ship Power Systems for Calculations of Transition Processes with ECM (Electronic Computing Machine)” in 1970. In 1992, he obtained a Doctoral degree in electrical engineering in the process of nostrification of a scientific degree at RTU Habilitation Council H-0.5. Since 1970, he has been working at the Department of Electrical Machines and Apparatus. After the commencement of work at RPI - RTU, he published a scientific monograph “Algorithmization of Calculations of Transient Processes of Autonomous Electric Power Systems” – Riga: Zinatne, 1981, 166 p. (with co-authors V.M.Sendjurevs, I.A.Kozlova).

Associate Professor Viesturs Bražis holds a Doctoral degree in electrical engineering. He has 19 years of professional academic experience as a Research Assistant, Assistant Professor, Associate Professor and Senior Researcher. His research interests are in the field of energy storage system application. The research component of his work with students is ensured through participation in scientific conferences and publications. The practical and academic experience is fully relevant to the specific nature of the courses implemented.

Associate Professor, Leading Researcher Edmunds Kamoliņš holds a Doctoral Degree in Electrical Engineering, in the sub-field of Electrical Machinery and Equipment, as well as an engineering qualification in computer control, information and electronic systems for transport. He has more than 10 years of experience in study process management, research and management of various scientific projects. He participates in international conferences, seminars and professional advancement courses. The acquired skills and knowledge are incorporated into the study courses, encouraging students to actively engage in various research and exploration activities. In 2012, he qualified as an International Welding Engineer (IWE). Since 2007, he has been an expert in the energy-related sectors of the German TÜV Rheinland Industrie Service GmbH and has participated in technical inspections in various international projects related to the manufacture of various equipment for thermal power plants, water supply and treatment, oil refining, food production, amusement parks, etc.

Leading Researcher A.Suzdaļenko received his PhD in Electrical Engineering in 2013 and has been an expert of the Latvian Council of Sciences since 2014. He has work experience in industry and a wide range of interests including renewable energy, digital control of power electronic converters, embedded system design, industrial automation. A.Suzdaļenko actively participates in implementation of scientific research projects, preparation and publication of scientific papers, supervision of students' graduate papers, and participates in public events as a lecturer. Recently, he has been actively taking advantage of internship opportunities abroad and has participated in professional advancement courses within his post-doc project, which has resulted in the elaboration of several new study courses, thus preparing to take up the post of assistant professor.

Pēteris Apse-Apsītis hold a Doctoral degree in engineering. He has more than 50 years of industrial and scientific research experience in electrical engineering, electronics, ICT, automation, printing, papermaking, audio-visual arts and automotive technology in Latvia and abroad. In total, he has managed and implemented more than 300 projects, including international ones, for various equipment and systems. Author and co-author of several patents and dozens of scientific publications. He received the Annual Award 2018 named after Professor Alfreds Vitols from Latvenergo JSC and the Latvian Academy of Sciences. Expert of the Latvian Council of Science. Professor and Senior Researcher at the Institute of Industrial Electronics and Electrical Engineering, Riga Technical University.

Professor **Andrejs Podgornovs** has a Doctoral degree in electrical engineering, in the sub-field of electrical machinery and equipment. He has more than 15 years of experience in the field of higher education: provision and management of the study process, research, management of international and local contract work. He actively works with students of all study levels, under his leadership more than 25 qualification papers have been developed and publicly presented. He has been regularly nominated for the lecturer's award by RTU Student Parliament. He continues to improve his professional experience by participating in international projects and performing contract work for state institutions and commercial companies. Chairman and active participant of the Latvian Technical Standardization Committee "Electrical Energy" since its establishment in 2012.

Visiting Lecturer Dāvis Meike holds a Doctoral degree in engineering and is a Planning Engineer in the manufacturing industry. His Doctoral Thesis is on energy efficiency in industrial robotics. His research areas include highly automated manufacturing systems, power transmission in direct current (DC) grids and related technologies, consumption and flow optimisation, as well as general industrial automation. In these areas, D. Meike has coordinated both publicly co-funded international research projects and product development in the private sector. He is the author of more than 20 peer-reviewed scientific publications and patent articles.

Oļegs Sļiskis holds a Dr.sc.ing. degree from RTU. Professional experience by working in the industry for more than 15 years is closely related to the design, manufacture and operation of electrical equipment. Current main place of work is JSC "Rīgas elektromašīnbūves rūpnīca", position: chief engineer of the special design bureau, also acting as a project manager in the company. Thus, together with ABB Schweiz, the production and commissioning of intelligent traction electrical equipment for the JSC Russian Railways was successfully mastered. He has participated in several industrial research projects as a researcher and leading researcher. He has more than 10 years of teaching experience at RTU, first as a thesis supervisor and since March 2017 as a researcher in the Department of Electrical Machines and Apparatus. The knowledge and skills acquired in the industry are integrated into lectures and seminars with the aim of successfully achieving learning outcomes and motivating students to expand their knowledge in a professional environment.

Professor Mihails Gorobecs holds a Doctoral degree in electrical engineering and a Master degree in Information Technology. He has more than 15 years of academic and research experience. Since 2012, M. Gorobecs has been an expert of the Latvian Council of Science in the field of Electrical Engineering, Electronics, Information and Communication Technologies (i.e., in computer control of industrial processes, motion control and optimisation using artificial intelligence equipment and methods). His main research interests are embedded software engineering, computer control of transportation systems, embedded intelligent electrical devices, decision support methods in transportation systems, adaptive systems and methods, genetic and evolutionary algorithms, neural networks, fuzzy logic control methods, railway transport control, safety and optimisation methods, computer control of unmanned electric vehicles, mathematical and simulation modelling of systems. M. Gorobecs has more than 10 years of experience in managing various international and national projects in the field of electric and railway transport. He is the author of several textbooks, methodological tools, and patents.

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

In the period from 2014 to 2020, the number of research publications by the members of academic staff involved in the implementation of the study programme is 993, including articles in full-text conference proceedings, articles in scientific journals, and monographs.

Information on the number of publications in SCOPS and Web of Science data bases, as well as citation indexes, is given in Table 4. In the reporting period, there was a rapid growth in the number of publications, citation indexes have also increased significantly.

Tabe 4. Number of publications in SCOPS and Web of Science data bases

	SCOPUS	Cited (times)	WoS	Cited (times)
2014	54	223	21	76
2015	63	305	21	72
2016	65	1686	38	1270
2017	191	4012	139	3245
2018	173	3582	161	2396
2019	170	2074	152	1100
2020	122	403	108	240
Total	838	12285	640	8399

Full list of publications by academic staff is given in Annex 17.

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

All academic staff participate in or lead various types of international and local research projects, such as ERDF, FLPP and others. Academic staff also participate in international ERASMUS+ projects, developing new courses and textbooks. The results of the projects are regularly reported in conference and journal publications and used in their pedagogical work - lectures, seminars, other activities with students, as well as in academic tools and monographs. Many of the graduation papers are written in the framework of the projects and on the scientific activities and results of the projects. The list of projects carried out is available in Annex 13.

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

The academic staff involved in the study programme participate in academic and scientific conferences. They participate in various projects and elaborate scientific publications. Data on the involvement of academic staff in scientific research are reflected in the list of academic staff publications for the reporting period.

Prof. L. Ribickis was the Chair of the Organising Committee of the global conference EPE ECCE Riga 2018. He organised the five-day conference, which was attended by about 700 scientists.

Faculty of Electrical and Environmental Engineering hosts the annual RTUCON series of international scientific conferences, where scientists and students from different countries exchange research results in electrical engineering, generate prospective ideas and establish contacts for potential research. Typical conference participation is 100-200 participants from 20-50 countries. Currently (as of 2014) the conference is supported by the IEEE and IEEE IAS Societies. As of 2014, about 650 papers had been published in the IEEE Xplore database as well as in the SCPOUS and TR-WoS databases.

POWERENG2015 is another electrical technology conference which took place in the EVIF. The conference was supported by IEEE and IEEE-IES association. 113 articles of the conference are available in the data bases IEEE Xplore, SCPOUS and TR-WoS.

There is a direct and indirect impact of the RTUCON conference series on the Faculty of Electrical and Environmental Engineering on the study process. The direct impact is realised through a dedicated working session on "Education in Engineering", which provides an opportunity for academic staff from several universities and countries to exchange methodological experiences in the field of engineering education. It also reflects the trend towards using the latest scientific developments in the academic work environment. In addition, RTUCON conferences support (special sessions and prizes) students presenting their research results. Finally, some instructors involve students in the conference, for example, through elaboration of papers in which students are invited to analyse and evaluate the achievements of other scientists for extra credit points.

Since 2011, the International Doctoral School “Electrical Energy Conversion and Saving Technologies” has been organised every year, where PhD students report on the results of their research and exchange ideas. Foreign guest lecturers are always invited to this doctoral school to give lectures on modern innovative technologies and new inventions. In recent years, the following guest lecturers have been invited:

Assoc.prof. Yongheng Yang, Aalborg University, Department of Energy Technology, “Active Bypassing Techniques for Solar PV Modules

Assoc.prof., Huai Wang, Department of Energy Technology, Aalborg University “An Introduction to Reliability of Power Electronic Components and Systems

Dr.sc.ing. Dāvis Meike, Technical Planner, Daimler AG. “Industrial Internet of Energy Technologies”

Prof. Dr. Sergio Pires Pimentel, Federal University of Goias (Brazil), Tallinn University of Technology (Estonia), Model Predictive Control (MPC) Methods Applied to Power Electronics

Serhii Stepenko PhD, Tallinn University of Technology, Estonia, Pursuing High-Efficient PV Energy Solutions Based on Quasi-Z-Source Inverters: Benefits and Challenges

Dr. sc. Ing. Ivana Kovacevic-Badstuebner, ETH, Advanced Power Semiconductor Laboratory (APS), ETH Zurich. Electromagnetic Modeling Approaches Towards Virtual Prototyping of WBG Power Electronics

Prof. Shoji Nishikata, Tokyo Denki University, Japan. Development of interconnecting method for wind turbine generator system - parallel or series connection?

Harold Kirkham PNNL, IEEE “The Third Revolution in Measurement”

Prof. Rik De Doncker, RWTH, Aachen “Modern Propulsion Systems for Electric Vehicles”

Dr.sc.ing. Andrej Blinov, TTU, “Technologies and Trends in Energy Storage Systems”.

In 2021, the following guest lecturers were invited:

Prof. Rik W. De Doncker, RWTH Aachen University, Power Electronic Solutions to integrate Renewables and eMobility in Distribution Grids

Andrii Chub, PhD, *Tallinn University of Technology,* Topology Morphing Control for Galvanically Isolated DC-DC Converters

Professor Frede Blaabjerg, *Aalborg University* “Power Electronics – Quo Vadis”

The results of research and projects are integrated in the study courses and presented to students. For example, the results of the European international projects LITES, ERDF uMOL and ERDF SAVAS are used as lecture material, laboratory work and practical calculation tasks in the study courses "Energy Efficient Lighting", “Introduction to Specialisation”.

In addition, the AREUS Project Laboratory is used for this study course in addition to practical work in the course "Control and Regulation of Electrical Drives". Since 2016, Dr.sc.ing, Production Planning Engineer Dāvis Meike from Mercedes-Benz delivers the study course "Fundamentals of Industrial Robotics".

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the

study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

To ensure that the content of the study courses does not overlap, an annual review of the courses of the study programme takes place, as well as seminars in which the academic staff involved in the implementation of the programme present the course outline and academic methods to their colleagues and discuss improvements that would ensure a higher quality of the programme content and meet the current trends in the field.

Analysing the student-academic staff ratio within the study programme at the time of submission of the self-assessment report, the programme has one elected faculty member per 1.75 students and one specialist in the respective field per 7 students.

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	5.pielik_Studējošo skaits REDO (2).docx	5.pielik_Studējošo skaits REDO (2).docx
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	6.pielik_Atbilstība valsts standartam_dok.docx	6.pielik_Atbilstība valsts standartam_dok.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	8.pielik_REDO kartējums_eng.xlsx	8.pielik_REDO kartējums_LV.xlsx
Curriculum of the study programme (for each type and form of the implementation of the study programme)	9.pielik_REDO plānojums_ENG (1).xlsx	9.pielik_REDO plānojums_LV (1).xlsx
Descriptions of the study courses/ modules	REDO course ENG (2).zip	REDO kursu aprakstiLV.zip
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	REDO diploms ENG.zip	REDO Diploms LV.zip
Description of the Study Programme - Other mandatory attachments		
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	Par iespēju studējošiem turpināt studijas_DSP.edoc	Par iespēju studējošiem turpināt studijas_DSP.edoc
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	Apliecinajums - Par zaudējumu kompensaciju.edoc	Apliecinajums - Par zaudējumu kompensaciju.edoc
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.	Apliecinājums - Svešvalodu prasme.edoc	Apliecinājums - Svešvalodu prasme.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.	Apliecinājums - LZP eksperti doktora programma.edoc	Apliecinājums - LZP eksperti doktora programma.edoc
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education	Apliecinājums - AL 55. pants par prof. skaitu akadēmiskas programmas.edoc	Apliecinājums - AL 55. pants par prof. skaitu akadēmiskas programmas.edoc
Sample (or samples) of the study agreement	Sample_of_study_agreements.zip	Studiju līgumi.zip
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.	Nr_05_RTU_Dokt_250__stud_REDO ATZINUMS_tulkots.docx	Augstākās izglītības padomes atzinums.edoc

Adaptronics (42522)

Study field	*Power Industry, Electrical Engineering, and Electrical Technologies*
ProcedureStudyProgram.Name	*Adaptronics*
Education classification code	*42522*
Type of the study programme	*Professional bachelor study programme*
Name of the study programme director	*Leonīds*
Surname of the study programme director	*Ribickis*
E-mail of the study programme director	*Leonids.Ribickis@rtu.lv*
Title of the study programme director	*habilitētais doktors*
Phone of the study programme director	
Goal of the study programme	*The general aim of the professional Bachelor study programme is to provide professional training in the field of electrical engineering and electronics, as well as enable students to acquire the basic knowledge of electrical engineering, and to develop the necessary skills for the commencement of practical work. The programme aims at providing students with the opportunity to acquire theoretical and practical knowledge, develop professional, creative, and research skills in adaptronics, electrical engineering, electronics, mechatronics, adaptive materials, adaptronic elements and systems, their regulation and management, as well as facilitate the successful integration of students in the local and international labour market in a variety of industries and fields and prepares students for further studies at the professional Master level in the respective area.*
Tasks of the study programme	*Tasks of the study programme: - to provide knowledge of mathematics, physics, computing, biology, and materials science for solving practical tasks in electrical engineering - to teach to use computer technology skilfully and efficiently in order to solve tasks, design automatic control devices, and develop adaptive systems; - to solve practical tasks in the field of electrical engineering at the project-oriented level; - to apply knowledge of the adaptive properties of the animals and plants in the design of modern electrical technologies; - to develop an understanding of the construction and operation principles of electrical equipment and automatic control systems; - to develop skills in solving practical electrical engineering automation tasks associated with the project design; - to develop an understanding of the energy efficiency of adaptronic equipment; - to develop an understanding and knowledge of work organisation and social issues of work, as well as the principles of economic operation and innovation; - to strengthen the knowledge of foreign languages.*

Results of the study programme	*Upon completion of the study programme, the graduates are able: - to use theoretical knowledge of mathematics, physics, computing, biology, and materials science for solving practical tasks in the field of electrical engineering and electronics; - to use computer technology efficiently in order to solve tasks and design automatic control and adaptive systems; - to solve practical tasks of automatic control systems under the specific conditions at the project level; - to recognise the adaptive properties of animals and plants that can be applied in electrical technologies; - to demonstrate an understanding of design, operation principles, and automatic control of electrical and electronic equipment; - to solve the adaptation tasks of electrical and electronic equipment under certain conditions at the project level; - to demonstrate an understanding of the aspects of energy efficiency and energy storage; - to demonstrate an understanding of the principles of work organisation, social and economic activity; - to study professional literature and exchange professional experience in foreign languages. During the professional Bachelor studies, a student will acquire the necessary knowledge, skills, and competencies for comprehensive and effective activity in the fields of electrical engineering and adaptronics. Graduates of the study programme will obtain a Professional Bachelor Degree in Electrical Engineering with specialisation in Adaptronics, which will allow them to continue their studies at the professional Master study programme, as well as obtain the qualification of an engineer.*
Final examination upon the completion of the study programme	*The Qualification Paper - Bachelor Paper with a project part.*

Study programme forms

Full time studies - 4 years, 6 months - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*180*
Admission requirements (in English)	*General or vocational secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Adaptronics*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 4 years, 6 months - english

Study type and form	*Full time studies*

Duration in full years	*4*
Duration in month	*6*
Language	*english*
Amount (CP)	*180*
Admission requirements (in English)	*General or vocational secondary education The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Adaptronics*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 6 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*6*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*180*
Admission requirements (in English)	*General or vocational secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Adaptronics*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 6 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*6*
Duration in month	*0*
Language	*english*
Amount (CP)	*180*
Admission requirements (in English)	*General or vocational secondary education The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Adaptronics*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 6 years - latvian

Study type and form	*Part time studies*
Duration in full years	*6*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*180*
Admission requirements (in English)	*General or vocational secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Adaptronics*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 6 years - english

Study type and form	*Part time studies*
Duration in full years	*6*
Duration in month	*0*
Language	*english*
Amount (CP)	*180*
Admission requirements (in English)	*General or vocational secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Adaptronics*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

Modern technologies are complex systems that include elements of different areas: electrical engineering, electronics, mechatronics, adaptive materials, adaptive elements and systems, their regulation, and computer control. This, in turn, requires professionals employed who have knowledge not only of their main field of specialisation and adjacent industries, but also of sectors that seem far and unrelated to the main field, such as medicine or biology. At the same time, skills and competencies are needed to interact with each other. In this context, students – future specialists – need knowledge and skills in the interdisciplinary sectors, which are not particularly widely offered by today's highly specialised study programmes.

In addition to the above-mentioned factor, in 2014 the requirements for the certification of specialists in construction and power engineering were changed: the specialists under discussion were required to obtain an engineering diploma that could only be acquired by completing the professional study programme. In this context, in recent years, the number of students of the academic study programme “Computerised Control of Electrical Technologies” has declined sharply, while at the same time the number of students in the corresponding professional study programme has remained at the previous level and started to increase even in extramural studies. This development has led to the idea of transforming the former academic study programme “Computerised Control of Electrical Technology” into a professional one, making substantial changes to it. Therefore, in 2015 the professional Bachelor study programme “Adaptronics” in the study field of power engineering and environmental engineering sciences was developed and launched. It incorporates an in-depth study of natural sciences and bio-adaptive properties, as well as the students acquire the knowledge of information technologies that can be applied to the development of modern high-precision unique technologies. The Institute of Industrial Electronics and Electrical Engineering prepared and submitted to RTU Senate the major changes to the academic Bachelor study programme “Computerised Control of Electrical Technologies” EBO0 (Industrial Electronics and Electrical Engineering):

1. The name of the programme was changed to “Adaptronics”;
2. Level of study – Professional Bachelor studies;
3. The total number of credit points was increased to 180 CP;
4. The duration of the programme was increased to 4.5 years for full-time studies and 5.5 – for part-time studies;
5. Degree to be obtained – Professional Bachelor Degree in Electrical Engineering with specialisation:

(a) Industrial Adaptronics;

(b) Adaptronics in Healthcare and Medicine;

(c) Adaptronics in Information Systems;

6. Qualification to be obtained - qualification of Electrical Engineer according to the 5th level of the Latvian Professional Qualifications;
7. An updated list of study courses.

The study programme shall be carried out in the form of full-time and part-time extramural studies in Latvian, as well as in the form of full-time studies in English. In each of these forms of study, there is a different duration of the study period but the same number of credit points.

The amendments of the programme were approved by RTU Senate at its meeting on 25 May 2015 (Minutes No. 590).

Information on changes made to the programme since 2015 is available at the minutes of the meeting of the Study Field Commission "Power, Electrical Engineering and Electrical Technologies" (Minutes No. 2015/02 as of 15 May 2015, No. 2017/02 as of 31 January 2017 and No. 2017/03 as of 6 June 2017). The Institute of Industrial Electronics and Electrical Engineering made significant changes to the academic study programme "Computerised Control of Electrical Technologies" (EBO0). The following changes were made to the programme:

1. To change study programme code from EBO0 to ECA0;
2. To change the volume of obligatory (A) Part from85 CP to 100 CP, inc. the courses of general education (Part A.1.) – 31 CP, field-specific theoretical study courses and ICT study courses (Part A.2.) – 43 CP, field-specific study courses of professional specialisation (Part A.3.) – 26 CP.
3. To exclude form Part (A) the following study courses:
    - *Economics – 3 CP* (code IET105);
    - *Electric Supply – 2 CP* (code EEA416);
    - *Models of Social Development – 2 CP* (code HFL118).
4. To include in Part (A) the following study courses:
    1. To the courses of general education (A.1.):
        - *New Product Design and Development Methodology – 4 CP* (code IVZ746;
        - *Business and Investments – 2 CP* (code IBO319);
        - *Labour Protection and Occupational Safety – 2 CP* (code IDA401);
        - *Descriptive Geometry and Engineering Graphics – 2 CP* (code BKO107)
    2. field-specific study courses of professional specialisation (A.3):
        - *Basics of Electric Power Engineering - 2 CP* (code EES263);
        - *Digital Electronics (Study Project) – 2 CP* (code EEI344);
        - *Electrical Drives (Study Project) – 2 CP* (code EEI213);
        - *Programming Technologies (study project) – 3 CP* (code EEI345);
        - *Basic Signal Theory – 3 CP* (code EES225);
    3. To change the volume of compulsory elective courses (Part B) from 20 CP to 34 CP, the volume of compulsory elective courses of professional specialisation (Part B.1.) – from 13 CP to 26 CP, languages (B.3.) – from 3 CP to 4 CP.
    4. To exclude from the list of compulsory elective courses of professional specialisation (Part B.1.) the mentioned list of study courses.

To include in the list of compulsory elective courses of professional specialisation (Part B.1.) specialisations with the following lists of the study courses;

1. Specialisation: *Industrial Adaptronics* (the students have to select the courses from the list in the amount of 26 CP)
    - *Modern production technologies – 5 CP* (code EEI355);
    - *Computer Vision – 4 CP* (code DAA501)
    - *Application of Computers in Electrical Equipment Design – 2 CP* (code EEP342);

- *Artificial Intelligence – 4 CP* (code DSP422);
- *In Biological Systems Rooted Robots – 3 CP* (code MTM406);
- *Biological Signal Analysis – 5 CP* (code RRI598);
- *Adaptive Systems in Industrial Electronics – 3 CP* (code EEI354);
- *Physics of Smart Materials and Sensors – 5 CP* (code MFB626);
- *Nonlinear Dynamics and Chaos – 4 CP* (code MMP538).

2. Specialisation: *Adaptronics in health care and medicine* (the students have to select the courses from the list in the amount of 26 CP)
    - *Introduction to Medical Engineering – 2 CP* (code MEE711);
    - *Biological Signal Analysis – 5 CP* (code RRI598);
    - *Smart Nanostructured Materials – 3 CP* (code MFB700);
    - *Physiological Measurement Equipment – 2 CP* (code MEE308);
    - *Medical Instrumentation – 3 CP* (code MEE509);
    - *Computer Aided Control Systems in Medicine – 3 CP* (code DAI520);
    - *Artificial Intelligence – 3 CP* (code DSP422);
    - *Nanobiomimetics– 9 CP* (code MEE704);
    - *Basis of Biomaterial Technology – 3 CP* (code ĶST561);
    - *Biological Systems Rooted Robots – 3 CP* (code MTM406).
3. Specialisation: *Adaptronics in information systems* ((the students have to select the courses from the list in the amount of 26 CP)
    - *Elements of Automatics – 9 CP* (code EEP750);
    - *Energy Effective Technologies – 2 CP* (code EEI700);
    - *Fundamentals of Industrial Computer Networks – 2 CP* (code EEI411);
    - *Adaptive Systems in Industrial Electronics – 3 CP* (code EEI354);
    - *Computer Modelling of Intelligent Agents – 6 CP* (code EEI564);
    - *Optimization Algorithms – 2 CP* (code EDE307);
    - *Databases for Transportation Networks – 2 CP* (code EDE410);
    - *WEB site design for transportation systems – 2 CP* (code EDE222).
4. <u>To exclude</u> from the list of compulsory elective study courses a study course in the block of courses on humanities and social sciences (Part B.2) *Politology – 2 CP* (code HSP378).
5. <u>To include</u> compulsory elective study courses in the block of courses on humanities and social sciences (Part B.2):
    - *Organization of Production – 2 CP* (code IRO415);
    - *Political System of Latvia – 2 CP* (code HSP379);
    - *Economics – 2 CP* (code IET 103);
6. <u>To change</u> the volume of a compulsory elective study course in languages (Part B.3.) from 3 CP to 4 CP and to <u>include</u> the followings study courses therein:
    - *The English language – 2 CP* (code HVD101);
    - *The English language – 2 CP* (code HVD216);
    - *The German language – 2 CP* (code HVD108);
    - *The French language – 2 CP* (code HVD119).
7. <u>To change</u> the volume of free elective study courses (Part C) from 5 CP to 6 CP.
8. <u>To include</u> Internship (Part D) amounting to 20 CP.
9. <u>To change</u> the volume of state examination (Part E) from 10 CP to 20 CP and include in the list of final examinations:
    - *Bachelor Thesis Including Project – 12 CP* (code EEI012);
    - *Engineering Design Project – 8 CP* (code EEI005).

New study courses were developed for the needs of this study programme in February 2016:

Introductive Course in Speciality	4 CP
Fundamentals of Electrical Engineering Theory, Part 2 (Chain Theory)	5 CP
Electric Drive Systems Theory	5 CP
Distributed Logic and Artificial Neural Networks	2 CP
Autonomous Robotic System (course project)	2 CP
Embedded Systems (course project)	2 CP
Information and communication technologies	3 CP
Industrial Sensors and Actuators	4 CP
Elements of Adaptive Systems	4 CP
Biological Robots (course project)	2 CP
Industrial Internship	5 CP
Technological Internship	5 CP
Constructive Internship	5 CP
Pre Diploma Internship	5 CP
Internship	6CP
Bachelor Thesis	10 CP
Engineering Design Project	10 CP

In May 2021 the following changes were made to the study programme in accordance with the Decision of the study field “Power and Electrical Engineering, Electrical Technologies” committee (Minutes No 27000-8.1/1):

Changes in Part (A):

1. To change the volume of the study courses of general education (Part A.1.) from 34 CP to 15 CP, the volume of field-specific theoretical study courses and ICT study courses (Part A.2.) – from 34 CP to 49 CP, the volume of the study courses of professional specialisation (Part A.3.) – from 32 CP to 36 CP;
2. To exclude the following study courses:

Part A.1.:

- *Mechanics* – 2 CP (code MMP169);
- *New Product Design and Development Methodology – 4 CP (code IVZ746;*
- *Business and Investments – 2 CP (code IBO319);*

- *Labour Protection and Occupational Safety – 2 CP (code IDA401)*;

Part A.2.:

- *Electronic Equipment* – 4 CP (code EEP475);
- *Programming Technologies in Industrial Electronics* – 3 CP (code EEI481);
- Computer Studies (basic course) – 3 CP (code DIP101);

Part A.3.:

- *Electrical Machines* – 5 CP (code EEM305);
- *Basics of Electric Power Engineering* – 2 CP (code EES263);
- *Digital Electronics (Study Project)* – 2 CP (code EEI344);
- *Electrical Drives (Study Project)* – 2 CP (code EEI213);

3. To include the following study courses:

Part A.1.:

- *Environment and Climate Roadmap* - 1 CP (code VAS038);
- *Basics of Labour Protection* - 1 CP (code IDA700);
- *Innovative Product Development and Entrepreneurship* - 6 CP (code SDD700);

Part A.2.:

Robot Kinematics - 2 CP (code MTM208);

Part A.3.:

- *Design of Adaptive Systems* - 4 CP (code EEI705);
- *Adaptive Processing of the Signals* - 3 CP (code EEI500);
- *Control of Electrical Drives* - 7 CP (code EEI302);

4. To move the following study courses:

- *Mathematics* – 9 CP (code DMF101) from Part A.1. to Part A.2.;
- *Physics* – 6 CP (code MFA101) from part A.1. to Part A.2.;
- *General Chemistry* – 2 CP (code ĶVĶ109) from part A.1. to Part A.2.;
- *Basic Signal Theory* – 3 CP (code EES225) form Part A.3. to Part A.2.;
- *Industrial Sensors and Actuators* – 4 CP (code EEI718) form Part B.1. specialisation *Industrial Adaptronics* to Part A.3.;
- *Elements of Adaptive Systems* - 4 CP (EEI714) form Part B.1. for specialisations *Industrial Adaptronics* and *Adaptronics in Health Care and Medicine* to Part A.2.;

5. To replace the study course *Programming Technologies (study project)* - 3 CP (EEI345) with the course *Programming Technologies (study project)* - 2 CP (EEI348) in Part A.3.;
6. To replace the study course *Power Electronics* - 3 CP (EEP344) with the study course *Power Electronics* - 4 CP (EEI729) in Part A.3.;

2. Changes in Part (B):

- To change the title of professional specialisation from *Adaptronics in Information Systems* to *Adaptronics in Transport Information Systems*;
- To exclude the study courses in professional specialization *Industrial Adaptronics* (Part B.1.):
- *Analysis of Biological Signals* – 5 CP (RRI598);
- To include in the list of the study courses in professional specialization *Industrial Adaptronics*

(Part B.1.) the following study courses:

- *Basics of Embedded Systems* - 3 CP (code EEI725);
- *Intelligent Electronic Equipment in Robotic Systems* - 3 CP (code EEI358)

1. To exclude from professional specialization *Adaptronics in Health Care and Medicine* the following study courses:

- *Computer Aided Control Systems in Medicine* – 3 CP (code DAI520);
- *Artificial Intelligence* – 4 CP (code DSP422);
- *Nanobiomimetics*– 9 CP (code MEE704);
- *In Biological Systems Rooted Robots*– 3 CP (code MTM406);

2. To include in professional specialization *Adaptronics in Health Care and Medicine* the following study courses:

- *Application of Computers in Electrical Equipment Design* - 2 CP (code EEP342);
- *Basics of Embedded Systems* - 3 CP (code EEI725);

3. To exclude from professional specialization *Adaptronics in Transport Information Systems* the following study courses:

- *Elements of Automatics* – 9 CP (code EEP570);
- *Energy Effective Technologies* - 2 CP (code EEI700);
- *Fundamentals of Industrial Computer Networks* - 2 CP (code EEI411);
- *Adaptive Systems in Industrial Electronics*– 3 CP (code EEI354);

4. To include professional specialization *Adaptronics in Transport Information Systems* the following study courses:

- *Internet of Things for Smart Electrical Technologies* - 3 CP (code EEI362);
- *Web technology and web-programming in electrical transport*- 2 CP (code EEI298);
- *Autonomous Robotic System (course project)* - 2 CP (code EEI720);
- *Artificial neural networks technology basics in electrical transport* - 2 CP (code EEI388);
- *Artificial immune systems and algorithms basics in electrical transport* - 2 CP (code EEI487);
- *Embedded Systems of Electrical Transport (study project)* - 2 CP (code EEI489);

5. To move the study course *Computer Vision* – 4 CP (code DAA501) from Part B.1. of specialization *Industrial Adaptronics* to Part B.1. of specialisation *Adaptronics in Health Care and Medicine;*
6. To replace the study course *Embedded Systems (course project)* - 2 CP (EEI717) with *Embedded Systems (course project)* - 2 CP (EEI724) in Part B.1. in specialisations *Industrial Adaptronics* and *Adaptronics in Health Care and Medicine.*

The following changes are made related to the improvement of the study process and its quality, taking into account the recommendations of the industry companies and associations, as well as technological developments, in order to provide up-to-date and sector-specific training.

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

During the development process of the study programme, the dynamics of the number of students at the study programme "Adaptronics" at different levels was analysed and taken into account (Table 1).

Table 2 shows the dynamics in the number of foreign students. The number of students increases every year.

Table 1. Dynamics of the Number of Students at RTU Study Programme "Adapronics" Demonstrating the Number of Students Obtaining the Scholarship and Full-Time Students.

	1st year	2nd year	3rd year	4th year	5th year	**Total**
Academic year						
2015/2016	27					**27**
2016/2017	27	9				**36**
2017/2018	24	19	3			**46**
2018/2019	21	13	13	6		**53**
2019/2020	24	11	10	8	3	**56**
2020/2021	25	11	10	7	9	**62**

Table 2. Dynamics of the Number of Foreign Students at RTU Study Programme

	Full-time	Mobility	**Total**
Academic year			
	AEBO0 – academic study program Computerised Control of Electrical Technologies		
2013/2014	6	15	**21**
2014/2015	11	18	**29**
2015/2016	1	25	**26**

	AECA0 - professional study program Adaptronics		
2016/2017	3	19	**22**
2017/2018	2	10	**12**
2018/2019	5	11	**16**
2019/2020	12	15	**27**
2020/2021	13	6	**19**

The analysis of the change in the number of students over the time period from academic year 2015/2016 until academic year 2020/2021 leads to the conclusion that the number of students has increased from 30 students in academic year 2015/2016 to 78 students in academic year 2020/2021. This can be explained by the fact that the program is new, admission of students was started in 2015 in a new program, every next year students of earlier years added to the total number of students.

The analysis of the number of students as per type of funding reveals that the state budget funding in the study program are filled every year. This should be assessed as a positive factor, as it indicates the demand for the program on the labour market and the high appreciation among future students.

The biggest drop-out rate of students of the remote program refers to the first and second year, where failing grades have been the major cause thereof (see the Annex). The ones who chose to discontinue studying in the study program voluntarily refer to “started working” and the inability to combine the work and studies and not considerate choice of the profession as their reasons.

The professional Bachelor study program “Adaptronics” is implemented both in Latvian and English, the program in English is only provided as full time studies. The analysis of the number of students depending on the language of instruction leads to the conclusion that the number of foreign students has increased from 3 to 13 over the time period from academic year 2016.2017 to 2020/2021 and this is a very positive indicator attesting that there is demand for the program also abroad. The number of mobility students in this study program fluctuated from 19 to 15 until academic year 2019/2020 and decreased to 6 students only during the last year, which can be explained by the restricted possibility to travel to other countries last year.

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

The main aim of the study programme is to provide professional training for the Bachelor students in electrical engineering and electronics, as well as enable students to develop the basic knowledge of electrical engineering, and gain the necessary skills for the commencement of practical work. The programme provides students with the opportunity to acquire theoretical and professional knowledge, to develop professional, creative, and research skills for work in the field of adaptronics, which ensures efficient development of new technologies, as well as to develop skills in electrical engineering, electronics, mechatronics, adaptive materials, adaptronic elements and systems, their regulation and management, and the programme facilitates successful integration of students in the local and international labour market in a variety of industries and fields and prepares students for further studies at the professional Master programme.

The main tasks are to provide knowledge of mathematics, physics, computing, biology, and materials science to address practical tasks in electrical engineering; to teach students to apply computing skills efficiently and effectively both in addressing tasks and in creating automatic control and adaptive systems; to teach them to address practical tasks of adapting equipment and systems to specific conditions at the project level; to provide knowledge of the adaptive properties of the animals and plants in the design of modern electrical technologies; to give an idea of the design of electrical engineering equipment, operation principles and automatic control systems; to address automatic control and adaptation tasks of electrical and electronic equipment at a project level; to develop an understanding of the performance of adaptive equipment; to develop an understanding and knowledge of the work organisation and social issues, as well as the foundations for economic activity and innovation; to strengthen knowledge of foreign languages.

Students with general secondary education or 4-year vocational secondary education are enrolled in the professional Bachelor study programme. The admission of students takes place based on the results of centralised examinations (CE) in mathematics, the Latvian language, and foreign language; the priority is also given to students who have CE results in physics and chemistry.

Upon completion of their studies, students obtain a Bachelor degree in Adaptronics and a Qualification of Electrical Engineer. The acquisition of the study programme requires basic knowledge of interdisciplinary science on adaptive and electrical systems. The programme is related to the field of electrical engineering, but with an in-depth exploration of natural sciences and biologically adaptive properties, as well as the acquisition of information technologies that can be applied to the development of unique high-precision technologies.

Adaptive structures and equipment include interoperable propulsion systems, actuators, sensors, and they are based on multi-functional materials, all mutually controlled by smart electronic equipment. The design of such systems requires deep knowledge of mechanical structures, propulsion systems, microprocessor equipment, sensors, control algorithms, and high-precision hardware.

The duration of the full-time studies is 4.5 years, andpart-time studies (evening and extramural) - 6 years for foreign students. The programme allows for specialisation into three fields: Industrial Adaptronics, Adaptronics in Healthcare and Medicine, and Adaptronics in transport Information Systems, which are planned to be implemented through the specialisation courses, but until then, as the programme is relatively new, specialisation is carried out in Industrial Adaptronics and, partly, in Adaptronics in Healthcare and Medicine. During the studies, the internship in the volume of 20 CP is undertaken, as well as three study projects are developed within study courses of the programme, thus enabling students to acquire practical design skills.

There is a need for good knowledge of system structure and dynamics, as well as of modelling methods. The selection of the free elective study courses is recommended. Interdisciplinary understanding of objects at a high level is required. Extensive knowledge of electrical engineering is also required, as well as additional knowledge of biology and medical technologies. The extent of the knowledge and the skills acquired during the studies shall comply with the requirements of the professional standard of Electrical Engineer of the Republic of Latvia with specialisation in Adaptronics. At the end of the studies, the Bachelor Paper with a project part is developed and publicly presented. Consequently, the student is awarded both a Bachelor degree and a qualification of Electrical Engineer according to the 5th level of the Latvian Qualifications Framework (which corresponds to the 6th level of the European Qualifications Framework). After completing the study programme, graduates can continue their studies at professional Master programme.

The programme is unique because it is the only programme in the field of adaptronics in the Baltic States and one of the very few programmes in the field of adaptronics at European higher education institutions. Until now, programmes in the field of adaptronics have been implemented at only a few universities in Germany.

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master’s and doctoral study programmes, 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 professional Bachelor study programme consists of 180 credit points, including study courses (140 CP), internship (20 CP), and state examination (20 CP), part of which is the viva voce examination of the Bachelor Paper with the project part. The selection, volume, and content of the study courses of the Bachelor study programme, as well as the content and tasks of the internship have been developed according to the professional degree and qualification to be obtained following the requirements of the professional standard “Electrical Engineer”.

All changes to the programme were designed to strengthen the relevance of the content of study courses to the needs of the labour market and scientific trends, as well as the specialty of adaptronics. For example, in line with the trends of recent years, the programme includes courses offering in-depth knowledge of computer technology management and automatic control systems in such sectors as web technologies, implementation of embedded systems, automatic control features, robotic and adaptive systems. For this reason, the following study courses have been included in the programme in recent years: “Design of Adaptive Systems”, “Adaptive Processing of Signals”, “Adaptive Systems in Biology”, “Basics of Embedded Systems”, “Embedded Systems (Study Project)”, “Analysis of Biological Signals”, “Website Design for Transportation Systems”, “Web Technology and Web-programming in Electrical Transport”. The study course “Environment and Climate Roadmap” dealing with the issues of environmental protection has also been included.

During studies, each student has to develop and publicly present three study projects. In the process of the development of the study projects, students are introduced to different types of electrical technologies, their adaptive functions, the need to adapt to external conditions. The students conduct research on operational principles of electrical technologies, analyse computer technology approaches, perform technical and economic calculations.

In order to strengthen theoretical knowledge and gain practical experience in the sector, the internship in the volume of 20 CP is implemented. A tripartite agreement among a university, a student, and an employer is concluded. In accordance with the aims and tasks of the programme and the internship, its content will include the student’s familiarization with the management structure and operational principles of the company, the specific nature of the sector, and the technologies applied. The representatives of the company with whom the internship agreement is concluded shall participate in defining the tasks of internship and its evaluation. The aim of the internship is achieved by the student on the basis of the acquired knowledge, skills, competences. Partial internship can be carried out at the Institute's laboratories and during the implementation of scientific projects, where students develop sophisticated practical skills and familiarise themselves with innovative ideas. If the company assesses the student’s performance positively, the student can become a company’s employee after the internship.

The structure of the programme and all formal conditions shall comply with the requirements laid down by the national law and the decisions of RTU Senate. As a result of professional studies, students acquire knowledge and professional competence that comply with the requirements of a professional Bachelor degree and allow them to start a professional activity appropriate to the speciality. The structure of the study programme is shown in Annex 11.

In order to align the content of the programme to the needs of the labour market, representatives of the industry shall participate in the State Examination Commission. The representatives of the industry formulate their proposals on the desired themes of students’ research that are topical in the labour market. In cooperation with employers' representatives, students shall develop study projects and graduation papers. Employers positively assess the research activities performed by the students within graduation papers, as well as the tasks fulfilled during the internship. As a result, the students are invited to participate in projects organised by employers.

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

The study programme “Adaptronics” defines nine learning outcomes to be achieved corresponding to the results of the professional standard “Electrical Engineer”.

The graduates are able:

- to use theoretical knowledge of mathematics, physics, computing, biology, and materials science for solving practical tasks in the field of electrical engineering and electronics;
- to use computer technology efficiently in order to solve tasks and design automatic control and adaptive systems;
- to solve practical tasks of automatic control systems under the specific conditions at the

project level;

- to recognise the adaptive properties of animals and plants that can be applied in electrical technologies;
- to demonstrate an understanding of design, operation principles, and automatic control of electrical and electronic equipment;
- to solve the adaptation tasks of electrical and electronic equipment under certain conditions at the project level;
- to demonstrate an understanding of the aspects of energy efficiency and energy storage;
- to demonstrate an understanding of the principles of work organisation, social and economic activity;
- to study professional literature and exchange professional experience in foreign languages.

The aims set out in the study courses are closely linked to the learning outcomes to be achieved by the joint programme. The content of the courses is fully in line with the learning outcomes (see Annex 8). There is regular monitoring and development of the content of study courses, which helps control the content of study courses, training methods and update the learning outcomes to be achieved.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

A variety of study methods and forms will be used during the education process, the choice of which is related to the specific nature of each study course. General subjects and theoretical aspects will be offered in the form of lectures, where the materials used will be made available to students electronically, including the e-learning environment. Practical work will also be organised in the form of traditional laboratory classes in special facilities, as well as in the form of practical tasks where students will be able to combine acquired knowledge from several courses, thereby promoting both interdisciplinarity and obtaining the necessary feedback on other courses and the effectiveness of their teaching methodologies. The resources available to students are replenished and improved regularly; several books and methodological aids are developed for publication, the existing training laboratories are also upgraded and improved. Some of the study courses implemented are gradually being digitised.

The training process (lectures, practical and laboratory classes) will be based on new technologies such as modelling computer programs, computer projectors, micro-control kits, unified digital and analogue control plates, and other types of technology. The resources available to students were added and improved, several books and methodological aids were developed for publication, and existing training laboratories were upgraded and improved. Some technological equipment and computer programs were self-created, and some of them were purchased. The study programme will be implemented through project tasks, their public presentation and assessment. Students will be involved in various research projects.

The study program is implemented as full time studies and remote studies in Latvian and English, by following the requirements defined by laws and regulations, the core principles of organisation of studies set by RTU and by complying with all the study course requirements. Course description of the study program defines the set of compliant knowledge, skills and competences and their evaluation system, defines the study outcomes for attaining which credits are granted, which do not depend on the form of the program implementation: full time studies in person, half-time studies in person or remote studies. The procedure of evaluation of students' knowledge, skills and competences is defined by Senate of RTU decision of 27 May 2017 "Regulation on the Assessment of Learning Outcomes", which conforms to the core principles and procedure of assessment of education on the relevant study level defined by the Cabinet Regulations. The cumulative assessment system is applied in assessing students' achievement where the final grade consists of several components.

Full time studies consist of 40 CP per academic year and 40 academic hours of the student's work per week accounting for 1 CP. In order to satisfy the requirements defined in the program and every course, in comparison to full time studies, a longer time for completing the program and a lower number of credit points is set for half-time studies, in particular, less than 40 CP per academic year and less than 40 academic hours per week. Thus, as the study program is implemented in different types and forms of studies, only the number of in person (or contact) and independent work hours and the study methodology or instruction approach of courses differs. The teaching methods for implementation of study courses, as well as the assessment methods are selected by the academic staff responsible for the study course in compliance with the specifics of the content of the study course and the study program, as well as students' needs. As full time students have less practical experience in the field of study, the applied methods include study trips to the industry companies, visiting lectures by the industry professionals, etc. As regards half-time students, who have practical experience in most cases, the employed teaching methods consist more of lectures, practical assignments, group works, home assignments and research involving cases studies and their explanation from both the theoretical and practical perspective. Within the half-time in person and half-time remote study process the focus is on the independent work of students by using both the problem-based learning and case studies, as well as the professor's advisory role.

As stated above, in addition to theory classes in classrooms, students also participate in study trips to the biggest companies and organisations of the industry, for example, within the scope of the study course "Introduction to the speciality" the first year students visit Latvenergo AS, Sadales tīkli, Rīgas mašīnbūves rūpnīca, Getliņi and other companies. Organisation of study trips and study visits ensures the link between the content of the study program and the industry specifics, in addition to the knowledge of the theory students can relate it to daily situations in companies on the matters of both automation processes, energy saving and efficiency improvement, to analyse issues and to substantiate their view.

The student-focused education principles are considered during the whole implementation of the study process:

1. Involvement of students in the study process and content improvement. RTU has developed procedures providing for the student feedback on the quality of the study process (surveys, regular meetings of students with the program director and leading teaching staff, etc.). Thus, students have an opportunity to affect the study process. Students in the program are regularly involved in the program quality assessment, participate in the work of decision making bodies and advisory bodies.

2. Study outcomes. The assessment of the study courses of the program and the number of credits is related to study outcomes. The study outcomes of each study course are notified to students. Professors relate the course outcomes to the study program outcomes, as well as substantiate the

necessity of acquisition of the information of the relevant course for mastering the profession of an electrical engineer.

3. Mobility. Within the study program “Adaptronics” mobility resources are used to improve the teaching process of the university, as the student-focused education is based on a powerful teaching process. Teaching staff of foreign universities is involved in the program implementation, thus benefiting not only students, but also the teaching staff involved in the program implementation by taking over the best practice.

4. Social dimension. When students study within this program, their study process is sufficiently flexible, providing an opportunity for students to combine studies with work starting from the second or third study year. Students of the day department also have an opportunity to change the form of studies to remote studies in order to combine studies and work. The fact that the premises of the RTU library are available to students round the clock and also on weekends should be mentioned as another advantage.

5. Teaching methods. Various teaching methods are applied in the program implementation process. For example, study projects are developed, there are group works, the peer-to-peer method is applied in some study courses. Students can receive individual consultations from the academic staff in personal meetings or by communicating in the e-environment.

6. Study environment. During the program implementation there is cooperation between librarians and the academic staff aimed to improve the teaching and learning process. Both students and the teaching staff involved in the program have access to premises with relevant equipment appropriate for research and the learning process.

7. Development of the academic staff competences. The academic staff involved in the program have regular opportunities for improvement of their methodological and teaching skills. The process of development of the academic staff competences includes also discussions on application of the teaching and learning methods, including innovative teaching methods. For instance, within the scope of ERASMUS+ and NordPlus projects workshops on innovative teaching methods were organised with participation of colleagues from Latvia, Lithuania, Estonia and Finland.

8. Extracurricular activities of students. The program management supports the work of the students’ self-government, thus allowing students improving their independence, providing opportunities for implementation of ideas, as well as to study additionally outside the scope of lectures. For example, students have an opportunity to implement their ideas in the laboratory of Latvenergo AS at the time most convenient for students. Everybody studying in the program is offered an opportunity to participate in extracurricular activities (sports teams, dance groups, choirs, debate associations, etc.). All the above attests that there is active study life and extracurricular possibilities for students.

Students studying in the study program are also involved in research work and studies on topics important for the field by participating in domestic and international conferences.

Descriptions of study courses will be available at RTU website, in the Study Programme Register (https://stud.rtu.lv/rtu/vaaApp/sprpub). Their description is based on the principles of Bloom's taxonomy, namely, including not only an annotation and a short description of the study course, but also providing information on the aims and tasks of the study course expressed in competencies and skills, defining the learning outcomes to be achieved and their assessment, as well as prerequisites for acquiring the study course.

The assessment of student knowledge is based on the Cabinet Regulation (Regulations No. 512 of 26 August 2014, Sections 45-54) and the corresponding decisions of RTU Senate.

The learning outcomes are assessed on the basis of two criteria: the qualitative criterion (**a 10-point grading scale**) and the quantitative criterion (**credit points** for obtaining a positive assessment on learning the content of the course).

The evaluation will take into consideration the following basic principles for the assessment of education:

- the principle of summing up positive achievements – the positive achievements within each course and overall within the programme are summed up;
- the principle of mandatory examination – it is mandatory to verify the knowledge at the end of each course;
- the principle of openness and clarity of evaluation criteria – test requirements are available to all members of the administration or academic staff of the programme and are stated at the beginning of the acquisition of each course; they are available electronically in the e-learning environment;
- principle of the various assessment forms – quizzes, case studies, independent work, seminars, credit tests, examinations (oral, written, practical), practical work, qualification/graduation paper to be publicly presented, etc.;
- the principle of accessibility of the test – the content and extent of the examinations correspond to the content specified in the study courses as well as meet the requirements for skills and knowledge stipulated in the professional standard. All conditions for passing credit tests are described in the respective study course.

The general evaluation form for completion of the study programme is an **examination** and a **credit test** that must be passed at the end of each study course.

The **internship** is also evaluated according to a 10-point grading scale. The internship is assessed by the internship supervisor and the internship committee, which evaluates public presentation of internship reports and the company's feedback. The internship committee shall be established by an order of the head of the responsible department.

In addition, academic staff will pay attention and evaluate the ability of students to work with the study and scientific literature, write papers, systemise materials, analyse, and draw conclusions. Attention is devoted to students' reading skills in foreign languages, setting out basic ideas of non-adapted texts, argumentation and reasoning skills, technical means of learning, conducting research at its basic level. The acquisition of these skills is encouraged by the use of the interactive learning environment in the learning process.

The acquisition of the programme shall be completed by a **state examination**, which is evaluated on the basis of a 10-point grading scale, the part of which is the viva voce examination of qualification/Bachelor Paper. The evaluation criteria of the qualification/Bachelor Paper are as follows:

- systematization of theoretical and practical knowledge, ability to update, and extend experience acquired in theoretical, individual, and training practices;
- the ability to read scientific literature, legislative and regulatory enactments corresponding to the selected speciality and other information sources, including in foreign languages;
- the ability and skills to address research challenges, including individual elements of innovation related to theoretical guidelines;
- the ability to perform problem analysis, systematisation;
- the ability to present the research findings and practical results.

Professional Bachelor Degree in Adaptronics shall be granted after the acquisition of theoretical study courses, the fulfilment of internship tasks, and the public presentation of qualification/Bachelor Paper in front of the State Examination Commission.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

The main tasks of the internship are fully in line with the objectives and learning outcomes of the study programme, as they are directly determined to apply and enhance knowledge, skills, and competencies acquired during studies:

- to use knowledge and skills acquired within the framework of the professional Bachelor study programme “Adaptronics”,
- to introduce students to the activities of modern businesses; to introduce instructors - to the needs of businesses,
- to involve partners in the study process by organising internship outside the higher education establishment,
- to ensure cooperation with the leading companies in the industry.

As a result of Bachelor studies, the following knowledge is acquired, which must be applied during internship at companies operating in the field of electrical engineering and can be regarded as the main tasks of internship:

- the ability to apply theoretical knowledge to address scientific challenges;
- the ability to design and create new computer management systems for electrical equipment in all sectors of the economy;
- the ability to design and develop electronic equipment, semiconductor energy converters, and propulsion systems;
- the ability to use computers, to develop programs for automation of technological processes;
- the ability to rationally use and save electric energy;
- the ability to use information technologies – personal computers, the Internet, computing devices;
- the ability to search, analyse and process data.

Special internship tasks shall be set on a case-by-case basis for each student, according to the specialisation of internship company.

In 2019, according to the Senate decision, the internship organisation procedure at RTU was reviewed. As indicated in the internship organisation procedure, an internship coordinator at the department assists students in finding the company. If additional assistance is needed, it is possible to resort to the Career Support and Services Department, where a career adviser and a project manager help students find internship site, as well as through a variety of measures, to develop career management skills that can provide successful results during the internship process. Once a year, the Career Support and Services Department organises RTU Career Day, which also allows students to meet with business representatives and communicate on future opportunities. Detailed information on RTU Career Day is available at https://www.rtu.lv/en/studentservice/career-centre/career-day.

An additional resource developed in 2015 is a home page where companies are invited to place job openings that are up to date for RTU students (https://ekarjera.rtu.lv/, in Latvian). Students have the opportunity to log in with the University username and keep abreast of current internships and job opportunities in their field.

RTU Development Fund provides additional support for practical skill promotion (https://www.rtu.lv/en/developmentfund). Hundreds of practical skill competitions are offered during the year, which are organised in cooperation with companies.

In addition, students can obtain information on internship places on the institute's website (www.ieei.rtu.lv), which includes a dedicated section with all the information on internship (http://ieei.rtu.lv/prakse.html).

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

The themes of the graduation papers are chosen according to the newest trends of the sector, as well as the latest and most important developments in the market. Themes are often selected in cooperation with industry partners and developed under their leadership.

A majority of the best graduation papers of the students of the programme are developed in cooperation with the industry companies and organisations where the students worked. The best graduation papers, which were evaluated with a grade of 8, 9 and 10, were developed on the following themes:

Academic year 2018/2019

Research and Development of a Mobile Personality Test Device, J. Graudone, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Academic year 2019/2020

The Project for the Redevelopment of Dombrovskis and Skuju Street Traffic Lights and Optimization Solution System Research, K. Pogulis, scientific adviser: M.sc., researcher A. Avotiņš;

Development of an Automated Battery Resistance Measuring Bench, R. Zemnieks, scientific adviser: M.sc., researcher K. Vītols;

Research and Development of an Automated Greenhouse Watering Plant, G. Tolstikovs, scientific adviser: Dr.sc.ing., assist. prof. A. Potapovs

Development of Air-Drying Demonstration Equipment for FESTO Laboratory, J. Moisejevs, scientific adviser: M.sc., assist. prof., A.Pumpurs;

Development of an Unmanned Aerial Vehicle for Indoor Filming, A. Nīmands, scientific adviser: Mr.sc., lecturer A. Šenfelds;

Electricity-Powered Bicycle Drive Research and Testing Bench, A. Būmanis, scientific adviser: M.sc., researcher A.Avotiņš.

The graduation papers are evaluated on the basis of a 10-point grading scale, the part of which is the viva voce examination of qualification/Bachelor Paper. The evaluation criteria of the qualification/Bachelor Paper are as follows:

- systematization of theoretical and practical knowledge, ability to update, and extend experience acquired in theoretical, individual, and training practices;
- the ability to read scientific literature, legislative and regulatory enactments corresponding to the selected speciality and other information sources, including in foreign languages;
- the ability and skills to address research challenges, including individual elements of innovation related to theoretical guidelines;
- the ability to perform problem analysis, systematisation;
- the ability to present the research findings and practical results.

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

RTU Office of Vice-Rector for Academic Affairs regularly conducts student surveys on the ORTUS portal (during autumn and spring semester). The results of these surveys are available to the head of the study programme, as well as to the instructor of each study course. The head of the study programme and the instructor of the study course evaluate the results and make the necessary improvements. It can be concluded from the surveys carried out that students positively evaluate the study process and teaching methods used.

The survey results are available at the ORTUS platform.

The results of the students’ surveys prove a high quality of the study process as well as provide an opportunity to improve permanently both the teaching methods and the content of the study courses. The results of the surveys are taken into account in the process of teaching staff promotion for vacancies.

The surveys of employers’ as well as the evaluation of the trainees at the internship show that the students are prepared very well for practical work at the industrial companies and highly evaluate the students' theoretical knowledge and practical skills.

Graduates in the answers for their surveys state that during the study process, the future professionals acquire good theoretical knowledge and high qualification skills for further successful engaging into the work at industrial enterprises, as well as they also get a solid foundation for further professional development and lifelong learning.

Student participation in the improvement of the study process is already being implemented and will take place in several ways. First of all, students will be regularly surveyed in ORTUS e-learning environment where, according to the results of the survey, the head of the study programme can assess the results and make the necessary improvements. Secondly, one of the themes for the Bachelor Paper may be the upgrading of a new or existing laboratory workspace, particularly when it relates to the needs of businesses and new technologies, as well as the development of methodological material for teaching (more representative for the Master level), or, for example, the addition of material with new computer models, electrical circuits, their descriptions, etc. Thirdly, students, also through the Student Self-government of the Faculty, organise various activities, field trips to production companies, competitions in the field of civil engineering, exhibitions, discussion clubs.

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

Students regularly have traineeship at foreign technical universities — Olborg in Germany, Zurich in Switzerland, and others. Cooperation has been launched with several foreign universities, where, through the ERASMUS+ exchange programme, students of the study programme “Adaptronics” successfully start training and successfully develop Bachelor and Master Theses. Students of the programme also actively participate in student exchange programs. From Table 3, it appears that over the last three years 5 students participated in the exchange programme at different European universities.

Recognition of study courses covered during mobility takes place according to the “Amendments to the Organisation Procedure of Erasmus+ Student Mobility” (Resolution of RTU Vice-Rector for Academic Affairs No. 01000-1.1/240 as of 29 October 2014) and “Regulation on the Recognition of the Courses Completed at Other Universities and RTU Study Programmes” (Resolution of RTU Vice-Rector for Academic Affairs No 02000-1.1/29 as of 4 April 2016). The recognition of ERASMUS+ mobility is carried out by the head of the study programme on the basis of the Transcript of Records submitted by the student after the ERASMUS+ mobility and a pre-signed application for the recognition of study courses.

In order to make the recognition of courses more successful, the student carefully chooses the most appropriate partner school for the curriculum and the area before applying for ERASMUS+. The study courses, which are coordinated with the Erasmus+ coordinator in the form of an application, are approved by the head of the study programme.

During the recognition process, the evaluation of courses acquired during ERASMUS+ programme is not converted to a 10-point grading scale, but the successfully covered ones are marked as “recognised” instead of an assessment of courses of partner higher education institution, thereby recognising the credit points obtained. If the application for recognition of courses calls for amendments to the study programme and the student has been successful during ERASMUS+ programme, an order of RTU Vice-Rector for Academic Affairs is issued regarding individual amendments to the study programme which are then prepared. Once the order has been issued, the courses of the partner higher education institution are included in RTU Study Register and the student’s individual plan is amended to include the courses acquired abroad. Amendments to the study programme are made only at the expense of Part B, replacing RTU study courses with courses of partner higher education institution.

In the joint assessment, it can be concluded that students are highly interested in mobility opportunities and the level of students’ knowledge corresponds to the level of knowledge, skills, and competencies of other internationally recognised higher education courses.

Table 3. Erasmus mobility within the professional bachelor study programme Adaptronics RECA0

	Name, surname	Country	Erasmus University	Period
1.	Marģers Liepiņš	Austria	Upper Austria University of Applied Sciences	15.09.2020-14.02.2021

2.	Henrihs Tauriņš	Hungary	Obuda University / Óbudai Egyetem	02.09.2019-15.01.2020
3.	Regnārs Krastiņš	Spain	University of Alicante / Universidad de Alicante	05.09.2019-24.01.2020
4.	Edgars Kalsnavs	Belgium	KU Leuven / KU Leuven	16.09.2019-02.02.2020
5.	Ralfs Krauze	Czechia	University of Pardubice	15.09.2018-30.01.2019

In total, 83 incoming students have participated in a mobility programme since 2013/2014 academic year, including 42 from the previous academic programme. The students came from the universities of France, Lithuania, the Czech Republic, Italy, Germany, Kazakhstan, Mexico, Finland, Turkey, and other countries. Information on inbound mobility is provided in Annex 14.

Within the scope of the professional Bachelor program “Adaptronics” mobility was only started in 2018 because the program implementation started only in 2015.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

The state budget subsidy to the students of professional Bachelor study programme “Adaptronics” amounts to EUR 204,351.66, tuition fee paid by the foreign students - EUR 27,000.25 or EUR 4,405.04 per student.

Table 4. Funding of the professional Bachelor study programme “Adaptronics”

	State budget subsidy	Tuition fees of local students	Tuition fees of foreign students	Total funding of the study programme	Costs per 1 student, EUR
2019/2020	204 351,66		27 000,25	231 351,91	4 405,04

2018/2019	116 262,15	-	9 587,68	125 849,83	4 229,68
2017/2018	86 225,59	-	9 174,18	95 399,77	4 040,66
REBO programme (academic bachelor study program Computerised Control of Electrical Technologies realised before)					
2016/2017	9 674,32	-	16 569,37	26 243,69	3 866,02
2015/2016	21 173,84	-	3 179,64	24 353,48	3 866,02
2014/2015	77 087,24	-		77 087,24	3 866,02
2013/2014	69 854,00	676,00		70 530,00	3 866,00

In order to improve the material and technical facilities, additional funding from the various types of contract work and outsourcing is used. The value of the Programme is determined taking into account the situation on the labour market to keep the competitiveness. Furthermore the teaching staff is actively involved into the scientific res earch, thus obtaining a significant part of the salary for the projects realisation.

The implementation of the study programme “Adaptronics” involves academic staff from 24 departments of the Faculty of Electrical and Environmental Engineering, the Institute of Industrial Electronics and Electrical Engineering, the Department of Electrical Physics, Industrial Electronics and Electrical Engineering.

In addition to the academic staff of the Faculty of Electrical and Environmental Engineering, general staff are involved in the management of the study programme that undertake study support processes, such as the organisation of study process, the management of public and international relations, student records, technical support of study programmes, work related to the implementation of the study programme. Their duties also include the organisation of business correspondence, the circulation of information, including cooperation organisations in Latvia and abroad, the coordination of telephone calls, e-mails, and correspondence, planning the work schedule of the manager, administration of appointments. They may also carry out simple financial records, analysis, assessment, and control of documentation, as well as drawing up various types of activity related reports on behalf of the manager and solving problems or non-standard situations.

Successful cooperation has been developed with the staff of the relevant faculty of Tallinn University of Technology, which ensures the improvement of the professional skills of employees and the exchange of students and employees.

In Latvia, study programmes in Power, Electrical Engineering and Electronics are implemented at Latvia University of Life Sciences and Technologies and the Latvian Maritime Academy, and the academic staff of the Faculty of Electrical and Environmental Engineering and Power Institute are actively involved in these programmes, creating joint scientific projects. The joint projects are also implemented with the Institute of Solid-State Physics of the University of Latvia, the Institute of

Physical Energetics of the Latvian Academy of Sciences, RTU Faculty of Mechanical Engineering, Transport and Aeronautics, as well as Faculty of Computer Science and Information Technology.

Students regularly have in-service training at foreign technical universities – Alborg in Germany, Zurich in Switzerland, and others. Cooperation has been launched with a number of foreign universities, where students from the Erasmus + exchange programme successfully start training and successfully develop their Bachelor and Master Theses.

With ERDF funding to the field of Power, Electrical Engineering and Electronics, since 2014 the study process has been implemented in a new and modern building with an up-to-date building management system with embedded sensors, climate control systems, energy-efficient lighting, etc., which also serve as a means of research. In parallel, existing and new laboratories have been upgraded:

- Power Electronics Training Laboratory;
- Electrical Propulsion Training and Research Laboratory;
- Manufacturing Automation Training and Research Laboratory;
- Computer Management Training and Research Laboratory;
- Microelectronics and Sensor Training and Research Laboratory;
- Energy Efficiency Training and Research Laboratory;
- Electronic Equipment Training Laboratory;
- Electrical Engineering Fundamentals Laboratory;
- Electrical Engineering and Electronics Training Laboratory;
- Research Laboratory of Semiconductor Converters;
- Industrial DC System Laboratory (AREUS Demo Lab);
- Student Creative Laboratory.

These laboratories have a brand-new infrastructure – furniture, network voltage links, blackboards, projectors, etc. In addition, the following training facilities have also been purchased: oscilloscope (RigolDS1052D, total number: 10 pcs), oscilloscope (Rigol DS4012, total number: 2 pcs), power measurement keys (Rigol RP1001C, 7 pcs), differential keys (RigolRP1025D, total number: 2 pcs), multimeters (u1233a, total number: 16 pcs), solar meter (solar-100), power parameter analysers (CIR-E3, number: 14 pcs), power units (EX752M - PSU, total number: 8 pcs), power units (QL355TP - PSU, PROG, TIPLE, 35V, 5A, 5V, 5V, 1A), total number: 2 pcs, power units (TTI - CPX400s - PSU, total number: 2 pcs), two power units (EA-PS 2042-20b - PSU), transformer (VELLEMAN sr-1000), accumulator-screwdriver/drill-machine (Festool), portable optical meter (Konica MINOLTA LS110)). New test benches have also been created for students' practical work: microelectronics, electron devices, propulsion system “lift drive” bench.

Within the FP7 project framework AREUS, a unique laboratory has been set up: a 600 V DC power supply network consisting of an industrial 21 kW robot KUKA Quantec Prime, a 55 kW active rectifier, two power benches capable of emulating electricity consumption of any robot, super condenser, and lithium-ion energy storage systems and other equipment. The Faculty of Electrical and Environmental Engineering has a compact solar storage system at its disposal; the storage system is with lithium-ion batteries and a charge-level control system; local, interlinked autonomous power supply systems with 3.6 kW wind generators and 6.6 kW solar panels; inverter electricity for grid transfer or lithium-ion storage systems for energy storage. In parallel, special programmable DC power units have also been purchased, which are capable of simulating solar panels or hydrogen systems with a power of 2 · 15 kW, 2 · 5 kW, 2 · 3 kW, fuel cell research set Ballard Nexa with a power of 2 1.2 kW and 8 kW.

For industrial process studies, the FESTO mini plant MPS and FMS complex, the compact water-level control work station FESTO Compact-Workstation, EMCO Concept Turn 105/EMCO Concept Mill 105 equipment kit are available.

Digital oscilloscope YOKOGAWA DLM6054-F-HE-L16/P4, oscilloscope (Rigol DS1052D – 10 pcs; Rigol DS4012 – 2 pcs), digital oscilloscope TEXTRONIX, Fluke, Rigol, etc. are available for signal measurement. In 2017, a fine BNC-type oscilloscope power key Ultra mini CWT015 was purchased to measure the current running through the legs of a transistor.

For the measurement of lighting parameters, the Avantes spectrometer, the solar meter (SOLAR-100), the portable optical meter (Konica Minolta LS-110), the infrared temperature meter Raynger ST60 ProPlus are available.

Training of robotic systems also uses the industrywide KUKA Agilus with KRC4 controller, virtual programming software KUKA SIM, Mistubishi robot, Festo Robotino mobile platforms.

To determine energy performance parameters, electricity parameter analysers (CIR-E3 – 14 pcs), power analyser set N4L PPA5530-3 Phase (5 pcs), network analysers AR5 and AR5L, Fluke network analysers, etc. are used.

Variable AC and DC power sources, as well as other sources are used for the development of various converters, such as diesel generator SDMO DX 6000TE, solar panels, wind generator, hydrogen fuel cells, power units (EX752M – PSU, 8 pcs), direct voltage laboratory power unit (EA-PSI 9360-120 3U), direct voltage electronic load (EA-ELR 9150-30 3U) and electronic load for DC Electro Automatic ea-el3400-2, direct voltage laboratory supply unit (EA-PS 8032-10 T).

Electronic Technology Management System Development Platform dSPACE, Matlab/Simulink R14 modeling programme, simulation programme PSIM Profesional 8.0, Synopsys Analog Simulation and Modeling Synopsys Advanced TCAD individual license, license OrCAD PCB Design University Edition, software PSIM-JMAG, etc. are also available.

Prototyping equipment for PCB plates is used such as LPKF ProtoMat S64 PCB prototyping equipment, LPKF ContacRS PCB metalizing plant, HAWK 3D axis microscope, automatic multi-layer PCB press (4-8 slice plate development) LPKF multi-press; and electrical coil (throttle) rolling stand are available with Jovil Manufacturing SMC-2 equipment.

In 2017, owing to the financial support of Latvenergo JSC shareholder, equipment was supplemented in Latvenergo Student Creative lLboratory by purchasing a programmable 6 kW three-phase AC power unit, electro-automatic EA-ACP3P 520-16.8-6000-20U f 45-450.

In 2017, scientific research equipment was purchased, such as smart network, industrial robots, human and environment interaction research equipment consisting of a physical motion simulator system (based on an industrial robot boom with lifting capacity from 500 kg), a robot boom assembly (with integrated video projection equipment and controls), which is compatible with a system simulation and can use computer data exchange protocols (EtherCat, etc.), and a physical grid emulator with an integrated HIL system and electrical unit measuring equipment (system power 200 kW, at least 6 (with the possibility to expand to 12) free programmable channels for power flow management as a source in its load mode, with integrated software support for the simulation of power grids, drives, solar panels).

All the equipment and laboratories mentioned above have been successfully used in the study process, students' research, and in the development of graduation papers.

The infrastructure and technical support available for the implementation of the study programme, thanks to a high level of digitization, provide an opportunity to increase the competitiveness, quality, and efficiency of the University, as well as the availability of information, by integrating information technology (IT) solutions into the University's administrative, study and research work processes, providing students, administrative and academic staff with modern, reliable, secure and integrated IT infrastructure and high quality IT services.

To ensure easy and efficient identification of IT users, an IT user identity management system has been introduced; as a result, each IT user has a unique electronic identity that is valid in all information systems. In addition to the aforementioned, a user session management system is ensured in IT systems, which means that there is no need for IT users to re-authenticate when logging in to RTU information systems. It gives the experience of using a unified integrated information system without having to memorize different identification data and re-enter them, implementing different IT application scenarios.

All IT users are provided access to the centralised portal ORTUS (https://ortus.rtu.lv), which functions as a single digital gateway, combining information from all RTU information system components and providing users with an easy-to-use way of accessing the directory of all IT services in one place.

The Centralised Study Management System is used for efficient administration of the study process, which ensures digital provision of the study life cycle, incl. Electronic Register of Study Programmes (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub), drawing up learning agreements and enrolment of students in study programmes, Register of Study Courses (its public part is available at https://stud.rtu.lv/rtu/discpub/list?english=true), designing student's individual study plans, drawing up orders, implementing study courses and study process, registering grades, recognising study courses, awarding qualifications, administering payments, hostel information, gathering information to issue diploma supplements, etc. This system is one of the main cornerstones in the administration of RTU study process.

To ensure effective implementation of the study process, Moodle e-learning system is used, where all relevant information is compiled in an automated way (study courses, users, groups, access rights, etc.). This system ensures student-instructor communication. The academic staff members place various electronic materials, assessment tests, homework assignments, information on a particular study course, etc. in the system. Students can also view their financial information on the ORTUS portal, as well as make request for documents (references, transcripts of records, copies of a learning agreement, etc.). For distance learning, RTU academic staff has options to use *Zoom* or *Microsoft Teams* videoconferencing platforms.

Since 2007, more than 130,000 unique study course sites have been generated in the e-learning environment of RTU. Students can access electronic learning resources anytime and anywhere.

Digitisation of classrooms and schedules has been carried out to ensure efficient premise management and study planning (https://telpas.rtu.lv; https://nodarbibas.rtu.lv/). Each RTU student and academic staff member can access their schedule, which provides information on the venue, time, instructor, room, title and type of lecture. In addition, for user's convenience purposes, the system greatly facilitates lecture planning and scheduling, as well as optimises the use and efficiency of premises.

Electronic Staff Management and Record-keeping Systems, which cover the circulation of record-keeping and personnel documents at RTU (https://docs.rtu.lv/), are also used to ensure the efficient administrative work. Electronic document coordination and document e-signing functionality have been introduced, thus reducing print-based document circulation and significantly increasing document circulation speed. Since autumn semester of 2019, students have been provided with electronically signed learning agreements. Since 2016, RTU graduates have been receiving electronically signed transcripts of records.

In terms of quality assurance, a digital student survey system is used, with the help of which the quality control of study courses and study programmes is implemented each semester. Based on the results of quality control, regular measures are taken to improve study programmes and the study process, in general.

For additional convenience of RTU students, academic and general staff members, RTU leases Microsoft Windows and Microsoft Office software, which provides all IT users with access to the latest Microsoft software. RTU students can use the licensed Windows operating system and the Microsoft Office productivity suite provided by RTU for study needs. All IT users have access to Microsoft Office 365 cloud computing platform with one terabyte of storage space available to each user and access to a variety of additional collaboration and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic and general staff have access to the University's email system.

To support research activities, RTU has developed the Centralised Research Support System, which records all information on publications, patents, commercialisation applications, PhDTheses, RTU scientific journals, research staff, etc. The system provides access to information according to Open Access principle (https://science.rtu.lv). RTU students and academic staff also have centralised access to research software.

RTU has the high-speed fibre optic Internet and extensive wireless network infrastructure with over 400 access points, including the international *Eduroam* service. In addition, desk phones and mobile communications are provided for fast and easy communication.

To ensure a stable and secure operation of the information technology infrastructure, continuous monitoring of the IT infrastructure and systems is performed, resulting in proactive incident control. Data backup is also ensured.

The Information Systems Security Policy has been developed and implemented with the primary goal of ensuring the secure use of RTU information systems by establishing and maintaining a sufficient set of measures to reduce or prevent potential or resulting harm. Implementation of the Information Systems Security Policy envisages security checks, data transmission network monitoring, as well as preventive measures. Regular IT security and personal data protection training is organised for IT users. Automated security incident management and risk management have been implemented. Statistics demonstrate that the number of IT security incidents dropped significantly 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.

The University library plays a major role in providing methodological and information support to the students. The Scientific Library of RTU (https://www.rtu.lv/en/studies/scientific-library) is an academic library of state significance, which has obtained its status as a result of library accreditation. The Scientific Library of RTU provides the necessary information for RTU study process and research activities, performs library, bibliographic and information services for RTU students, teaching staff, and employees. The Library's collection includes 1.4 million printed documents and e-resources in the databases relevant to RTU fields.

In 2016, significant investment was made in the development of the library infrastructure, with the construction of an additional 2240 m2 of space for the Central Library. The total area of the library premises is 6393 m2, of which 3417 m2 are for reader services. There are 713 workstations for library users. The library has four group rooms and six individual cubicles, a Western reading room and a conference room. The library is accessible to users with reduced mobility.

To improve the work of the Scientific Library of RTU and to ensure the availability of information needed for study and research work, the Library Council has been established, which decides on the replenishment of the library's collection with printed publications and subscriptions to the necessary databases. The Library Council has approved the "*RTU SL Collection Completion Policy*", which defines the basic principles of collection formation and development in accordance with the fields of RTU study and scientific activities.

When RTU provides funding for the library, the funding for information resources for each study programme is calculated. The collection is replenished according to the recommendations of the heads of study programme, researchers, and the allocated funding. The desired titles can be ordered by contacting the Library's Collection Development Department, ordering on the Library's website, filling in the order form, filling in the application form, by phone 67089353 or by visiting the Library at Paula Valdena 5-105. The Scientific Library offers a guide to ordering titles and e-resources, which brings together the websites of various publishers and bookshops in Latvia and abroad.

Database subscription contracts are concluded both directly with the supplier and through the "Cultural Information Systems Centre" state agency, which is the Latvian national representative of the international non-profit organisation EIFL (Electronic Information for Libraries, http://www.eifl.net/). The EIFL Licensing Programme offers national libraries subscriptions to internationally recognised databases at significantly reduced subscription fees not offered to individual subscribers, thus saving financial resources of the libraries.

The database subscriptions maintained by RTU Scientific Library

(https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/abonetas-datubazes):

- ProQuest Ebook Central, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, EBSCOhost eBook Academic Collection, Wiley Online Library, SpringerLink, The International Monetary Fund.
- Databases financed by the Ministry of Education and Science available to RTU Scientific Library: ScienceDirect, SCOPUS (Elsevier), Web of Science.
- Latvian databases: LETA, Letonika, the Database of Latvian Standards (available on the premises of the Library).

Database usage at the Scientific Library of RTU has been growing since 2016. E-resource loans have increased from 75,391 to 525,194 items.

The new library premises have allowed to extend the range of services. Since the opening of the new premises in 2018, the number of visits to the library has increased from 103,825 to 235,600. The Scientific Library of RTU is open to everyone. The Central Library is open to users from Monday to Saturday. There is a 24/7 reading room. During the summer period, the Central Library is open every weekday with reduced opening hours. (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3).

The library sources are housed in an open-access collection. Books and periodicals according to the field of study and the UDC indexes are located in the central building of the Scientific Library, 5 Paula Valdena Street, Riga. The last copies of the oldest publications corresponding to the RTU profile are kept in the library repository. They are always available to the users.

The librarian on duty helps visitors find their way around the collection. Bibliographers (information specialists) provide more detailed information and advice. The library has a branch librarian service. (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija)

The library resource search is supported by the Primo Discovery search tool (https://www.rtu.lv/lv/studijas/biblioteka/vienota-informacijas-meklesana). It allows searching the library catalogue (https://kopkatalogs.lv/F/?func=find-b-0&local_base=rtu01), the subscribed databases, as well as databases created by the RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes) in one interface. Searching for information in the electronic joint catalogue (https://kopkatalogs.lv/F), it is possible to simultaneously obtain information on the resources available in 12 Latvian libraries. Both the electronic catalogue and the RTU portal ORTUS allow remote reservation of library resources, as well as remote access to the databases. Since the introduction of RFID technology, users can use five self-service book-dispensing machines and check out books from the pick-up machines around the clock.

The library provides students, academic personnel and other stakeholders with various levels of individual consultations and group training in information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas).

Publications not available in the library are delivered via an interlibrary loan or an international loan. Internet access is available throughout the library. The library has copying, scanning, printing, binding services and a self-service dining room.

During the reporting period 118 textbooks and 15 electronic books totally amounting to 133 study materials were purchased for the program acquisition.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

The programme is implemented by both academic staff and industry experts. The results of the student survey led to a high evaluation of the academic staff. Table 5 below shows the changes in the number of faculty members involved in the implementation of the study programme by position. It can be seen that the number of professors, associate professors and assistant professors is 33, specialists in the field are also involved in the study process.

The academic staff conforms to the requirements of implementation of the study subjects. This is confirmed by both the description indices and CV’s, the scientific and methodological developments by the teaching staff, their participation in international scientific and methodological conferences organised by Latvia and RTU. Generally, the data confirm the qualification of the teaching staff and that this qualification can provide the quality of study subjects. The number of teaching staff holding the Ph.D degree has increased during the reporting period. In parallel, some professors work in industrial companies, therefore the practical work skills and competences are transferred to the study program.

Table 5. Changes in the academic personnel in 2013 - 2020

	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020
Professors	7	9	8	8	8	9	13
Acting Professor	1	1	2	2			
Associate professor	4	4	2	3	4	4	8
Acting associate professor	2	3	3	4	3	1	
Assistant professor	4	7	8	9	6	10	11
Assistant professor at the professional programme	2	2	1	1	1	1	1
Acting assistant professor						1	
Acting lecturer	1			3	5	2	2
Lecturer	2	2	2	2	4	6	7
Assistant						1	3
Acting assistant					2	1	1
Total	23	28	15	32	33	36	46

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The implementation of the study programme is ensured by the academic staff of the Institute of

Industrial Electronics and Electrical Engineering of RTU Faculty of Electrical and Environmental Engineering - professors and lecturers with PhDand Master degrees, each of whom are experts in their field.

Academic staff from partner universities abroad will be recruited as needed to implement the Study programme, as well as industry professionals will be invited to give more practical oriented lectures. Cooperation partners from Tallinn University of Technology, Aachen University, University of Duisburg-Essen will provide face-to-face and remote lectures and practical/laboratory sessions.

Latvian industry experts were also involved, such as Dr.sc.ing. Oļegs Tetervenoks (Ltd. Mikrotik, Ltd. Vizulo), Agris Želvis (Ltd ELKO), Dr.sc.ing. A. Suzdaļenko (Ltd. Citintelly) who gave guest lectures and practical engineering examples in the study course "Energy Efficient Lighting" for both local and foreign student groups, Alvis Kaļāns (Ltd. EK-Sistēmas) and Dzintars Mednis (Ltd. EMT) delivered lectures on electric drive and electric drive control and organised workshops using new energy-efficient technologies available on the market. This is also the case in other study courses, thus allowing students to familiarise themselves with the specifics of the companies and to choose their internships in good time. Guest lecturers have a degree in engineering and work experience at manufacturing companies.

According to the aims of the study programme, the primary criteria for the selection of academic staff are (a) knowledge of the latest technologies and participation in scientific and research projects in their fields, (b) pedagogical skills relevant to current trends in the field, and (c) experience in academic courses to foreign students in English.

In order to ensure the quality of the study content, the academic staff involved in the implementation of the programme regularly improve their professional and academic knowledge at methodological seminars, conferences (national and international), as well as in scientific and research work (see List of publications of academic staff for the reporting period), participate in various scientific and methodological projects.

The involved academic staff actively benefit from international cooperation mobility programmes. For example, from 2014 to 2019, Prof. Ribickis visited the following universities: in 2014 - Moscow State Technical University, Chennai University, Delhi University, Autonomous University of Barcelona, University of Catalonia, Technical University of Valencia, Bordeaux University, Paris Tech University, Compiègne University, University of Florence, Lausanne Polytechnic University; in 2015 - Lausanne Polytechnic University, University of Moratuwa (Sri Lanka), University of Colombo (Sri Lanka), University of Antwerp, Holon Institute of Technology, Technical University of Wroclaw; in 2016 - Czech University of Life Sciences, Prague, Lodz University of Technology, Royal Institute of Technology, Sweden, Blackburn University; in 2017 - University of Malaga, University of Granada, University of La Laguna, University of Bergen, University of Porto, University of Ottawa, Polytechnique Montréal, Leiden University, Aalborg University, Muhammed V University in Rabat, Budapest University of Technology and Economics; in 2018 - Kumamoto University, University of Tokyo, Tokyo Denki University, Waseda University, Tallinn University of Technology, Palackas University, University of Madeira, University of Las Palmas de Gran Canaria, Kyungook National University, National Taiwan University of Science and Technology, WuFeng University, University of Duisburg Essen, University of Bucharest, LaSapienza University, University of Turku, Swiss Federal Institute of Technology, University of Bucharest; in 2019 - University of Trieste, University of Padova, University of Bergamo, Polytechnic University of Turin, University of Oulu, Albert Einstein University (Mexico), Monterrey Institute of Technology and Higher Education (Mexico), University of Peru, University of San Ignacio de Loyola (Lima), Catholic Pontifical University of Peru, Catholic University of Santiago del Estero, Tsukuba University (Japan), Shizoko University (Japan), University of the Azores, Alto University, Université Libre de Bruxelles, Vilnius Gediminas University, Mykolas

Romeris University (Lithuania).

In 2013 and 2014, Professor Anastasija Žiravecka and Assistant Professor Svetlana Andrianova participated in the ERSAMUS+ staff mobility programme and visited the University of Ljubljana and Varna Technical University for an exchange of experience. In 2020, the head of the study programme Professor L. Ribickis, Professor A. Žiravecka, Researcher A. Avotiņš, with the PhDstudents involved in the academic process visited Aalborg University. Professor N. Kunicina visited Berlin University of Technology, Germany in 2014, Kaunas University of Technology, Lithuania in 2018. In 2019, Professor O. Krievs undertook internship at Ltd. EK Sistēmas within the ESF project SAM 8.2.2 – "Improvement of professional skills on the latest industrial automation technologies in academic year 2019/2020". In 2018, he visited the Robotics Laboratory of the University of Duisburg-Essen and attended lectures (16 hours) on the use of industrial manipulator motion control software.

Mobility of academic staff, international scientific cooperation within projects, as well as publications ensure that the programme content changes and teaching methods are in line with the latest trends in the world, thus helping achieve the aims and learning goals of the study programme.

Professor Leonīds Ribickis holds a Doctoral degree in engineering. Alongside his academic, scientific and organisational activities, he is actively involved in Latvian and global scientific organisations, contributing to the development and improvement of the power and electrical engineering sector. He has more than 40 years of experience in higher education: study process management, scientific research, project management. Leonīds Ribickis is an academician of the Latvian Academy of Sciences and an expert in the field of engineering and technology - electrical engineering, electronics, information and communication technologies, as well as a member of RTU Senate and the Council of RTU Faculty of Electrical and Environmental Engineering, Chairman of RTU Promotion Council in Electrical Engineering, Chairman of RTU Council of Professors in Electrical Engineering. He has co-authored more than 600 publications, including 21 monographs and 77 patents on the following topics: electrical engineering, electronics, electrical drives, technological process and motion control, industrial robot equipment; semiconductor power converters, power electronics equipment and their control systems; energy efficiency of electrical equipment, smart DC networks; electric transport and e-mobility; electromechanical converters, AC and special electrical machines; alternative energy systems. He supervises Bachelor, Master and Doctoral Theses in subjects related to electric drive systems, industrial electronics and control systems for power electronic converters. He managed and executed more than 50 international and national projects related to scientific research.

Professor I. Raņķis carries out scientific work in the field of design and optimisation of DC electrical drives for electric trains, industrial and public electric transport.

1. Raņķis has worked with both full-time and part-time students, as well as delivered study courses to foreign students in English. He has also been a guest lecturer at Tallinn University of Technology and a trainee at the Royal University of Technology in Stockholm. He has supervised the internship of young lecturers of electrical engineering subjects at Vilnius Gediminas University and Riga Technical University.
2. Raņķis has been active as a scientific adviser of students' qualification papers, i.e., engineering projects (50), Bachelor Papers (30), Master Theses (40). Prof. I. Raņķis has supervised 9 PhDTheses in engineering.

Professor I. Raņķis is active in the field of science. His research interests include the development and study of energy storage systems in active cooperation with various enterprises, the study of pulse regulation systems for AC electrical systems, and the study of the efficiency of the application of non-linear inductances.

In general, Prof. I. Raņķis purposefully improves his qualification, actively cooperates with young engineering specialists, is able to confidently help students overcome study difficulties and problems and promotes students' professional growth. He is a very effective member of the student learning system.

Professor Oskars Krievs holds a Doctoral degree in the field of power electronics and has 20 years of academic experience in electrical engineering and power electronics. During this period, O. Krievs has led or participated in 16 scientific projects, including two international ones. Since 2020, O. Krievs has been the Dean of the Faculty of Electrical and Environmental Engineering at RTU, and from 2011 to 2020 - Dean of the Faculty of Power and Electrical Engineering at RTU. Currently O. Krievs delivers 3 study courses in the field of electrical engineering, but in total he has developed or participated in the development of more than 10 study courses. To improve his qualifications, O. Krievs has participated in 36 international scientific conferences, as well as undertaken internships at the Polytechnic University of Turin (2007), University of Duisburg-Essen (2018) and Ltd. EK Sistēmas (2020). In 2019, O. Krievs received the award of the Latvian Academy of Sciences for the most significant achievements in science, and in 2017 - the annual award of the Latvian Academy of Sciences and JSC Latvenergo for significant contribution to the field of power engineering. Since 2019, O. Krievs has been a member of the Latvian Association of Power Engineers and Energy Constructors.

Professor I. Galkins holds a Doctoral degree in Electrical Engineering, which he obtained in 2001 for his Doctoral Thesis "Design and Research of Matrix Converters". He has more than 20 years of experience in the participation and management of national and international projects. He is currently leading or has led from 2001 to 2021 more than 10 projects with a total budget of around 2 million EUR. Several years of research experience - author of 3 books and 88 articles related to power electronic converters, electrical drives and electrical devices for orthopaedic applications, as well as 6 patents. I. Galkins' h-index in SCOPUS database is 11, his 88 articles have been cited 364 times. He conducts research in the field of power electronics, including lighting and medical electrical equipment. He has been the scientific adviser of 6 successfully developed Doctoral Theses in the field of electrical engineering and the reviewer of 4 Doctoral Theses. He has several years of experience in the field of education as well as in the management of the study process. He has developed and delivered 15 study courses. He has supervised 36 graduation papers. He is the chairman of IEEE - Professional Electrical Engineers Society, a joint chapter of IEEE Latvia IAS/IES/PELS. He is an expert of the Latvian Council of Science in Electrical and Power Engineering. He is the Editor-in-Chief of RTU Scientific Journal on Electrical, Control and Communication Engineering.

PhD student, Research Assistant Aleksandrs Bubovičs has obtained a professional Master degree in engineering (M.sc.ing.) in 2018 and now continues his studies at RTU Doctoral study programme "Computerised Control of Electrical Technologies". Since 2016, he has been working at the Institute of Industrial Electronics and Electrical Engineering and since 2017 he has been involved in the implementation of the study process. From 2017 to 2019, he worked as a Lecturer at Ltd. IQTC Management (an exclusive and authorised partner of TÜV Rheinland Akademie in the Baltic States), where he taught courses "Electrical Safety for Non-Electrical Engineering Personnel" (EuP - Elektrotechnisch unterwiesene Person), "EE", "GWO BTT Electrical Module". He has participated in several international and national research projects, has authored and co-authored 13 scientific publications, and applies his experience in academic work environment.

Associate Professor and Senior Researcher Igors Uteševs holds a Doctoral degree in electrical engineering, electrical technology and automation. He is engaged in scientific research, participates in international conferences, seminars and courses. He has more than 16 years of professional experience at the University. Igors Uteševs' acquired skills and knowledge are integrated in study courses such as "Biotechnological Processes and Equipment", "Fundamentals of Industrial Computer Networks", "Computerization of Mathematical Tasks in Electrical Engineering", "Elements of Automation", "Industrial Safety", Control Fundamentals of Critical Infrastructures", "Design of Adaptive Systems", and others. The competence of Igors Uteševs ensures the successful achievement of learning results by students.

Associate Professor Andrejs Potapovs holds a Doctoral degree in electrical engineering and automation. He has more than 10 years of professional experience in higher education. The research component of his work with students is ensured by regular exhibition and presentation of research papers, as well as by participation in more than 15 international research projects. Academic knowledge is regularly improved by attending various RTU pedagogical qualification improvement courses. During the classes, students are actively involved in various practical assignments, providing an opportunity to apply the theoretical knowledge learned in practice.

Lecturer Kaspars Kroičs holds a Doctoral degree and a Master degree in electrical engineering. He has more than 10 years of experience in electrical and electronic engineering. He also has more than 5 years of scientific experience in power electronics and electrical drives, which are the main topics of the course "Control and Regulation of Electrical Drives". He is the author of more than 40 publications indexed in the Scopus database and has participated as a Researcher in more than 5 practical studies. K. Kroičs has attended RTU pedagogical qualification improvement courses, online training courses on the Coursera platform and gained international experience within the ERASMUS programme.

Anastasija Žiravecka, Dr.sc.ing., Professor. She publicly presented her Doctoral Thesis in 1999 at Riga Technical University. She has worked as an Assistant Professor, Associate Professor since 2005, and as Professor since 2014 at the Institute of Industrial Electronics and Electrical Engineering. Author of more than 90 scientific publications and textbooks related to electrical drives and their control, power electronics, energy saving. Participated in and managed local and international research and training projects - TEMPUS, ERASMUS+, ERDF. In 2014/2015 she participated and coordinated the development of the new professional Bachelor study programme "Adaptronics", in 2019/2020 she coordinated the development and licensing of the new professional Master study programme "Adaptronics". In addition, she publicly presented her Master Thesis in English Philology in 1998. She participates in, as well as coordinates the work with foreign students.

Research Assistant and Lecturer Ģirts Staņa has a Master degree in electrical engineering and has completed his Doctoral studies as a candidate for a scientific degree at study programme "Computerised Control of Electrical Technologies" of RTU Faculty of Electrical and Environmental Engineering. He has two years of academic experience at RTU, working with students in practical classes. Currently he continues to work on the Doctoral Thesis and scientific publications, participates in research projects. Participated and presented research findings at scientific conferences in different countries, improving his knowledge of the latest trends in the field.

Associate Professor Ingars Steiks holds a Doctoral degree in electrical engineering. He has accumulated scientific experience as a Research Assistant, Researcher, Senior Researcher, Assistant Professor and Associate Professor over the past 15 years. Knowledge is actively developed both in international research projects and in the academic staff strengthening programme in the field of electrical engineering. The thematic areas include both power converter development and industrial automation, i.e., hardware and software. The development of research skills is further enhanced by the regular supervision of graduation papers at all levels of study.

Professor Nadežda Kuņicina holds a Doctoral degree in electrical engineering and has been elected Professor of Electrical Engineering, Electronics, Information and Communication Technologies (Electrical Engineering and Automation). She holds the Expert status of the Latvian Council of Science in Social Sciences - Educational Sciences until 6 January 2024 and in Engineering and Technology - Electrical Engineering, Electronics, Information and Communication Technology until 3 September 2023. Professor Nadežda Kuņicina conducts research in the field of electrical engineering, mainly related to improving the efficiency of electricity use in industrial electronics and electric vehicles. Nadežda Kuņicina has participated in the development of study programmes, such as Erasmus plus KA 2 Applied Curricula in Space Exploration and Intelligent Robotics Systems - APPLE (2017-20); Electrical Energy Markets and Engineering Education - ELEMEND (2017-21); Innovative Approach towards a Master Program on Smart Cities Technologies - SMARTCITY (2018-21); Development of Practically-Oriented Student-Centred Education in the Field of Modelling of Cyber-Physical Systems - CybPhys (2019-22), Knowledge Triangle for a Low Carbon Economy - KALCEA (2020-23). Within the projects, academic objects and methodological tools have been developed on the following topics: innovation in information and communication technologies; introduction to the specialisation in design of energy-efficient technologies; metrology and mathematical modelling; Internet of Things and smart electrical technologies; energy saving in electrical equipment; electrical processes and equipment in biotechnology; thermal energy, fundamentals of control theory; energy efficient technologies; fundamentals of industrial computer networks; automation theory; automation elements; non-traditional non-contact electromechanical converters; non-traditional energy converter systems and storage; methods of analysis and calculation of electronic circuits. Nadežda Kuņicina develops study materials within the following study courses: “Fundamentals of Industrial Computer Networks”, “Computerization of Mathematical Tasks in Electrical Engineering”, “Elements of Automation”, “Industrial Safety”, “Control Fundamentals of Critical Infrastructures”, “Design of Adaptive Systems”, “Linear and Non-linear Systems”.

Associate Professor Viesturs Bražis holds a Doctoral degree in electrical engineering. He has 19 years of professional academic experience as a Research Assistant, Assistant Professor, Associate Professor and Senior Researcher. His research interests are in the field of energy storage system application. The research component of his work with students is ensured through participation in scientific conferences and publications. The practical and academic experience is fully relevant to the specific nature of the courses implemented.

Research Assistant Jānis Mārks holds a Doctoral degree in electrical engineering. He carries out scientific research work, participates in the development of scientific research project applications and publications. He has gained professional academic experience working as a Research Assistant for 5 years and has acquired practical skills as a project administrator and coordinator. Several years of scientific publishing have given him the skills to present the most relevant information on a given topic and to present new information in an easily understandable and structured way. During the development of the Doctoral Thesis, several numerical data processing methods have been reviewed and refined; as a result, the knowledge gained coincides with the subject matter of the study courses and provides an additional contribution to the study process.

Ansis Avotiņš, the Head of the laboratories and Researcher, has obtained a Master degree in electrical sciences (M.sc.ing.), studying at RTU study programme "Computerised Control of Electrical Technologies", and is currently working on his Doctoral Thesis. He has more than 15 years of experience in supervising student laboratory work in electric drives, student internships, as well as supervising Bachelor Papers and engineering projects. He is the author of 46 SCOPUS publications, and actively participates in industry associations (LATEA, LITAA, IEEE). He has completed 23 international and local scientific and academic projects, as well as more than 20 industrial contract works, which regularly allow getting acquainted with the latest technologies and participating in their development, gaining valuable know-how that can exchanged with students. He also participates in the management of the Student Creative Lab, which develops students' practical skills, makes them ready for internships and develops their skills in conducting research and analysing the results.

Associate Professor Aivars Pumpurs holds a Master degree in engineering (M.sc.ing.). After completing his studies, he has more than 15 years of practical work experience in manufacturing related to the development and operation of electronic and automation equipment. He has participated in several research projects and scientific conferences. He has more than 20 years of academic experience: delivering lectures, supervising laboratory work and graduation papers, and developing a number of study courses. He has completed his Doctoral studies and is currently working on his Doctoral Thesis. He continues to keep abreast of trends in automation processes, reading the latest literature and putting into practice the knowledge acquired in the process of training students, both in theory and in laboratory work.

Lecturer Agris Treimanis completed the PhD study programme "Computerised Control of Electrical Technologies", before that he had obtained a professional Master degree in electrical engineering and a Qualification of Electrical Engineer within the framework of RTU professional Master study programme "Computerised Control of Electrical Technologies". Since 2013, he has been giving lectures and supervising laboratory work of RTU undergraduate students within several study courses related to electrical engineering. He has a Bachelor degree in electrical engineering within the framework of the study programme "Power and Electrical Engineering". He obtained his Professional Qualification of Electrician at Liepaja State Technical College, where he also worked as an Instructor and Laboratory Assistant for 6 years.

PhD student, Researcher and Lecturer Armands Šenfelds holds a Master degree in electrical engineering from Riga Technical University and a Master degree in electrical engineering from RWTH Aachen University in Germany. He continues his Doctoral studies at RTU and carries out research work in the fields of robotic production systems, their energy efficiency and DC power supply system applications. Professional experience is related to the development of energy-efficient technological solutions for robotic applications in manufacturing, in cooperation with industrial partners Daimler AG, KUKA GmbH, Siemens AG. He is a member of the Institute of Electrical and Electronics Engineers (IEEE) and Deputy Head of the Latvian Section. Member of the Latvian Alumni Board of the Latvian-German Academic Exchange Service (DAAD). He is active in international research cooperation and exchange of study experience with universities in Germany (RWTH Aachen, Universität Duisburg-Essen, Stuttgart University), Denmark (Aalborg University) and the Baltic States.

Pēteris Apse-Apsītis hold a Doctoral degree in engineering. He has more than 50 years of industrial and scientific research experience in electrical engineering, electronics, ICT, automation, printing, papermaking, audio-visual arts and automotive technology in Latvia and abroad. In total, he has managed and implemented more than 300 projects, including international ones, for various equipment and systems. Author and co-author of several patents and dozens of scientific publications. He received the Annual Award 2018 named after Professor Alfreds Vitols from Latvenergo JSC and the Latvian Academy of Sciences. Expert of the Latvian Council of Science. Professor and Senior Researcher at the Institute of Industrial Electronics and Electrical Engineering, Riga Technical University.

Associate Professor Jūlija Maksimkina holds a Doctoral degree in electrical engineering, in the sub-discipline of electrical machinery and equipment. The development of research skills is ensured through the elaboration of the Doctoral Thesis, writing scientific articles. She has 18 years of professional academic experience as an Assistant, Lecturer, Assistant Professor. She delivers the following study courses: "Fundamentals of Electrical Engineering Theory", "Theory of Circuits", and "Electricity and Magnetism". Since 2017, she has been a responsible lecturer of the study courses "Fundamentals of Electrical Engineering Theory" and "Theory of Circuits", "Electrical Engineering and Electronics". She improves her knowledge by attending RTU pedagogical qualification improvement courses.

Associate Professor Jānis Voitkāns holds a Doctoral degree in engineering (Dr.sc.ing.). His professional experience of more than 40 years is related to electrophysics, electricity and magnetism, fundamentals of electricity and circuit theory, as evidenced by scientific publications and participation in international scientific conferences. The professional and academic experience is fully relevant to the specificities of the study courses delivered. The acquired knowledge and skills are successfully integrated in the study courses, ensuring the successful achievement of the learning outcomes by the students. In the classes, students are actively involved in practical activities, thus enabling them to apply the theoretical knowledge in practice.

Visiting Lecturer Dāvis Meike holds a Doctoral degree in engineering and is a Planning Engineer in the manufacturing industry. His Doctoral Thesis is on energy efficiency in industrial robotics. His research areas include highly automated manufacturing systems, power transmission in direct current (DC) grids and related technologies, consumption and flow optimisation, as well as general industrial automation. In these areas, D. Meike has coordinated both publicly co-funded international research projects and product development in the private sector. He is the author of more than 20 peer-reviewed scientific publications and patent articles.

Associate Professor Svetlana Andrianova holds a Doctoral degree in energy and electrical engineering. She has 20 years of professional academic experience as a Research Assistant, Lecturer, and Assistant Professor. The research component of her work with students is provided by scientific conferences and publications. Professional knowledge and skills continue to improve by attending seminars and conferences organised by RTU, as well as seminars and conferences outside RTU. Acquired knowledge and skills are successfully integrated in study courses, ensuring successful achievement of learning outcomes by students.

Professor Mihails Gorobecs holds a Doctoral degree in electrical engineering and a Master degree in Information Technology. He has more than 15 years of academic and research experience. Since 2012, M. Gorobecs has been an expert of the Latvian Council of Science in the field of Electrical Engineering, Electronics, Information and Communication Technologies (i.e., in computer control of industrial processes, motion control and optimisation using artificial intelligence equipment and methods). His main research interests are embedded software engineering, computer control of transportation systems, embedded intelligent electrical devices, decision support methods in transportation systems, adaptive systems and methods, genetic and evolutionary algorithms, neural networks, fuzzy logic control methods, railway transport control, safety and optimisation methods, computer control of unmanned electric vehicles, mathematical and simulation modelling of systems. M. Gorobets has more than 10 years of experience in managing various international and national projects in the field of electric and railway transport. He is the author of several textbooks, methodological tools, and patents.

Associate Professor, Senior Researcher Aigars Vītols received his Doctor of Engineering degree in 2007 from Riga Technical University. While working for Siemens as a Sales Engineer, A. Vītols has participated in several Latvenergo substation modernisation projects, as well as in the organisation of the construction project of Riga City High Voltage Network Substation "Hanza" and has been involved in the supply and installation of the necessary structures and equipment, including international sales and operation of modern electrical equipment. A. Vītols is the author of 18 scientific articles in the field of electrical engineering and has participated and presented research results at 14 international scientific conferences in the aforementioned field. A. Vītols received the Best Paper Award in the subsection of Information and Communication Technologies (ICT) and Low-Power Electronics and Electrical Engineering. A. Vītols is the author of three Latvian patents, one of which is a patent entitled "Bidirectional Power Flow AC-DC Controller". Since 2007, he has been delivering study courses such as “Foundation of Electrical Engineering Theory”, “Theory of Circuits”, “Electrical Engineering and Electronics”, etc. Since 2010, he has been delivering the above courses to international students. A. Vītols has completed courses in Intellectual Property Protection in 2004 and since then he has been delivering the study course "Patents" at Riga Technical University.

Overall, the qualification of all the teaching staff comply with the conditions of implementation of the study program and the requirements of laws and regulations, as well as ensures attainment of the program goals and study outcomes, which is attested by their qualifications and CV’s.

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

The academic staff involved in the implementation of the study programme participate in academic and scientific conferences. They are engaged in various projects (see Annex 13) and develop scientific publications. Data on the involvement of the academic staff in scientific research are presented in the list of publications of the academic staff during the reporting period (see Annex 17).

All academic staff participate in or lead various types of international and local research projects, such as ERDF, FLPP and others. Academic staff also participate in international ERASMUS+ projects, developing new courses and textbooks. The results of the projects are regularly reported in conference and journal publications and used in their pedagogical work - lectures, seminars, other activities with students, as well as in academic tools and monographs. Many of the graduation papers are written in the framework of the projects and on the scientific activities and results of the projects. The list of projects carried out is available in Annex 13.

Data on the involvement of academic staff in scientific research are presented in the list of publications of academic staff during the reporting period.

Prof. L. Ribickis was the Chair of the Organising Committee of the global conference EPE ECCE Riga 2018. He organised the five-day conference, which was attended by about 700 scientists.

Faculty of Electrical and Environmental Engineering hosts the annual RTUCON series of international scientific conferences, where scientists and students from different countries exchange research results in electrical engineering, generate prospective ideas and establish contacts for potential research. Typical conference participation is 100-200 participants from 20-50 countries. Currently (as of 2014) the conference is supported by the IEEE and IEEE IAS Societies. As of 2014, about 650 papers had been published in the IEEE Xplore database as well as in the SCPOUS and TR-WoS databases.

One more conference taking place at FEEE is POWERENG2015. The conference wes supported by IE EE and IEEE-IES. 113 articles of the conference are available in IEEE Xplore, SCPOUS and TR-WoS data bases.

There is a direct and indirect impact of the RTUCON conference series on the Faculty of Electrical and Environmental Engineering on the study process. The direct impact is realised through a dedicated working session on "Education in Engineering", which provides an opportunity for academic staff from several universities and countries to exchange methodological experiences in the field of engineering education. It also reflects the trend towards using the latest scientific developments in the academic work environment. In addition, RTUCON conferences support (special sessions and prizes) students presenting their research results. Finally, some instructors involve students in the conference, for example, through elaboration of papers in which students are invited to analyse and evaluate the achievements of other scientists for extra credit points.

The results of research and projects are integrated in the study courses and presented to students. For example, the results of the European international projects LITES, ERDF uMOL and ERDF SAVAS are used as lecture material, laboratory work and practical calculation tasks in the study courses "Energy Efficient Lighting", “Introduction to Specialisation”.

In addition, the AREUS Project Laboratory is used for this study course in addition to practical work in the course "Control and Regulation of Electrical Drives". Since 2016, Dr.sc.ing, Production Planning Engineer Dāvis Meike from Mercedes-Benz delivers the study course "Fundamentals of Industrial Robotics".

The FP7 project also involved senior students in the development of an innovative DC power supply laboratory and unique four-quadrant electric drive stands that allowed for the emulation of dynamic electrical loads (e.g., in industrial robots) and were later demonstrated to other students. The Deputy Head of the Institute Pēteris Apse-Apsītis actively involves students in various projects, such as remote real-time practical laboratory work in the development of academic stands, applications of microcontroller and Internet of Things technology, control or monitoring of various systems (e.g., ERDF project "uMOL", LAD project "IRIS", etc.), development of new sensors. Other professors also allow students to participate in both contractual and scientific projects, resulting in joint publications in SCOPUS databases and the drawing up of new project applications.

The most active students are also involved in other local projects funded by RTU Development

Fund, various start-up programmes and companies, as well as international projects (e.g., Interreg project SpringBoard). Students also participate in various events, for example "Staro Rīga", where 5-storey high dynamic and interactive faculty lighting for one stairwell was created, using LED and IoT technologies.

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

To ensure that the content of the study courses does not overlap, an annual review of the courses of the study programme takes place, as well as seminars in which the academic staff involved in the implementation of the programme present the course outline and academic methods to their colleagues and discuss improvements that would ensure a higher quality of the programme content and meet the current trends in the field.

Analysing the student-academic staff ratio within the study programme at the time of submission of the self-assessment report, the programme has one elected faculty member per 6.6 students and one specialist in the respective field per 22.7 students.

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	5.pielik_RECA studenti statistika_ENG (1).docx	5.pielik_RECA studenti statistika _LV (1).docx
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	6.pielik_Atbilstība VIS RECA0 _EN.docx	6.pielik_Atbilstība VIS RECA0_LV.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)	7.pielikums RECA Atbilstība profesijas standaram _ENG.doc	7.pielikums_Elektroinzenieris_RECA_lv.doc
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	8.pielik_RECA kartējums_EN.xlsx	8.pielik_RECA kartējums LV.xlsx
Curriculum of the study programme (for each type and form of the implementation of the study programme)	9.pielik_RECA plānojums EN.xlsx	9.pielik_RECA plānojums LV.xlsx
Descriptions of the study courses/ modules	RECA_courses_ENG.zip	RECA-kursu apraksti_LV.zip
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	RECA diploms ENG.zip	RECA diploms LV.zip
Description of the Study Programme - Other mandatory attachments		
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	Par iespēju studējošiem turpināt studijas_BSP.edoc	Par iespēju studējošiem turpināt studijas_BSP.edoc
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	Apliecinajums - Par zaudējumu kompensaciju.edoc	Apliecinajums - Par zaudējumu kompensaciju.edoc
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.	Apliecinājums - Svešvalodu prasme.edoc	Apliecinājums - Svešvalodu prasme.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education		
Sample (or samples) of the study agreement	Sample_of_study_agreements.zip	Studiju līgumi.zip
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.		

Computerised Control of Electrical Technologies (47522)

Study field	*Power Industry, Electrical Engineering, and Electrical Technologies*
ProcedureStudyProgram.Name	*Computerised Control of Electrical Technologies*
Education classification code	*47522*
Type of the study programme	*Professional master study programme*
Name of the study programme director	*Leonīds*
Surname of the study programme director	*Ribickis*
E-mail of the study programme director	*Leonids.Ribickis@rtu.lv*
Title of the study programme director	*habilitētais doktors*
Phone of the study programme director	
Goal of the study programme	*The aim of the professional Master study programme is to provide higher professional education and prepare high level specialists with engineering qualification and Master degree, who would be able to formulate and solve complex electrical equipment automation tasks in various economic sectors, at research institutions and companies, as well as perform pedagogical activities.*
Tasks of the study programme	*The study programme includes lectures, practical classes, laboratory works and projects to acquire in-depth knowledge in electrical engineering and to acquire skills in the basics of scientific research work and in-depth knowledge in economic, social and pedagogical issues.*
Results of the study programme	*Upon the completion of the professional Master study programme, the following knowledge is acquired for further work: - ability to apply theoretical and practical knowledge in the field of development and operation of electrical equipment; - ability to implement scientific and pedagogical activity; - ability to design, create and operate new computer control systems for electrical equipment of all sectors of the economy; - ability to design, build and operate modern electronic equipment, semiconductor energy converters and drive systems; - ability to use computer equipment, compile programmes for automation of technological processes; - ability to develop technologies for saving and rational use of electrical energy.*
Final examination upon the completion of the study programme	*The Qualification paper – Master Thesis.*

Study programme forms

Full time studies - 1 years - latvian

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*0*

Language	*latvian*
Amount (CP)	*40*
Admission requirements (in English)	*professional bachelor degree in electrical engineering, energy or electronics and qualification of electrical engineer or comparable education and fifth level professional qualification*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 1 years, 6 months - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*1*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*40*
Admission requirements (in English)	*professional bachelor degree in electrical engineering, energy or electronics and qualification of electrical engineer or comparable education and fifth level professional qualification*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 1 years - english

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*0*
Language	*english*
Amount (CP)	*40*
Admission requirements (in English)	*professional bachelor degree in electrical engineering, energy or electronics and qualification of electrical engineer or comparable education and fifth level professional qualification. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 1 years, 6 months - english

Study type and form	*Part time extramural studies*
Duration in full years	*1*
Duration in month	*6*
Language	*english*
Amount (CP)	*40*
Admission requirements (in English)	*professional bachelor degree in electrical engineering, energy or electronics and qualification of electrical engineer or comparable education and fifth level professional qualification. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics or comparable education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*

Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics or comparable education. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 2 years, 6 months - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics or comparable education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Part time extramural studies - 2 years, 6 months - english

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*6*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics or comparable education. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

The study programme is designed to be implemented in the form of full-time and part-time studies in Latvian, just as it has been implemented until now, and in full-time form in English. The study programme is implemented in two options: the first option is intended for applicants with a previously obtained qualification in electrical engineering; the duration of studies is one year and the volume is 40 CP. The second option is a two-year study programme in the amount of 80 CP intended for applicants with a Bachelor degree in electrical engineering.

During the reporting period (June 2017), the following changes were made to the professional Master study programme "Computerised Control of Electrical Technologies":

I (one-year study programme) and II (two-year study programme):

1. Changes in compulsory Part (A):
    - To change the volume of the part from 10 CP to 9 CP (only for one-year study programme);
    - To move the study course *Innovation Strategy Management – 3 CP* (code EEP586) from Part A to Part B. 1 of professional specialisation Industrial *Electronics and Electrical Technologies*;
    - To include the study course *Scientific Seminar in Industrial Electronics – 2 CP* (code EEP301);
2. Changes in compulsory elective study courses, Part (B):
    - To change the volume of the part from 4 CP to 5 CP;
    - To terminate professional specialisations: *Road Electrical Transport, Automation* and *Computerised Control of Railway Transport;*
    - To exclude the study courses attributable to professional specialisations *Road Electrical Transport, Automation and Computerised Control of Railway Transport* from the list of study courses;
    - To create a professional specialisation *Computerised Control of Electrical Transport* and include in Part (B.1.) the following study courses:
    - *Control and design of smart electrical transport – 3 CP (code EEI781),*
    - *Artificial neural networks in electric transport control – 2 CP (code EEI782),*
    - *Genetic algorithms in electrical transport optimal control – 2 CP (code EEI783),*
    - *Adaptive Systems in Industrial Electronics – 2 CP (code EEI784);*
    - To terminate the block of study courses in pedagogy and psychology;

Only II (two-year study programme):

1. Changes in compulsory Part (A):
    - To change the volume of the part from 16 CP to 19 CP;
    - To include the study course *Power Electronics – 4 CP (code EEI729);*
2. Changes in Practical Placement (D):

- To change the volume of the part from 32 CP to 26 CP;
- To exclude the study course *Practical Placement – 26 CP* (code EEI010);
- To include the study course *Practical Placement – 20 CP* (code EEI785).

3. Changes in state/final examination (G):
   - To change the volume of the part from 28 CP to 30 CP;
   - To exclude the study course *Engineering Design Project – 8 CP* (code EEI005);
   - To include the study course *Engineering Design Project – 10 CP* (code EEI786).

The qualification of a leading electrical engineer is conferred to students following successful defence of the engineering project. In 31 May 2021, the study programme was updated with the Decision of RTU Senate No650, envisioning the opportunity to implement the study programme in the English language.

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

Table 1 shows that over the past six years the number of students at the professional Master study programme "Computerised Control of Electrical Technologies" has been increasing. This can be explained by the changes in certification requirements for specialists in construction and power engineering that took place in 2014. In order to obtain a work certificate or license, a professional qualification is required, which can be obtained only by completing a professional study programme.

Table 1. Student number dynamics at RTU Master study programme
"Computerised Control of Electrical Technologies"

	2013/2014	**2014/2015**	**2015/2016**	**2016/2017**	**2017/2018**	**2018/2019**	**Total**
Professional Master study programme "Computerised Control of Electrical Technologies"	99	115	110	110	108	104	646

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

The aim of the professional Master study programme is to provide higher professional education and prepare high level specialists with engineering qualification and Master degree, who would be able to formulate and solve complex electrical equipment automation tasks in various economic sectors, at research institutions and companies, as well as perform pedagogical activities.

The study programme includes lectures, practical classes, laboratory works and projects to acquire in-depth knowledge in electrical engineering and to acquire skills in the basics of scientific research work and in-depth knowledge in economic, social and pedagogical issues.

The professional Master study programme is the next level after obtaining a Bachelor degree – a one-year programme for applicants with a Professional Bachelor Degree or equivalent education in Electrical Engineering, Power Engineering, Electronics and 5th level Qualification of Electrical Engineer e, and a two-year programme for applicants with an Bachelor Degree in Electrical Engineering or Electronics and Automation, or equivalent education.

During the professional Master study programme, students acquire technical study courses of the highest importance for the specialty, as well as undergo internship (in the amount of 26 CP if students have previous academic education and in the amount of 6 CP if students have previously obtained a qualification of engineer) and developed an engineering project (if they do not have a qualification of engineer). However, the main task is the development of a Master Thesis, in which, based on theoretical knowledge and practical skills, the student formulates the principles of automation of specific electrical technologies and introduces an engineering solution of an automated system.

During the studies, students get acquainted with the types of electrical technologies, conduct research on their operating principles, analyse computer control methods of technologies, develop new technologies or control methods, offer improvements to existing technologies, perform technical and economic calculations.

Upon completion of the study programme, students obtain a Professional Master Degree in Electrical Engineering and the Qualification of Leading Electrical Engineer.

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master's and doctoral study programmes, 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 volume of the 1st variant of the professional Master study programme is 40 CP, which consists of study courses (14 CP), internship (6 CP) and state examination (20 CP), part of which is the development and public presentation of the Master Thesis. The volume of the 2nd variant of the professional Master study programme is 80 CP, which consists of study courses (24 CP), internship (26 CP) and state examination (30 CP), part of which is the development and public presentation of an engineering project (10 CP) in the 1st study year and the development and public presentation of the Master Thesis (20 CP) in the second study year. The choice, scope and content of the study courses of the Master programme, as well as the content and tasks of the internship have been developed in accordance with the professional degree and qualification to be obtained following the professional standard of Leading Electrical Engineer.

In accordance with the industry trends, as well as recommendations for improving the content of the programme, the content of study courses and the programme is regularly improved. For example, in the reporting period the internship content was supplemented, the programme content was supplemented with the specialization of Computerised Control of Electric Transport that is also related to smart transport management. The programme was also supplemented with the study course “Scientific Seminar in Industrial Electronics” - 2 CP (EEP301), so that students could get acquainted with innovative technologies and the latest trends in the scientific literature of the field.

To reinforce theoretical knowledge and gain practical experience in the field, internship in the amount of 6 CP and 26 CP (according to the implementation option of the study programme) is implemented. A tripartite agreement is concluded among the university, the student and the employer. According to the aims and tasks of the programme and internship, the content of the internship includes the student's acquaintance with the management structure and operating principles of the internship company, the specifics of the industry and the applied technologies. Representatives of the company with which the contract for the implementation of the internship has been concluded participate in the determination of the aims and tasks of the internship, as well as in the assessment of the internship. The student achieves the aims of internship based on the acquired knowledge, skills and competence.

The structure of the programme and all formal conditions comply with the state regulatory enactments and the requirements specified in the decisions of RTU Senate. If the student has not acquired knowledge in compliance with the requirements stipulated by the Law on Environment protection and the Law on Civil Defence at a lower level study program, within the scope of the Ph.D program students can choose the study courses “Civil defence” of 1 CP (ICA301) and Environment and Climate Roadmap of 1 CP (VAS038), if such disciplines were not included in the preceding study program, and students of the program in English can choose to study the Latvian language in the study course “Latvian language for foreign students” amounting to 1 CP.

As a result of professional studies, students acquire knowledge and professional competence that meet the requirements of a professional Master degree and allow them to start professional activities corresponding to the specialty. The structure of the study programme is shown in Annex 11.

To make the content of the programme as close as possible to the needs of the labour market, several industry professionals participate in the State Examination Commission during the viva voce examination of the graduation papers. They evaluate how relevant is the research theme for the needs of the market, as well as express their proposals on the desired themes of students’ research. In cooperation with representatives of employers, students develop study projects and graduation papers. Employers positively evaluate students' performance in researching the themes of graduation papers and publicly presenting research findings, as well as highly asses tasks completed during the internship, by inviting students to participate in projects or undertake employment at a company.

Master students are involved in scientific research projects, selection of the topics for Master Thesis conforms with the priorities defined by the national research programs, Latvenergo, NexIT and goals of other projects, including international projects. Students regularly submit research results to scientific conferences and receive appreciation at competitions, for example, the annual competition of students' works organised by "Latvenergo".

RTU has established the Golden Fund of graduates, which includes the most outstanding graduates of RTU study programs, based on academic achievements and social activities. The following graduates of the program "Computerised Control of Electrical Technologies" have been included in the Golden Fund of graduates during the reporting period:

- Artūrs Paugurs, academic year 2014/2015
- Jevgēnijs Stegura, academic year 2015/2016
- Artūrs Brēķis, academic year 2016/2017
- Aleksandrs Korņejevs, academic year 2017/2018
- Juris Fedotovs, academic year 2017/2018
- Maiyani Vikash Shyamjibhai, academic year 2018/2019 (foreign student)

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

The study programme "Computerised Control of Electrical Technologies" defines 6 learning outcomes to be achieved that correspond to the professional standard of Electrical Engineer:

- ability to apply theoretical and practical knowledge in electrical equipment development and operation;
- ability to conduct scientific and pedagogical activity;
- ability to design, create and operate new computer control systems for electrical equipment of all sectors of the economy;
- ability to design, build and operate modern electronic equipment, semiconductor energy converters and drive systems;
- ability to use computer equipment, compile programs for automation of technological processes;
- ability to develop technologies for efficient and rational use of electrical energy.

The aims set out in the study courses are closely linked to the learning outcomes to be achieved by the joint programme. The content of the courses is fully in line with the learning outcomes. There is regular monitoring and development of the content of study courses, which helps control the content of study courses, training methods and update the learning outcomes to be achieved.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

Various methods and modes of teaching are used in the study process, their choice is conditioned by specifics of every study course. General issues and theoretical aspects are discussed at the lectures, the lecture materials are available to the students in the electronic format, also in ORTUS e-learning environment. Practical assignments and classes are organized in the form of traditional labs using specialised equipment, as well as in the form of practical tasks, where students should demonstrate that they are able to integrate knowledge acquired within various study courses. The learning resources available to the students are updated, numerous books and learning aids are submitted to publishing, the existing study laboratories are modernised and improved.

The study program is implemented as full time studies and remote studies in Latvian and English, by following the requirements defined by laws and regulations, the core principles of organisation of studies set by RTU and by complying with all the study course requirements. Course description of the study program defines the set of compliant knowledge, skills and competences and their evaluation system, defines the study outcomes for attaining which credits are granted, which do not depend on the form of the program implementation: full time studies in person, half-time studies in person or remote studies. The procedure of evaluation of students' knowledge, skills and competences is defined by Senate of RTU decision of 27 May 2017 "Regulation on the Assessment of Learning Outcomes", which conforms to the core principles and procedure of assessment of education on the relevant study level defined by the Cabinet Regulations. The cumulative assessment system is applied in assessing students' achievement where the final grade consists of several components.

Full time studies consist of 40 CP per academic year and 40 academic hours of the student's work per week accounting for 1 CP. In order to satisfy the requirements defined in the program and every course, in comparison to full time studies, a longer time for completing the program and a lower number of credit points is set for half-time studies, in particular, less than 40 CP per academic year and less than 40 academic hours per week. Thus, as the study program is implemented in different types and forms of studies, only the number of in person (or contact) and independent work hours and the study methodology or instruction approach of courses differs. The teaching methods for implementation of study courses, as well as the assessment methods are selected by the academic staff responsible for the study course in compliance with the specifics of the content of the study course and the study program, as well as students' needs. As full time students have less practical experience in the field of study, the applied methods include study trips to the industry companies, visiting lectures by the industry professionals, etc. As regards half-time students, who have practical experience in most cases, the employed teaching methods consist more of lectures, practical assignments, group works, home assignments and research involving cases studies and their explanation from both the theoretical and practical perspective. Within the half-time in person and half-time remote study process the focus is on the independent work of students by using both the problem-based learning and case studies, as well as the professor's advisory role.

As stated above, in addition to theory classes in classrooms, students also participate in study trips to the biggest companies and organisations of the industry, for example, within the scope of the study course "Introduction to the speciality" the first year students visit Latvenergo AS, Sadales tīkli, Rīgas mašīnbūves rūpnīca, Getliņi and other companies. Organisation of study trips and study visits ensures the link between the content of the study program and the industry specifics, in addition to the knowledge of the theory students can relate it to daily situations in companies on the matters of both automation processes, energy saving and efficiency improvement, to analyse issues and to substantiate their view.

The student-focused education principles are considered during the whole implementation of the study process:

1. Involvement of students in the study process and content improvement. RTU has developed procedures providing for the student feedback on the quality of the study process (surveys, regular meetings of students with the program director and leading teaching staff, etc.). Thus, students have an opportunity to affect the study process. Students in the program are regularly involved in the program quality assessment, participate in the work of decision making bodies and advisory bodies.
2. Study outcomes. The assessment of the study courses of the program and the number of credits is related to study outcomes. The study outcomes of each study course are notified to students. Professors relate the course outcomes to the study program outcomes, as well as substantiate the necessity of acquisition of the information of the relevant course for mastering the profession of an electrical engineer.
3. Mobility. Within the study program “Adaptronics” mobility resources are used to improve the teaching process of the university, as the student-focused education is based on a powerful teaching process. Teaching staff of foreign universities is involved in the program implementation, thus benefiting not only students, but also the teaching staff involved in the program implementation by taking over the best practice.
4. Social dimension. When students study within this program, their study process is sufficiently flexible, providing an opportunity for students to combine studies with work starting from the second or third study year. Students of the day department also have an opportunity to change the form of studies to remote studies in order to combine studies and work. The fact that the premises of the RTU library are available to students round the clock and also on weekends should be mentioned as another advantage.
5. Teaching methods. Various teaching methods are applied in the program implementation process. For example, study projects are developed, there are group works, the peer-to-peer method is applied in some study courses. Students can receive individual consultations from the academic staff in personal meetings or by communicating in the e-environment.
6. Study environment. During the program implementation there is cooperation between librarians and the academic staff aimed to improve the teaching and learning process. Both students and the teaching staff involved in the program have access to premises with relevant equipment appropriate for research and the learning process.
7. Development of the academic staff competences. The academic staff involved in the program have regular opportunities for improvement of their methodological and teaching skills. The process of development of the academic staff competences includes also discussions on application of the teaching and learning methods, including innovative teaching methods. For instance, within the scope of ERASMUS+ and NordPlus projects workshops on innovative teaching methods were organised with participation of colleagues from Latvia, Lithuania, Estonia and Finland.
8. Extracurricular activities of students. The program management supports the work of the students’ self-government, thus allowing students improving their independence, providing opportunities for implementation of ideas, as well as to study additionally outside the scope of lectures. For example, students have an opportunity to implement their ideas in the laboratory of Latvenergo AS at the time most convenient for students. Everybody studying in the program is offered an opportunity to participate in extracurricular activities (sports teams, dance groups, choirs, debate associations, etc.). All the above attests that there is active study life and extracurricular possibilities for students.

Students studying in the study program are also involved in research work and studies on topics important for the field by participating in domestic and international conferences.

Assessment of the students' knowledge is based on the Cabinet Regulations (Clauses 45-54 of Cabinet Regulations of the Republic of Latvia No. 512 (26 August 2014) and relevant decision of the RTU Senate.

Study outcomes are assessed based on two criteria, in particular, the quality criterion (**the assessment according to a scale of 10 points**) and quantity criterion (**credit points**, obtaining positive assessment of acquiring the study course content).

The following core principles of assessment of eduction are followed in the assessment:

- The principle of adding of positive achievements - positive achievements within every course and totally within the program are added;
- The principle of mandatory checks - the assessment is mandatory at the conclusion of every study course;
- The principle of transparency and clarity of assessment criteria - test requirements are accessible to all stakeholders from the program administration or teaching staff and are described accordingly upon starting every subject, they are electronically available in ORTUS environment;
- The principle of a variety of assessment forms - classroom tests, study works, independent works, presenting at seminars, tests, exams (verbal, written, containing a practical assignment), defence of the internship work, defence of the Master's Thesis, etc.
- The principle of accessibility of the examination - the scope and content of examinations conforms to the content defined by subject syllabus and the requirements regarding the professional qualification skills and knowledge. All the conditions for obtaining credit points are described in the syllabus of every subject.

  An **exam and test** are the basic forms of assessment of acquisition of the program and they need to taken at the completion of every study subject.

  Also the **internship** is assessed based on the 10 point scale. The assessment of the internship is provided by the head of the internship and the internship defence commission by accepting the defence of the internship reports and assessing the reference of the internship company. The commissions of defence of the internship are assigned based on the order of the head of the relevant structural unit.

In addition, the teaching staff pays attention to and assesses also the students' ability to work with the study and scientific literature sources, to prepare notes, to draft reports, to arrange materials, to analyse, to draw conclusions. A lot of attention is on the students' ability to read literature in foreign languages, to present the main ideas of not adapted texts, to discuss with other students, to use technical study aids, to perform scientific research work on the basic level. Development of these skills is encouraged by using the interactive study environment in the study process.

The qualification paper – **Master Thesis** – is presented publicly. It is assessed by the State Examination Committee. The State Examination Committee appointed by the Rector in 2017 shall consist of 5 members: representatives of the Faculty of Electrical and Environmental Engineering, representatives of the industry, and the Chairman, Alnis Kaļāns (EK Sistēmas Ltd). The volume of the Master Thesis is about 50 pages with diagrams and figures, which showcase research of modern electrical equipment. The Master Thesis should also provide proposals and recommendation for the technical implementation of such equipment. The following criteria are applied for defence of the Master Thesis:

- systematisation, updating and expansion of theoretical and practical knowledge, the experience gained within the individual and study practice,;

- independent acquisition of the study and scientific literature, laws and regulations compliant with the selected speciality and information in other information sources, including in foreign languages;
- the ability to solve the issue of research, comprising particular novelty elements and tasks, by relating this to theoretical guidelines;
- analysis of problems, systematisation;
- the skill of presenting of performed research and obtained practical results.

The training process (lectures, practical and laboratory classes) will be based on new technologies such as modelling computer programs, computer projectors, micro-control kits, unified digital and analogue control plates, and other types of technology. Some technological equipment and computer programs were self-created, and some of them were purchased. For example, two power benches are available for labs, which were at the IEEI designed within the framework of the international FP7 research project AREUS. The study programme is implemented through project tasks, their public presentation and assessment. Students are involved in various research projects.

Descriptions of study courses will be available at RTU website, in the Study Programme Register. Their description is based on the principles of Bloom's taxonomy, namely, including not only an annotation and a short description of the study course, but also providing information on the aims and tasks of the study course expressed in competencies and skills, defining the learning outcomes to be achieved and their assessment, as well as prerequisites for acquiring the study course.

Assessment of student learning outcomes is carried out in accordance with the “Regulation on the Assessment of Learning Outcomes” (approved at the Meeting of RTU Senate on 27 May 2017, Minutes No 610), which is available on Studies Regulations page of RTU web page (https://www.rtu.lv/writable/public_files/RTU_studiju_rezultatu_vertesanas_nolikums.pdf (in Latvian) English translation is Annex 04 in the zip folder "List of Internal regulations"). Pedagogical methods used in the implementation of study courses, as well as assessment forms and methods are selected by the instructors responsible for the study courses in compliance with course curriculum and specifics of the programme, as well as student needs. A member of academic staff should inform students about particular assessment criteria at the fist lecture/practical class.

The main advantage of the summative assessment system is that the final grade is made up of several components. Therefore, the students may contribute to their final grade working during semester. Criteria for assessment of the study courses and individual/home tasks are published on ORTUS e-study system beforehand. During semester, the assessment for each home task, test, report, presentation and any other task is ascribed certain weight in the final grade. Exam grade may not exceed 50% of the final grade. Academic staff may take into consideration and also assess student attendance. Assessment structure for the study course is determined by the academic staff themselves, abiding the resolution of RTU Senate that the exam grade may not contribute more than 50% to the final grade. Selecting assessment criteria and methods for evaluation of student achievements, specifics of each study programme and learning outcomes are taken into consideration.

In order to advance professional pedagogical competences of the academic staff, courses and seminars on the newest pedagogical methods are organized regularly. Qualification advancement is provided at both the University and faculty level, organizing academic conferences and methodological seminars. The Centre for Academic Excellence has been established and successfully operates at RTU; it organizes various events aimed at professional advancement of academic personnel at the University level. All members of academic staff annually take part in the international scientific conferences in the areas of industrial electronics, power electronics and motion control, as well as robotics, automation, mechatronics and energy efficiency improvement.

The members of academic staff shall inform the students on the specific assessment criteria of the study course at the first lecture, they are also published in the e-page of the study course.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

The main aims of the internship fully correspond to the aims and learning outcomes of the study programme, as they are designed to encourage students to apply and develop knowledge, skills and competencies acquired during studies:

- to practically apply the knowledge and skills acquired within the professional Master study programme "Computerised Control of Electrical Technologies",
- to acquaint students with the activities of modern companies, and instructors with the needs of companies,
- to involve partners in the educational process by organizing internship outside the educational institution,
- to ensure cooperation with leading companies in the industry.

As a result of Master studies, the following knowledge and skills are acquired, which must be applied during internship at companies operating in the field of electrical engineering and can be regarded as the main tasks of internship:

- ability to design and create new computer control systems for electrical equipment of various sectors of the economy;
- ability to design and develop electronic equipment, semiconductor energy converters and drive systems;
- ability to demonstrate knowledge of how to rationally use and save electrical energy and the ability to apply appropriate technologies;
- ability to apply theoretical knowledge in solving practical problems in the field of electrical engineering;
- ability to use computers, compile computer programmes for automation of technological processes;
- ability to use IT technologies - personal computers, Internet, computing devices;
- ability to search, analyse and process data;
- ability to organize and perform pedagogical work.

Special internship tasks are set to each student individually in accordance with the profile of the internship enterprise. Internship is organised and its tasks are set so as to ensure the learning outcomes of the internship are fully compatible with the learning outcomes of the study programme. Within the first and second version of the study program, the scope of the internship amounts to 10 CP, and in the third version for those who have graduated from the academic program, it is 26 CP. The internship is organised in various Latvian and foreign companies, providing an opportunity to provide internship for foreign students, and there are also Latvian companies prepared to accept foreign students for internship and to employ them, for instance, Rīgas mašīnbūves rūpnīca, etc. In addition to the internship, students can use the laboratories of IEEI where practical or research work is performed.

In 2019, according to the Senate decision, the internship organisation procedure at RTU was reviewed. As indicated in the internship organisation procedure, an internship coordinator at the department assists students in finding the company. If additional assistance is needed, it is possible to resort to the Career Support and Services Department, where a career adviser and a project manager help students find internship site, as well as through a variety of measures, to develop career management skills that can provide successful results during the internship process. Once a year, the Career Support and Services Department organises RTU Career Day, which also allows students to meet with business representatives and communicate on future opportunities. Detailed information on RTU Career Day is available at https://www.rtu.lv/lv/studentuserviss/karjeras-centrs-ssc/karjeras-diena/vesture-5. in Latvian.

An additional resource developed in 2015 is a home page where companies are invited to place job openings that are up to date for RTU students (https://ekarjera.rtu.lv/ in Latvian). Students have the opportunity to log in with the University username and keep abreast of current internships and job opportunities in their field.

RTU Development Fund provides additional support for practical skill promotion (https://www.rtu.lv/en/developmentfund). Hundreds of practical skill competitions are offered during the year, which are organised in cooperation with companies.

In addition, students can obtain information on internship places on the institute's website (www.ieei.rtu.lv), which includes a dedicated section with all the information on internship (http://ieei.rtu.lv/prakse.html).

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

The themes of the graduation papers are chosen according to the newest trends of the sector, as well as the latest and most important developments in the market. Themes are often selected in cooperation with industry partners and developed under their leadership.

A majority of the best graduation papers of the students of the programme are developed in cooperation with the industry companies and organisations where the students worked. The best graduation papers, which were evaluated with a grade of 8, 9 and 10, were developed on the following themes:

Academic year 2013/2014

Development of a Motion Sensor for Outdoor Control of Outdoor Lighting, Viktors Boroviks, scientific adviser: Dr.sc.ing., assoc. prof. P.Apse-Apsītis;

Industrial Electrical Drive System Optimization Based on Shared DC Bus, Rihards Dziedātājs, scientific adviser: Dr.sc.ing., prof. O. Krievs;

Analysis and Development of Energy Efficient Lighting for Veneer Processing Rooms, Artis Sniedze, scientific adviser: Dr.sc.ing., prof. Dr.sc.ing., prof. I. Galkins;

Improvement of Industrial Robots Energy Efficiency by Energy Storage Applications, Oskars Bormanis, scientific adviser: M.sc., lecturer A. Šenfelds;

Research and Development of Piezoelectric Ultrasonic Equipment for Diving Positioning, Valts

Bērziņš, scientific adviser: Dr.sc.ing., A. Stepanovs;

Construction and Control of an Industrial Robot Arm, Kristaps Širaks, scientific adviser: Dr.sc.ing., assoc. prof. J. Valeinis;

Academic year 2014/2015

Wireless Control Solutions for Technological Processes in the Oil/Gas Industry, Manoj Prabhakar Periyasamy, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Development and Research of PID Regulation System Based on Microcontroller, Aleksandrs Redkins, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Research and Implementation of Small HPP Efficiency Improvement Automation Systems, Deniss Mihejevs, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Optimization of Photovoltaic Systems, Igors Romanovs, scientific adviser: Dr.sc.ing., A. Stepanovs;

Development of a Permanent Magnet Synchronous Generator Maximum Power Tracking Algorithm for Wind Equipment, Dmitrijs Ivančenko, scientific adviser: Dr.sc.ing., A. Sokolovs;

Sewage Pump Station Automation and Telemetry, Roberts Broks, scientific adviser: Dr.sc.ing., assoc. prof. J. Valeinis;

Application of Automated Switches in 0.4 kV Electrical Network, Rolands Agafonovs, scientific adviser: Dr.sc.ing., assoc. prof. J. Valeinis;

Application of Frequency Converter Vector Control in Industrial Objects, Vilnis Riņķis, scientific adviser: Dr.sc.ing., prof. O. Krievs;

Research of Automation and Economy of Commercial Engineering Systems, Rihards Krūmiņš, scientific adviser: Dr.sc.ing., assoc. prof. J. Valeinis;

Optimization of Ventspils Station Sorting Hill Operation Using SIEMENS MSR32 System, Aleksejs Vasiljevs, scientific adviser: Dr.sc.ing., prof. M. Mezītis;

Heat Pump Systems, their Automation and Efficiency Evaluation, Linda Nierliņa, scientific adviser: Dr.habil.sc.ing., prof. I. Rankis;

Step Motors and their Control Principle Application of Digital Control Equipment, Vitālijs Daļeckis, scientific adviser: Dr.sc.ing., prof. A. Žiravecka;

Research of High-Precision Ultrasonic Drilling Machine Automation Possibilities, Filipps Suharevs, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Modernization of the Electric Drive System of the Extrusion Equipment Using a Stepper Motor, Jānis Ancāns, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Development of a Bidirectional DC Power Flow Emulator, Artūrs Paugurs, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Academic year 2015/2016

Reduction of Failure Time in an Automated Grid, Dace Gulbe, scientific adviser: Dr.sc.ing., assoc. prof. J. Valeinis;

The Principles of Automation of Oil Pump Stations in Centralized Automation System Structure, Gunārs Lūsveris, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Improvement of Reliability and Availability of Water Ultrafiltration Plant Automated Control System, Anfisa Barana, scientific adviser: Dr.sc.ing., prof. M.Gorobecs;

Milk Factory “Latvijas Piens” Ice Water Cooling Process Analysis and Optimization, Vitālijs Savickis, scientific adviser: Dr.sc.ing., assist. prof. I. Uteševs;

Research and Improvement of the Automated Control System of Viesmann Turbomat-RN-HW Boilers and Ancillary Equipment at Boiler House “G”, Andrejs Suharevs, scientific adviser: Dr.sc.ing., leading researcher, Aleksandrs Suzdaļenko;

Research and Development of Control System with Remote Access for Industrial Process, Ritvars Barbaniška, scientific adviser: Dr.sc.ing., assoc.prof I. Steiks;

Control Systems of Buildings Engineering Networks, Egīls Dzelzītis, scientific adviser: Dr.sc.ing., prof. O. Krievs;

Academic year 2016/2017

Analysis of Types, Electric Processes and Feasibility of Automatic Reactive Power Compensation Systems, Toms Ziemelis, scientific adviser: Dr.sc.ing., assoc.prof J. Zaķis;

Research of Harmonic Distortion Effects Generated by Nonlinear Loads and Design of Distortion Estimation Model, Kaspars Frišfelds, scientific adviser: Dr.sc.ing., prof. O. Krievs;

Solving of Exploitation Problems in the Smart Electrical Meters Power Line Communication Systems, Aleksandrs Šiškevičs, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Consideration of Possibility to Install Electrical Traction Drives in System of the Passenger Diesel Trains, Ervīns Alberts, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Control and Monitoring System Development of Drinking Water Iron Removal Plant of City of Grobina, Kārlis Sējejs, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Training Material: Drone Automation Components and Control, Armands Sīlītis, scientific adviser: A. Sokolovskis;

The Research and Analysis of Electromagnetic Combatility Problems in the LED Lighting Market Latvia, Mārtiņš Zalonskis, scientific adviser: G. Ašmanis;

Quadcopters Flight Optimal Trajectory Planning Using Shortest Route Algorithms, Viktors Bikovs, scientific adviser: Dr.sc.ing., prof. A. Ļevčenkovs;

Theoretical and Experimental Research of Thermoacoustic Alternating Current Magnetohydrodynamic Generator, Artūrs Brēķis, scientific adviser: A. Gailītis;

Academic year 2017/2018

Investigation of Usefulness to Install Frequence Converters for Multi-Pumps System of Carnikavas Polders Chain, Ģirts Dziedātājs, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Electrical Power Measuring Method Research and Development of New Measuring Method Using Fourier Transformations, Edgars Grinfogels, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Battery Characteristics and their Suitability Testing with an Electric Vehicle Model, Juris Fedotovs, scientific adviser: Dr.sc.ing., prof. A. Žiravecka;

Research and Development of Flame Recognition Algorithm for Fire Safety Systems, Māris Sardiko, scientific adviser: Dr.sc.ing., prof., M. Gorobecs;

Research of Automotive Power Electronics Digital Control Module, Ričards Poriņš, scientific adviser:

Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Industrial Robot Control Using Robot Operating System - ROS, Jānis Ārents, scientific adviser: M. Greitāns;

Research and Development of Software for Power Line Communication, Dmitrijs Bovts, scientific adviser: Dr.sc.ing., assoc.prof I. Steiks;

Research and Implenentation of Optimization Algorithm for Energy Consumption Minimization of Electrical Unmanned Aerial Vehicle, Aleksandrs Korņejevs, scientific adviser: Dr.sc.ing., prof. M. Gorobecs;

Research of Existing DC Link Smoothing Solutions and New Approaches for Variable Speed Drives, Kalvis Timšāns, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Comparison and Analysis of Control Methods of Wheelchair Electrical Machines and Battery Interface Converters, Aleksandrs Bubovičs, scientific adviser: Dr.sc.ing., prof. I. Galkins;

Academic year 2018/2019

Riga's Water Treatment Station "Daugava" Coagulant System Analyzing, Inspection and its Modernization Possibilities, Mihails Šepelevs, scientific adviser: Dr.sc.ing., assoc.prof. I. Steiks;

High-precision Current and Voltage Measuring System for Constrained Power Devices, Didzis Lapsa, scientific adviser: K. Ozols;

Optimization Possibilities for Piezoresistive MENS Sensors to Increase their Sensitivity, Olga Zīle, scientific adviser: Dr.sc.ing., assoc.prof. V. Bražis;

Designing of the Air Temperature Regulator for Living Room, Aleksandrs Ševcovs, scientific adviser: Dr.sc.ing., prof. A. Žiravecka;

Calculation Methodology of the Heat Dissipation in Electrical Panel and Impact on Product Life Cycle, Aigars Šmuksts, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Analysis and Evaluation of Measurement Methodology of Generators for Pļaviņas HPP, Ainārs Zībarts, scientific adviser: Dr.sc.ing., assoc.prof. I. Steiks;

Speed Governor PID Parameters of Riga HPP Refurbished Units and their Optimization, Raimonds Ratniks, scientific adviser: Dr.sc.ing., prof. I. Galkins;

Academic year 2019/2020

Research and Development of Technical Solution for Compressor Cascade Working Cycle Optimization, Oskars Janševskis, scientific adviser: Dr.sc.ing., prof. O. Krievs;

The Energy Supply Reliability Assurance by Deployment of Emerging Battery Energy Storage Systems (BESS) for RegionalSubstations, Gatis Mickevičs, scientific adviser: Dr.sc.ing., prof. N. Kuņicina;

Development of a Sound and Vibration Microcontroller-Based Waring System to Determine the Distance between Objects, Vlads Vladinovskis, scientific adviser: Dr.sc.ing., prof. I.Galkins;

Developing Approach for Operational Indicators Assessment of Hydrogenerator Unit, Based on Online Sensor System Data, Mārtiņš Juškāns, scientific adviser: Dr.sc.ing., prof. N. Kuņicina;

Aeration Control System in Biological Wastewater Treatment Plant with Process Monitoring, Rinalds Puriņš, scientific adviser: Dr.sc.ing., prof. A. Žiravecka;

Automation of Water Pumping Station and Exploring Energy Efficiency Improvement Options, Austris Bogdanovs, scientific adviser: Dr.sc.ing., prof. A. Žiravecka;

Research and Development of Electrical Drive Control System for Electrical Vehicle in Urban Environment, Vsevolod Burenin, scientific adviser: Dr.sc.ing., prof. A. Žiravecka

Elaboration of Automatic Assembly Device for Needle Bearing, Andrejs Odincovs, scientific adviser: Dr.sc.ing., prof. A. Žiravecka;

Sensor Network Technology Application for Development of Autonomous Beekeeping System, Aleksandrs Mihailovs, scientific adviser: Dr.sc.ing., prof. N. Kuņicina;

Research of Evaluation of Clothing Fit by Sensor Matrix, Jolanta Graudone, scientific adviser: Dr.sc.ing., prof. P. Apse-Apsītis, Dr.sc.ing., head of laboratory I.Dāboliņa;

Design of an Electric Vehicle Fast-Charging Station with Integration of Renewable Energy, Roberts Grants, scientific adviser: Dr.sc.ing., prof. N. Kuņicina;

Greenhouse Climate Management Options and Reduction of Energy Resources, Edgars Cērps, scientific adviser: Dr.sc.ing., assoc.prof V. Bražis;

Research of Automatic Recognition Methods of Parasitic Circuit Elements of Power Electronic Converters, Viktorija Ņikiforova, scientific adviser: Dr.sc.ing., leading researcher A. Suzdaļenko;

Investigation of Feasibility to Develop Uninterruptible Power Supply Systems for Powerful Electro-Technological Processes, Mikus Ančevs, scientifc adviser: Dr.habil.sc.ing., prof. I. Raņķis.

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

RTU Office of Vice-Rector for Academic Affairs regularly conducts student surveys on the ORTUS portal (during autumn and spring semester). The results of these surveys are available to the head of the study programme, as well as to the instructor of each study course. The head of the study programme and the instructor of the study course evaluate the results and make the necessary improvements. It can be concluded from the surveys carried out that students positively evaluate the study process and teaching methods used. The survey results are available at the ORTUS portal.

Student participation in the improvement of the study process is already being implemented and will take place in several ways. First of all, students will be regularly surveyed in ORTUS e-learning environment where, according to the results of the survey, the head of the study programme can assess the results and make the necessary improvements. Secondly, one of the themes for the graduate papers may be the upgrading of a new or existing laboratory workspace, particularly when it relates to the needs of businesses and new technologies, as well as the development of methodological material for teaching, or, for example, the addition of material with new computer models, electrical circuits, their descriptions, etc. Thirdly, students, also through the Student Self-government of the Faculty, organise various activities, field trips to production companies, competitions in the field of civil engineering, participate in exhibitions and discussions.

After internship, the survey of internship supervisors from the enterprises is also conducted on of students' knowledge, skills and achievements during internship, as well as their evaluation thereof. Summarizing the responses of internship supervisors, it may be concluded that the assessment of students’ knowledge and skills developed in the course of studies in most cases is positive.

The results of employer surveys as well as intern evaluations show that students are very well educated and trained for practical work at companies, that their theoretical knowledge and practical skills are at the highest level.

The overall opinion of students and graduates regarding the studies at RTU is reflected by the fact that the university has been the most recommended university by employers in Latvia for the last eight years. This annual research is performed by the Latvian Confederation of Employers (LDDK) in cooperation with the career and education portal prakse.lv.

Analysis of the references of students and graduates regarding the study process allows viewing the situation within the context and implement improvements in both organisation of studies and the teaching approach in the program as a whole and in individual subjects taught by various professors.

The results of graduate surveys show that during the studies, future professionals gained good theoretical knowledge and high-qualification skills in order to successfully work in the industry, as well as built serious foundation for further professional advancement and lifelong learning (Annex 15). 90% of respondents are satisfied with the selected study programme and the quality of studies. It should be noted that one hundred per cent of students combine work with studies and around 90-95% work in the field of power and electrical engineering, electronics, automation (or other related fields).

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

Students regularly have an in-service training at foreign technical universities. Cooperation with several foreign universities has been launched, where within the framework of ERASMUS+ mobility programmes students of the study programme “Computerised Control of Electrical Technologies” successfully start studies and successfully defend Master Thesis. The Tables below show that as of 2014, 3 students have participated in mobility programmes at different European universities, and one of these students used this opportunity twice. It can be concluded that overall students have an interest in mobility opportunities, and the level of knowledge of students is appropriate to the level of knowledge, skills and competences of study courses implemented by other internationally recognized universities. During the mobility, students study and take tests and exams at some of the best European universities, such as RWTH Aachen University.

ERASMUS exchange mobility programme atthe study programme “Computerised Control of Electrical Technologies”

No.	Name, surname	Country	Erasmus University	Period
1.	Matīss Stunda	Finland	University of Lappenranta	01.09.2014 - 19.12.2014
2.	Matīss Stunda	Finland	Lappeenrannan Teknillinen yliopisto	12.01.2015 - 23.05.2015

3.	Aleksandrs Gorjainovs	Germany	RWTH Aachen University	01.10.2013 - 28.02.2014

ERASMUS internship at the study programme “Computerised Control of Electrical Technologies”

No.	Name, surname	Country	Erasmus University	Period
1.	Ritvars Grēbers	Finland	Stora Enso Packaging Oy	01.05.2018 – 07.09.2018

In total, 166 incoming students have participated in a mobility programme since academic year 2013/2014. The students came from the universities of France, Lithuania, Czechia, Italy, Germany, Kazakhstan, Mexico, Finland, Turkey, and other countries, including Mongolia. Information on inbound mobility is provided in Annex 14.

Recognition of study courses covered during mobility takes place according to the “Amendments to the Organisation Procedure of Erasmus+ Student Mobility” (Resolution of RTU Vice-Rector for Academic Affairs No. 01000-1.1/240 as of 29 October 2014) and “Regulation on the Recognition of the Courses Completed at Other Universities and RTU Study Programmes” (Resolution of RTU Vice-Rector for Academic Affairs No 02000-1.1/29 as of 4 April 2016). The recognition of ERASMUS+ mobility is carried out by the head of the study programme on the basis of the Transcript of Records submitted by the student after the ERASMUS+ mobility and a previously signed application for recognition of study courses.

For the successful study course recognition, students are required to carefully choose a partner higher education institution in accordance with students’ study program and study field. The study courses and the application form must be approved by the ERASMUS+ coordinator and by the head of the study program.

During the recognition process, the evaluation of the courses acquired during ERASMUS+ program is not converted to a 10-point grading scale; the successfully acquired courses at the partner higher education institution are marked as “recognized” instead of the evaluation, thus recognizing the obtained credit points. If the application for course recognition includes amendments to the study program and the student has been successful during the ERASMUS+ program, RTU Vice-Rector for Academic Affairs draws up an order for individual amendments to the study program. Once the order has been issued, the study courses of the partner higher education institution are included in the RTU Study Register and amendments are made to the student's individual plan, including the courses acquired abroad. Amendments to the study program are made only at the expense of Part B, replacing the study courses with the study courses of the partner higher education institution.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the

information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

State budget subsidy to the students of professional Master study programme “Computerised Control of Electrical Technologies” amounts to EUR 249,861.05, tuition fee is EUR 14,205.00, EUR 264,066.05 in total or EUR 6 607,56 per one student.

Table 2. Funding of the Master study programme “Computerised Control of Electrical Technologies”

	State budget subsidy	Tuition fees of local students	Tuition fees of foreign students	Total funding to the study programme	Costs per 1 student, EUR
2019/2020	249861,05	14 205,00	-	264 066,05	6 607,56
2018/2019	214028,05	28 467,39	-	242 495,44	6 344,52
2017/2018	194007,59	24 904,00	-	218 911,59	6 060,99
2016/2017	174137,83	27 652,00	-	201 789,83	5 799,03
2015/2016	181902,52	35 934,00	-	217 836,52	5 799,03
2014/2015	202354,00	29 912,01		232 266,01	5 799,03
2013/2014	160254,00	12 631,00		172 885,00	5 799,00

In order to improve the resource base, additional financing from contractual work conducted by the faculty units is attracted. For example, two power benches are available for labs, which were at the IEEI designed within the framework of the international FP7 research project AREUS.

14 members of academic staff of the Department of Industrial Electronics and Electrical Technologies of FEEE IEEI are involved in the implementation of the study programme “Computerised Control of Electrical Technologies”.

In addition to the academic staff of the Faculty of Electrical and Environmental Engineering, general staff are involved in the management of the study programme that undertake study support processes, such as the organisation of study process, the management of public and international relations, student records, technical support of study programmes, work related to the implementation of the study programme. Their duties also include the organisation of business correspondence, the circulation of information, including cooperation organisations in Latvia and abroad, the coordination of telephone calls, e-mails, and correspondence, planning the work schedule of the manager, administration of appointments. They may also carry out simple financial records, analysis, assessment, and control of documentation, as well as drawing up various types of activity related reports on behalf of the manager and solving problems or non-standard situations.

Successful cooperation has been developed with the staff of the relevant faculty of Tallinn University of Technology, which ensures the improvement of the professional skills of employees and the exchange of students and employees.

In Latvia, study programmes in Power, Electrical Engineering and Electronics are implemented at Latvia University of Life Sciences and Technologies and the Latvian Maritime Academy, and the academic staff of the Faculty of Electrical and Environmental Engineering and Power Institute are actively involved in these programmes, creating joint scientific projects. The joint projects are also implemented with the Institute of Solid-State Physics of the University of Latvia, the Institute of Physical Energetics of the Latvian Academy of Sciences, RTU Faculty of Mechanical Engineering, Transport and Aeronautics, as well as Faculty of Computer Science and Information Technology.

With ERDF funding to the field of Power, Electrical Engineering and Electronics, since 2014 the study process has been implemented in a new and modern building with an up-to-date building management system with embedded sensors, climate control systems, energy-efficient lighting, etc., which also serve as a means of research. In parallel, existing and new laboratories have been upgraded:

- Power Electronics Training Laboratory;
- Electrical Propulsion Training and Research Laboratory;
- Manufacturing Automation Training and Research Laboratory;
- Computer Management Training and Research Laboratory;
- Microelectronics and Sensor Training and Research Laboratory;
- Energy Efficiency Training and Research Laboratory;
- Electronic Equipment Training Laboratory;
- Electrical Engineering Fundamentals Laboratory;
- Electrical Engineering and Electronics Training Laboratory;
- Research Laboratory of Semiconductor Converters;
- Industrial DC System Laboratory (AREUS Demo Lab);
- Student Creative Laboratory.

These laboratories have a brand-new infrastructure – furniture, network voltage links, blackboards, projectors, etc. In addition, the following training facilities have also been purchased: oscilloscope (RigolDS1052D, total number: 10 pcs), oscilloscope (Rigol DS4012, total number: 2 pcs), power measurement keys (Rigol RP1001C, 7 pcs), differential keys (RigolRP1025D, total number: 2 pcs), multimeters (u1233a, total number: 16 pcs), solar meter (solar-100), power parameter analysers (CIR-E3, number: 14 pcs), power units (EX752M - PSU, total number: 8 pcs), power units (QL355TP - PSU, PROG, TIPLE, 35V, 5A, 5V, 5V, 1A), total number: 2 pcs, power units (TTI - CPX400s - PSU, total number: 2 pcs), two power units (EA-PS 2042-20b - PSU), transformer (VELLEMAN sr-1000), accumulator-screwdriver/drill-machine (Festool), portable optical meter (Konica MINOLTA LS110)). New test benches have also been created for students' practical work: microelectronics, electron devices, propulsion system “lift drive” bench.

Within the FP7 project framework AREUS, a unique laboratory has been set up: a 600 V DC power supply network consisting of an industrial 21 kW robot KUKA Quantec Prime, a 55 kW active rectifier, two power benches capable of emulating electricity consumption of any robot, super condenser, and lithium-ion energy storage systems and other equipment. The Faculty of Electrical and Environmental Engineering has a compact solar storage system at its disposal; the storage system is with lithium-ion batteries and a charge-level control system; local, interlinked autonomous power supply systems with 3.6 kW wind generators and 6.6 kW solar panels; inverter electricity for grid transfer or lithium-ion storage systems for energy storage. In parallel, special programmable DC power units have also been purchased, which are capable of simulating solar panels or hydrogen systems with a power of 2 · 15 kW, 2 · 5 kW, 2 · 3 kW, fuel cell research set Ballard Nexa with a power of 2 1.2 kW and 8 kW.

For industrial process studies, the FESTO mini plant MPS and FMS complex, the compact water-level control work station FESTO Compact-Workstation, EMCO Concept Turn 105/EMCO Concept Mill 105 equipment kit are available.

Digital oscilloscope YOKOGAWA DLM6054-F-HE-L16/P4, oscilloscope (Rigol DS1052D – 10 pcs; Rigol DS4012 – 2 pcs), digital oscilloscope TEXTRONIX, Fluke, Rigol, etc. are available for signal measurement. In 2017, a fine BNC-type oscilloscope power key Ultra mini CWT015 was purchased to measure the current running through the legs of a transistor.

For the measurement of lighting parameters, the Avantes spectrometer, the solar meter (SOLAR-100), the portable optical meter (Konica Minolta LS-110), the infrared temperature meter Raynger ST60 ProPlus are available.

To determine energy performance parameters, electricity parameter analysers (CIR-E3 – 14 pcs), power analyser set N4L PPA5530-3 Phase (5 pcs), network analysers AR5 and AR5L, Fluke network analysers, etc. are used.

Variable AC and DC power sources, as well as other sources are used for the development of various converters, such as diesel generator SDMO DX 6000TE, solar panels, wind generator, hydrogen fuel cells, power units (EX752M – PSU, 8 pcs), direct voltage laboratory power unit (EA-PSI 9360-120 3U), direct voltage electronic load (EA-ELR 9150-30 3U) and electronic load for DC Electro Automatic ea-el3400-2, direct voltage laboratory supply unit (EA-PS 8032-10 T).

Electronic Technology Management System Development Platform dSPACE, Matlab/Simulink R14 modeling programme, simulation programme PSIM Profesional 8.0, Synopsys Analog Simulation and Modeling Synopsys Advanced TCAD individual license, license OrCAD PCB Design University Edition, software PSIM-JMAG, etc. are also available.

Prototyping equipment for PCB plates is used such as LPKF ProtoMat S64 PCB prototyping equipment, LPKF ContacRS PCB metalizing plant, HAWK 3D axis microscope, automatic multi-layer PCB press (4-8 slice plate development) LPKF multi-press; and electrical coil (throttle) rolling stand are available with Jovil Manufacturing SMC-2 equipment.

In 2017, owing to the financial support of Latvenergo JSC shareholder, equipment was supplemented in Latvenergo Student Creative lLboratory by purchasing a programmable 6 kW three-phase AC power unit, electro-automatic EA-ACP3P 520-16.8-6000-20U f 45-450.

In 2020, the Ergonomic Electrical Technology Research Laboratory joined the Institute. The Laboratory promotes interdisciplinary research, integrating the developments of materials science, electrical engineering, electronics and anthropometrics in ergonomic applications. Creating innovative and completive environment, it is possible to attract young researchers offering them opportunity to develop their PhD Theses for promotion of new research, creation of new products and services to promote sustainable development of Latvia in cooperation with the industry. In the process of studies, students have opportunity to conduct research in the fields of anthropometry and ergonometry using the equipment available at the laboratory (Vitus Smart XXL 3D scanner, traditional measuring equipment used in anthropometrics, twin-axis goniometer for measuring movement amplitude, relevant software).

All the equipment and laboratories mentioned above have been successfully used in the study process, students’ research, and in the development of graduation papers.

The infrastructure and technical support available for the implementation of the study programme, thanks to a high level of digitization, provide an opportunity to increase the competitiveness, quality, and efficiency of the University, as well as the availability of information, by integrating information technology (IT) solutions into the University's administrative, study and research work processes, providing students, administrative and academic staff with modern, reliable, secure and integrated IT infrastructure and high quality IT services.

To ensure easy and efficient identification of IT users, an IT user identity management system has been introduced; as a result, each IT user has a unique electronic identity that is valid in all information systems. In addition to the aforementioned, a user session management system is ensured in IT systems, which means that there is no need for IT users to re-authenticate when logging in to RTU information systems. It gives the experience of using a unified integrated information system without having to memorize different identification data and re-enter them, implementing different IT application scenarios.

All IT users are provided access to the centralised portal ORTUS (https://ortus.rtu.lv), which functions as a single digital gateway, combining information from all RTU information system components and providing users with an easy-to-use way of accessing the directory of all IT services in one place.

The Centralised Study Management System is used for efficient administration of the study process, which ensures digital provision of the study life cycle, incl. Electronic Register of Study Programmes (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub), drawing up learning agreements and enrolment of students in study programmes, Register of Study Courses (its public part is available at https://stud.rtu.lv/rtu/discpub/list), designing student's individual study plans, drawing up orders, implementing study courses and study process, registering grades, recognising study courses, awarding qualifications, administering payments, hostel information, gathering information to issue diploma supplements, etc. This system is one of the main cornerstones in the administration of RTU study process.

To ensure effective implementation of the study process, Moodle e-learning system is used, where all relevant information is compiled in an automated way (study courses, users, groups, access rights, etc.). This system ensures student-instructor communication. The academic staff members place various electronic materials, assessment tests, homework assignments, information on a particular study course, etc. in the system. Students can also view their financial information on the ORTUS portal, as well as make request for documents (references, transcripts of records, copies of a learning agreement, etc.).

Since 2007, more than 130,000 unique study course sites have been generated in the e-learning environment of RTU. Students can access electronic learning resources anytime and anywhere.

Digitisation of classrooms and schedules has been carried out to ensure efficient premise management and study planning (https://telpas.rtu.lv; https://nodarbibas.rtu.lv/). Each RTU student and academic staff member can access their schedule, which provides information on the venue, time, instructor, room, title and type of lecture. In addition, for user's convenience purposes, the system greatly facilitates lecture planning and scheduling, as well as optimises the use and efficiency of premises.

Electronic Staff Management and Record-keeping Systems, which cover the circulation of record-keeping and personnel documents at RTU (https://docs.rtu.lv/), are also used to ensure the efficient administrative work. Electronic document coordination and document e-signing functionality have been introduced, thus reducing print-based document circulation and significantly increasing document circulation speed. Since autumn semester of 2019, students have been provided with electronically signed learning agreements. Since 2016, RTU graduates have been receiving electronically signed transcripts of records.

In terms of quality assurance, a digital student survey system is used, with the help of which the quality control of study courses and study programmes is implemented each semester. Based on the results of quality control, regular measures are taken to improve study programmes and the study process, in general.

For additional convenience of RTU students, academic and general staff members, RTU leases Microsoft Windows and Microsoft Office software, which provides all IT users with access to the latest Microsoft software. RTU students can use the licensed Windows operating system and the Microsoft Office productivity suite provided by RTU for study needs. All IT users have access to Microsoft Office 365 cloud computing platform with one terabyte of storage space available to each user and access to a variety of additional collaboration and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic and general staff have access to the University's email system.

To support research activities, RTU has developed the Centralised Research Support System, which records all information on publications, patents, commercialisation applications, Doctoral Theses, RTU scientific journals, research staff, etc. The system provides access to information according to Open Access principle (https://science.rtu.lv). RTU students and academic staff also have centralised access to research software.

RTU has the high-speed fibre optic Internet and extensive wireless network infrastructure with over 400 access points, including the international *Eduroam* service. In addition, desk phones and mobile communications are provided for fast and easy communication.

To ensure a stable and secure operation of the information technology infrastructure, continuous monitoring of the IT infrastructure and systems is performed, resulting in proactive incident control. Data backup is also ensured.

The Information Systems Security Policy has been developed and implemented with the primary goal of ensuring the secure use of RTU information systems by establishing and maintaining a sufficient set of measures to reduce or prevent potential or resulting harm. Implementation of the Information Systems Security Policy envisages security checks, data transmission network monitoring, as well as preventive measures. Regular IT security and personal data protection training is organised for IT users. Automated security incident management and risk management have been implemented. Statistics demonstrate that the number of IT security incidents dropped significantly 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.

The University library plays a major role in providing methodological and information support to the students. The Scientific Library of RTU (https://www.rtu.lv/en/studies/scientific-library) is an academic library of state significance, which has obtained its status as a result of library accreditation. The Scientific Library of RTU provides the necessary information for RTU study process and research activities, performs library, bibliographic and information services for RTU students, teaching staff, and employees. The Library's collection includes 1.4 million printed documents and e-resources in the databases relevant to RTU fields.

In 2016, significant investment was made in the development of the library infrastructure, with the construction of an additional 2240 m2 of space for the Central Library. The total area of the library premises is 6393 m2, of which 3417 m2 are for reader services. There are 713 workstations for library users. The library has four group rooms and six individual cubicles, a Western reading room and a conference room. The library is accessible to users with reduced mobility.

To improve the work of the Scientific Library of RTU and to ensure the availability of information needed for study and research work, the Library Council has been established, which decides on the replenishment of the library's collection with printed publications and subscriptions to the necessary databases. The Library Council has approved the "*RTU SL Collection Completion Policy*", which defines the basic principles of collection formation and development in accordance with the fields of RTU study and scientific activities.

When RTU provides funding for the library, the funding for information resources for each study programme is calculated. The collection is replenished according to the recommendations of the heads of study programme, researchers, and the allocated funding. The desired titles can be ordered by contacting the Library's Collection Development Department, ordering on the Library's website, filling in the order form, filling in the application form, by phone 67089353 or by visiting the Library at Paula Valdena 5-105. The Scientific Library offers a guide to ordering titles and e-resources, which brings together the websites of various publishers and bookshops in Latvia and abroad.

Database subscription contracts are concluded both directly with the supplier and through the "Cultural Information Systems Centre" state agency, which is the Latvian national representative of the international non-profit organisation EIFL (Electronic Information for Libraries, http://www.eifl.net/). The EIFL Licensing Programme offers national libraries subscriptions to internationally recognised databases at significantly reduced subscription fees not offered to individual subscribers, thus saving financial resources of the libraries.

The database subscriptions maintained by RTU Scientific Library

(https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/abonetas-datubazes):

- ProQuest Ebook Central, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, EBSCOhost eBook Academic Collection, Wiley Online Library, SpringerLink, The International Monetary Fund.
- Databases financed by the Ministry of Education and Science available to RTU Scientific Library: ScienceDirect, SCOPUS (Elsevier), Web of Science.
- Latvian databases: LETA, Letonika, the Database of Latvian Standards (available on the premises of the Library).

Database usage at the Scientific Library of RTU has been growing since 2016. E-resource loans have increased from 75,391 to 525,194 items.

The new library premises have allowed to extend the range of services. Since the opening of the new premises in 2018, the number of visits to the library has increased from 103,825 to 235,600. The Scientific Library of RTU is open to everyone. The Central Library is open to users from Monday to Saturday. There is a 24/7 reading room. During the summer period, the Central Library is open every weekday with reduced opening hours. (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3) in Latvian.

The library sources are housed in an open-access collection. The last copies of the oldest publications corresponding to the RTU profile are kept in the library repository. They are always available to the users.

The librarian on duty helps visitors find their way around the collection. Bibliographers (information specialists) provide more detailed information and advice. The library has a branch librarian service. (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija).

The library resource search is supported by the Primo Discovery search tool (https://www.rtu.lv/lv/studijas/biblioteka/vienota-informacijas-meklesana in Latvian). It allows searching the library catalogue (https://kopkatalogs.lv/F/?func=find-b-0&local_base=rtu01), the subscribed databases, as well as databases created by the RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes) in one interface. Searching for information in the electronic joint catalogue (https://kopkatalogs.lv/F), it is possible to simultaneously obtain information on the resources available in 12 Latvian libraries. Both the electronic catalogue and the RTU portal ORTUS allow remote reservation of library resources, as well as remote access to the databases. Since the introduction of RFID technology, users can use five self-service book-dispensing machines and check out books from the pick-up machines around the clock.

The library provides students, academic personnel and other stakeholders with various levels of individual consultations and group training in information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas) in Latvian.

Publications not available in the library are delivered via an interlibrary loan or an international loan. Internet access is available throughout the library. The library has copying, scanning, printing, binding services and a self-service dining room.

During the reporting period 89 textbooks and 15 electronic books totally amounting to 104 study materials were purchased for the program acquisition.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

Academic staff with PhD degree and highly qualified professionals with the relevant work experience, which is approved in each CV, participate in the implementation of the study programme. The list of academic staff and their CV are included in the Appendices. Academic staff complies with the requirements for the implementation of study courses. This is reflected in both CV and scientific and methodological publications of academic staff, their participation in international and RTU scientific and methodological conferences. Academic staff and instructors with work experience in the industry participate in the implementation of the study programme. The results of student surveys show an overall high assessment of academic staff. The implementation of the study programme is ensured by the academic staff of RTU FEEE IEEE – professors and lecturers with a PhD degree, each of whom is an expert in their field.

As much as possible, academic staff from foreign partner universities are also involved in the implementation of the study programme: partners from Tallinn University of Technology, RWTH Aachen University, the University of Duisburg-Essen provide onsite and online lectures and practical/laboratory classes. Industry professionals, who provide classes that are orientated more towards practical tasks, have also been involved for several times during the reporting period – production planning engineer from the Mercedes-Benz plant in Germany, Davis Meike has conducted series of training for configuration of industrial robots.

According to the tasks of the study programme, the primary criteria by which academic 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.

Data on academic staff included in the Appendices show that their qualification can ensure the quality of study courses. During the reporting period, the number of academic staff members who have obtained a PhD degree has increased. For example, during the reporting period, new academic staff members have been involved in the implementation of the study programme, among them young doctors: Kaspars Kroičs, who obtained his PhD in 2018, Ričards Poriņš, who is currently a PhD student, Genādijs Zaļeskis (degree obtained in 2017), Jānis Marks (2019), Andrejs Potapovs (2014).

Overall, the qualification of all the teaching staff comply with the conditions of implementation of the study program and the requirements of laws and regulations, as well as ensures attainment of the program goals and study outcomes, which is attested by their qualifications and CV's.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The implementation of the study programme is ensured by the academic staff of RTU FEEE IEEE – professors and lecturers with a PhD and Master degree, each of whom is an expert in their field, as evidenced by their scientific publications and implemented research projects.

The academic staff involved in the study programme participate in academic and scientific conferences. They participate in various projects (see Annex 13) and elaborate scientific publications. Data on the involvement of academic staff in scientific research are reflected in the list of academic staff publications for the reporting period (see Annex 12). The results of scientific publications and participation in conferences are successfully used by academic staff in the teaching process, as well as in methodological work – published textbooks and teaching aids.

The implementation of the study programme is ensured by the academic staff of RTU FEEE IEEE – professors and lecturers with a PhD and Master degree, each of whom is an expert in their field, as evidenced by their scientific publications and implemented research projects. As much as possible, academic staff from foreign partner universities are also involved in the implementation of the study programme: partners from Tallinn University of Technology, RWTH Aachen University, the University of Duisburg-Essen provide onsite and online lectures and practical/laboratory classes.

Industry professionals, who provide classes that are orientated more towards practical tasks, have also been involved for several times during the reporting period – production planning engineer from the Mercedes-Benz plant in Germany, Davis Meike has conducted series of training for configuration of industrial robots.

According to the tasks of the study programme, the primary criteria by which academic 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.

The process of regular election and re-elections ensures that the academic personnel complies to regulations of Republic of Latvia, moreover – each semester teaching staff is being evaluated within the quality assurance procedure of RTU.

In order to ensure the quality of the study content, the academic staff involved in the implementation of the programme regularly improve their professional and academic knowledge at methodological seminars, conferences (national and international), as well as in scientific and research work (see List of publications of academic staff for the reporting period), participate in various scientific and methodological projects.

The involved academic staff actively benefit from international cooperation mobility programmes. For example, from 2014 to 2019, Prof. Ribickis visited the following universities: in 2014 - Moscow State Technical University, Chennai University, Delhi University, Autonomous University of Barcelona, University of Catalonia, Technical University of Valencia, Bordeaux University, Paris Tech University, Compiègne University, University of Florence, Lausanne Polytechnic University; in 2015 - Lausanne Polytechnic University, University of Moratuwa (Sri Lanka), University of Colombo (Sri Lanka), University of Antwerp, Holon Institute of Technology, Technical University of Wroclaw; in 2016 - Czech University of Life Sciences, Prague, Lodz University of Technology, Royal Institute of Technology, Sweden, Blackburn University; in 2017 - University of Malaga, University of Granada, University of La Laguna, University of Bergen, University of Porto, University of Ottawa, Polytechnique Montréal, Leiden University, Aalborg University, Muhammed V University in Rabat, Budapest University of Technology and Economics; in 2018 - Kumamoto University, University of Tokyo, Tokyo Denki University, Waseda University, Tallinn University of Technology, Palackas University, University of Madeira, University of Las Palmas de Gran Canaria, Kyungook National University, National Taiwan University of Science and Technology, WuFeng University, University of Duisburg Essen, University of Bucharest, LaSapienza University, University of Turku, Swiss Federal Institute of Technology, University of Bucharest; in 2019 - University of Trieste, University of Padova, University of Bergamo, Polytechnic University of Turin, University of Oulu, Albert Einstein University (Mexico), Monterrey Institute of Technology and Higher Education (Mexico), University of Peru, University of San Ignacio de Loyola (Lima), Catholic Pontifical University of Peru, Catholic University of Santiago del Estero, Tsukuba University (Japan), Shizoko University (Japan), University of the Azores, Alto University, Université Libre de Bruxelles, Vilnius Gediminas University, Mykolas Romeris University (Lithuania).

In 2013 and 2014, Professor Anastasija Žiravecka and Assistant Professor Svetlana Andrianova participated in the ERSAMUS+ staff mobility programme and visited the University of Ljubljana and Varna Technical University for an exchange of experience. In 2020, the head of the study programme Professor L. Ribickis, Professor A. Žiravecka, Researcher A. Avotiņš, with the Doctoral students involved in the academic process visited Aalborg University. Professor N. Kunicina visited Berlin University of Technology, Germany in 2014, Kaunas University of Technology, Lithuania in

2018. In 2019, Professor O. Krievs undertook internship at Ltd. EK Sistēmas within the ESF project SAM 8.2.2 – “Improvement of professional skills on the latest industrial automation technologies in academic year 2019/2020”. In 2018, he visited the Robotics Laboratory of the University of Duisburg-Essen and attended lectures (16 hours) on the use of industrial manipulator motion control software.

Mobility of academic staff, international scientific cooperation within projects, as well as publications ensure that the programme content changes and teaching methods are in line with the latest trends in the world, thus helping achieve the aims and learning goals of the study programme.

Professor Leonīds Ribickis holds a Doctoral degree in engineering. Alongside his academic, scientific and organisational activities, he is actively involved in Latvian and global scientific organisations, contributing to the development and improvement of the power and electrical engineering sector. He has more than 40 years of experience in higher education: study process management, scientific research, project management. Leonīds Ribickis is an academician of the Latvian Academy of Sciences and an expert in the field of engineering and technology - electrical engineering, electronics, information and communication technologies, as well as a member of RTU Senate and the Council of RTU Faculty of Electrical and Environmental Engineering, Chairman of RTU Promotion Council in Electrical Engineering, Chairman of RTU Council of Professors in Electrical Engineering. He has co-authored more than 600 publications, including 21 monographs and 77 patents on the following topics: electrical engineering, electronics, electrical drives, technological process and motion control, industrial robot equipment; semiconductor power converters, power electronics equipment and their control systems; energy efficiency of electrical equipment, smart DC networks; electric transport and e-mobility; electromechanical converters, AC and special electrical machines; alternative energy systems. He supervises Bachelor, Master and Doctoral Theses in subjects related to electric drive systems, industrial electronics and control systems for power electronic converters. He managed and executed more than 50 international and national projects related to scientific research.

Professor I. Raņķis carries out scientific work in the field of design and optimisation of DC electrical drives for electric trains, industrial and public electric transport. mRaņķis has worked with both full-time and part-time students, as well as delivered study courses to foreign students in English. He has also been a guest lecturer at Tallinn University of Technology and a trainee at the Royal University of Technology in Stockholm. He has supervised the internship of young lecturers of electrical engineering subjects at Vilnius Gediminas University and Riga Technical University. Raņķis has been active as a scientific adviser of students' qualification papers, i.e., engineering projects (50), Bachelor Papers (30), Master Theses (40). Prof. I. Raņķis has supervised 9 Doctoral Theses in engineering.

Professor I. Raņķis is active in the field of science. His research interests include the development and study of energy storage systems in active cooperation with various enterprises, the study of pulse regulation systems for AC electrical systems, and the study of the efficiency of the application of non-linear inductances.

In general, Prof. I. Raņķis purposefully improves his qualification, actively cooperates with young engineering specialists, is able to confidently help students overcome study difficulties and problems and promotes students' professional growth. He is a very effective member of the student learning system.

PhD student, Researcher Kristaps Vītols, has obtained a Master's Degree in electrical science (M.sc.ing.), has completed doctoral studies at Riga Technical University and is a candidate for a scientific degree in electrical science, the defence of the dissertation is planned in the near future.

Participates as researcher in projects at the Institute of Industrial Electronics and Electrical Engineering of Riga Technical University for more than 12 years. He is a member of the IEEE organization and regularly reviews the content of the IEEE publications to get the latest news on technological and scientific developments. He regularly publishes publications and participates in scientific conferences, as well as transfers accumulated knowledge to students by supervising bachelor papers, consulting master thesis and providing practical classes in microcontroller programming and digital electronics.

Professor Oskars Krievs holds a Doctoral degree in the field of power electronics and has 20 years of academic experience in electrical engineering and power electronics. During this period, O. Krievs has led or participated in 16 scientific projects, including two international ones. Since 2020, O. Krievs has been the Dean of the Faculty of Electrical and Environmental Engineering at RTU, and from 2011 to 2020 - Dean of the Faculty of Power and Electrical Engineering at RTU. Currently O. Krievs delivers 3 study courses in the field of electrical engineering, but in total he has developed or participated in the development of more than 10 study courses. To improve his qualifications, O. Krievs has participated in 36 international scientific conferences, as well as undertaken internships at the Polytechnic University of Turin (2007), University of Duisburg-Essen (2018) and Ltd. EK Sistēmas (2020). In 2019, O. Krievs received the award of the Latvian Academy of Sciences for the most significant achievements in science, and in 2017 - the annual award of the Latvian Academy of Sciences and JSC Latvenergo for significant contribution to the field of power engineering. Since 2019, O. Krievs has been a member of the Latvian Association of Power Engineers and Energy Constructors.

Professor I. Galkins holds a Doctoral degree in Electrical Engineering, which he obtained in 2001 for his Doctoral Thesis "Design and Research of Matrix Converters". He has more than 20 years of experience in the participation and management of national and international projects. He is currently leading or has led from 2001 to 2021 more than 10 projects with a total budget of around 2 million EUR. Several years of research experience - author of 3 books and 88 articles related to power electronic converters, electrical drives and electrical devices for orthopaedic applications, as well as 6 patents. I. Galkins' h-index in SCOPUS database is 11, his 88 articles have been cited 364 times. He conducts research in the field of power electronics, including lighting and medical electrical equipment. He has been the scientific adviser of 6 successfully developed Doctoral Theses in the field of electrical engineering and the reviewer of 4 Doctoral Theses. He has several years of experience in the field of education as well as in the management of the study process. He has developed and delivered 15 study courses. He has supervised 36 graduation papers. He is the chairman of IEEE - Professional Electrical Engineers Society, a joint chapter of IEEE Latvia IAS/IES/PELS. He is an expert of the Latvian Council of Science in Electrical and Power Engineering. He is the Editor-in-Chief of RTU Scientific Journal on Electrical, Control and Communication Engineering.

Associate Professor Andrejs Potapovs holds a Doctoral degree in electrical engineering and automation. He has more than 10 years of professional experience in higher education. The research component of his work with students is ensured by regular exhibition and presentation of research papers, as well as by participation in more than 15 international research projects. Academic knowledge is regularly improved by attending various RTU pedagogical qualification improvement courses. During the classes, students are actively involved in various practical assignments, providing an opportunity to apply the theoretical knowledge learned in practice.

Anastasija Žiravecka, Dr.sc.ing., Professor. She publicly presented her Doctoral Thesis in 1999 at Riga Technical University. She has worked as an Assistant Professor, Associate Professor since 2005, and as Professor since 2014 at the Institute of Industrial Electronics and Electrical Engineering. Author of more than 90 scientific publications and textbooks related to electrical drives and their control, power electronics, energy saving. Participated in and managed local and international research and training projects - TEMPUS, ERASMUS+, ERDF. In 2014/2015 she participated and coordinated the development of the new professional Bachelor study programme "Adaptronics", in 2019/2020 she coordinated the development and licensing of the new professional Master study programme "Adaptronics". In addition, she publicly presented her Master Thesis in English Philology in 1998. She participates in, as well as coordinates the work with foreign students.

Associate Professor **Gundars Ašmanis** has a Doctoral degree in electrical engineering. He has more than 12 years of experience working as a Radio Engineer, Quality System Manager, Leading Researcher and Technical Director at an internationally accredited electromagnetic compatibility testing laboratory of the Latvian Electronic Equipment Testing Center. He has more than 12 years of experience working at Riga Technical University as a Research Assistant, Lecturer, Associate Professor, Researcher. He spent six months at the European Space Agency (ESA ESTEC) in the Electromagnetic Compatibility Testing Division, developing and testing power filters for the Columbus International Space Station scientific module. Gundars Ašmanis' qualification is appropriate for the implementation of the study course.

Associate Professor and Leading Researcher Jānis Zaķis has a PhD degree in electrical engineering. He has more than 15 years of experience in the field of higher education: participation in the study process, research and international project management. As the leading researcher and scientific project manager, he has participated in the elaboration of project applications, project management and implementation, the elaboration of scientific articles for conferences and journals. He regularly attends international conferences and seminars on relevant research topics, reviews scientific articles and projects, is a member of conference and scientific journal editorial board. J. Zaķis regularly develops his knowledge by attending teaching qualification courses, as well as various seminars organized at RTU. The knowledge and skills acquired in the field of research are integrated into the content of lectures, thus ensuring the topicality of study courses. The achievement of high-quality study results is ensured by both academic knowledge and scientific activities performed by J. Zaķis.

Associate Professor Viesturs Bražis holds a Doctoral degree in electrical engineering. He has 19 years of professional academic experience as a Research Assistant, Assistant Professor, Associate Professor and Senior Researcher. His research interests are in the field of energy storage system application. The research component of his work with students is ensured through participation in scientific conferences and publications. The practical and academic experience is fully relevant to the specific nature of the courses implemented.

Associate Professor Aivars Pumpurs holds a Master degree in engineering (M.sc.ing.). After completing his studies, he has more than 15 years of practical work experience in manufacturing related to the development and operation of electronic and automation equipment. He has participated in several research projects and scientific conferences. He has more than 20 years of academic experience: delivering lectures, supervising laboratory work and graduation papers, and developing a number of study courses. He has completed his Doctoral studies and is currently working on his Doctoral Thesis. He continues to keep abreast of trends in automation processes, reading the latest literature and putting into practice the knowledge acquired in the process of training students, both in theory and in laboratory work.

Pēteris Apse-Apsītis hold a Doctoral degree in engineering. He has more than 50 years of industrial and scientific research experience in electrical engineering, electronics, ICT, automation, printing, papermaking, audio-visual arts and automotive technology in Latvia and abroad. In total, he has managed and implemented more than 300 projects, including international ones, for various equipment and systems. Author and co-author of several patents and dozens of scientific publications. He received the Annual Award 2018 named after Professor Alfreds Vitols from Latvenergo JSC and the Latvian Academy of Sciences. Expert of the Latvian Council of Science. Professor and Senior Researcher at the Institute of Industrial Electronics and Electrical Engineering, Riga Technical University.

Visiting Lecturer Dāvis Meike holds a Doctoral degree in engineering and is a Planning Engineer in the manufacturing industry. His Doctoral Thesis is on energy efficiency in industrial robotics. His research areas include highly automated manufacturing systems, power transmission in direct current (DC) grids and related technologies, consumption and flow optimisation, as well as general industrial automation. In these areas, D. Meike has coordinated both publicly co-funded international research projects and product development in the private sector. He is the author of more than 20 peer-reviewed scientific publications and patent articles.

Professor Mihails Gorobecs holds a Doctoral degree in electrical engineering and a Master degree in Information Technology. He has more than 15 years of academic and research experience. Since 2012, M. Gorobecs has been an expert of the Latvian Council of Science in the field of Electrical Engineering, Electronics, Information and Communication Technologies (i.e., in computer control of industrial processes, motion control and optimisation using artificial intelligence equipment and methods). His main research interests are embedded software engineering, computer control of transportation systems, embedded intelligent electrical devices, decision support methods in transportation systems, adaptive systems and methods, genetic and evolutionary algorithms, neural networks, fuzzy logic control methods, railway transport control, safety and optimisation methods, computer control of unmanned electric vehicles, mathematical and simulation modelling of systems. M. Gorobets has more than 10 years of experience in managing various international and national projects in the field of electric and railway transport. He is the author of several textbooks, methodological tools, and patents.

Associate Professor **Inna Buņina** has a Doctoral Degree. She has more than 15 years of experience in the field of higher education; she has been engaged in study process management, research, and quality assessment. She has worked as a Research Assistant, Assistant Professor, and Researcher. The qualification of engineer and work experience in the industry ensure the achievement of thorough learning outcomes. The acquired knowledge and professional skills are successfully integrated in the Bachelor study programs "Computerised Control of Electrical Technologies" and "Adaptronics". She improves her knowledge by attending pedagogical qualification improvement courses.

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the

relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

The academic staff involved in the implementation of the study programme participate in academic and scientific conferences. They are engaged in various projects and develop scientific publications. Data on the involvement of the academic staff in scientific research are presented in the list of publications of the academic staff during the reporting period.

All academic staff participate in or lead various types of international and local research projects, such as ERDF, FLPP and others. Academic staff also participate in international ERASMUS+ projects, developing new courses and textbooks. The results of the projects are regularly reported in conference and journal publications and used in their pedagogical work - lectures, seminars, other activities with students, as well as in academic tools and monographs. For example, within TEMPUS and ERASMUS+ projects in cooperation with the partners from other European universities in the reporting period 10 learning aids were published, which are used in the implementation of the professional Master study programme “Computerised Control of Electrical Technologies”. Many of the graduation papers are written in the framework of the projects and on the scientific activities and results of the projects. The list of projects carried out is available in Annex 13.

Data on the involvement of academic staff in scientific research are presented in the list of publications of academic staff during the reporting period.

Prof. L. Ribickis was the Chair of the Organising Committee of the global conference EPE ECCE Riga 2018. He organised the five-day conference, which was attended by about 700 scientists.

Faculty of Electrical and Environmental Engineering hosts the annual RTUCON series of international scientific conferences, where scientists and students from different countries exchange research results in electrical engineering, generate prospective ideas and establish contacts for potential research. Typical conference participation is 100-200 participants from 20-50 countries. Currently (as of 2014) the conference is supported by the IEEE and IEEE IAS Societies. As of 2014, about 650 papers had been published in the IEEE Xplore database as well as in the SCPOUS and TR-WoS databases.

POWERENG2015 is another electrical technology conference which took place in the EVIF. The conference was supported by IEEE and IEEE-IES association. 113 articles of the conference are available in the data bases IEEE Xplore, SCPOUS and TR-WoS.

There is a direct and indirect impact of the RTUCON conference series on the Faculty of Electrical and Environmental Engineering on the study process. The direct impact is realised through a dedicated working session on "Education in Engineering", which provides an opportunity for academic staff from several universities and countries to exchange methodological experiences in the field of engineering education. It also reflects the trend towards using the latest scientific developments in the academic work environment. In addition, RTUCON conferences support (special sessions and prizes) students presenting their research results. Finally, some instructors involve students in the conference, for example, through elaboration of papers in which students are invited to analyse and evaluate the achievements of other scientists for extra credit points.

The results of research and projects are integrated in the study courses and presented to students. For example, the results of the European international projects LITES, ERDF uMOL and ERDF SAVAS are used as lecture material, laboratory work and practical calculation tasks in the study courses "Energy Efficient Lighting", “Introduction to Specialisation”.

In addition, the AREUS Project Laboratory is used for this study course in addition to practical work in the course "Control and Regulation of Electrical Drives". Since 2016, Dr.sc.ing, Production Planning Engineer Dāvis Meike from Mercedes-Benz delivers the study course "Fundamentals of Industrial Robotics".

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

To ensure that the content of the study courses does not overlap, an annual review of the courses of the study programme takes place, as well as seminars in which the academic staff involved in the implementation of the programme present the course outline and academic methods to their colleagues and discuss improvements that would ensure a higher quality of the programme content and meet the current trends in the field.

Analysing the student-academic staff ratio within the study programme at the time of submission of the self-assessment report, the programme has one elected faculty member per 7 students and one specialist in the respective field per 15 students.

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	5.pielik_REGO studenti statistika ENG.odt	5.pielik_REGO studenti statistika ENG.odt
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	6.pielik_Atbilstība valsts izglītības standartam REGO0_EN.docx	6.pielik_Atbilstība valsts izglītības standartam REGO0 (3).docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)	7.pielikums Atbilstība profesijas standartam REGO EN.doc	7.pielikums_Vad.Elektroinženieris_REGO_2 (1).doc
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	8.pielik_REGO kartējums_ENG.xlsx	8.pielik_REGO kartējums_LV.xlsx
Curriculum of the study programme (for each type and form of the implementation of the study programme)	9.pielik_REGO plānojums_eng (1).xlsx	9.pielik_REGO plānojums_LV (2).xlsx
Descriptions of the study courses/ modules	REGO0_courses_ENG.zip	REGO0_kursu apraksti LV.zip
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	REGO diploms_ENG.zip	REGO diploms LV.zip
Description of the Study Programme - Other mandatory attachments		
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	Confirmation of the possibility to continue education MSP (1).pdf	apliecinājums par studiju turpināšanas iespējām.edoc
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	Apliecinajums - Par zaudējumu kompensaciju.edoc	Apliecinajums - Par zaudējumu kompensaciju.edoc
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.	Apliecinājums - Svešvalodu prasme.edoc	Apliecinājums - Svešvalodu prasme.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education		
Sample (or samples) of the study agreement	Sample_of_study_agreements.zip	Studiju līgumi.zip
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.		

Smart Power Systems (51522)

Study field	*Power Industry, Electrical Engineering, and Electrical Technologies*
ProcedureStudyProgram.Name	*Smart Power Systems*
Education classification code	*51522*
Type of the study programme	*Doctoral study programme*
Name of the study programme director	*Antans Sauļus*
Surname of the study programme director	*Sauhats*
E-mail of the study programme director	*Antans.Sauhats@rtu.lv*
Title of the study programme director	*habilitētais doktors*
Phone of the study programme director	
Goal of the study programme	*The aim of the PhD studies is to train highly qualified specialists in the area of power and electrical engineering, who can solve research and innovation tasks in the field.*
Tasks of the study programme	*The tasks of the PhD study programme are as follows: - To provide in-depth theoretical knowledge in the fundamental study courses of the study field, to ensure acquisition of skills through scientific and research work, as well as scientific discussion skills; - To develop PhD students' knowledge of technical innovation methods; - To provide PhD students with the knowledge and skills for their pedagogical activities; - To develop foreign language skills to the level required for international scientific communication; - To promote internationally relevant research, presentation of its results and participation of PhD students in international and local conferences.*
Results of the study programme	*The students are able to independently evaluate and select research methods appropriate to the fields of electricity and electrical engineering and have gained new understanding of the existing knowledge and its application in practice by conducting a substantial amount of original research, some of which is at the level of internationally cited publications. The students are able to communicate on topics related to their field of scientific activity with other scientists and the general public. The students are able to independently improve their scientific qualifications, implement scientific projects and manage research or development tasks. The students are able to complete significant research or innovation tasks by independently performing critical analysis, synthesis, and evaluation. The students are proficient in research methodology and modern research methods.*
Final examination upon the completion of the study programme	*PhD Thesis (dissertation).*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*

Amount (CP)	*192*
Admission requirements (in English)	*master degree of engineering or comparable education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D.) in Electrical Engineering, Electronics, Information and Communication Technologies*
Qualification to be obtained (in english)	—

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 4 years - english

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*english*
Amount (CP)	*192*
Admission requirements (in English)	*master degree of engineering or comparable education The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D.) in Electrical Engineering, Electronics, Information and Communication Technologies*
Qualification to be obtained (in english)	—

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 5 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*192*
Admission requirements (in English)	*master degree of engineering or comparable education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D.) in Electrical Engineering, Electronics, Information and Communication Technologies*
Qualification to be obtained (in english)	-

Part time extramural studies - 5 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*english*
Amount (CP)	*192*

Admission requirements (in English)	*master degree of engineering or comparable education The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D.) in Electrical Engineering, Electronics, Information and Communication Technologies*
Qualification to be obtained (in english)	-

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

The PhD study programme “Smart Power Systems” (further referred to as the Study Programme) is the only PhD study programme in Latvia that trains highly qualified specialists (Doctors of Science) in power engineering and electrical engineering who are recognised on an international level, by providing theoretical and practical knowledge necessary for independent scientific and research work and pedagogical work, thus ensuring the intellectual potential and renewal necessary for the country’s economic development.

On 31 May 2021 (RTU Senate Meeting Minutes No. 650), based on a decision of the meeting of RTU Power and Electrical Engineering and Electrical Technology study direction commission (minutes Nos. 27000-8.1/2 un 27000-8.1/6), significant changes were made to the Study Programme, the main aim of which was to modernise and partially modify the existing doctoral study programme “Power and Electrical Engineering”, taking its transformation as a basis for studies in the field of smart power systems, namely:

1. To change the title of the Study Programme, “Power and Electrical Engineering”, to “Smart Power Systems”;
2. To make changes to the content of the Study Programme with the aim to improve and fine-tune it;
3. To add to the composition of languages of implementing the Study Programme, making it possible to implement it in English;
4. To change the teaching staff of the Study Programme.

Appendix 15 contains information about the parameters of the Study Programme before the above changes.

The activities to be carried out during the modernisation of the study programme and the expected results (competitive graduates) are optimal to promote the development of knowledge, skills, competences and adaptability of young specialists to new trends, by addressing the challenges of scientific research and innovation in the field.

The place of implementation of the study programme is Riga. The mode of implementation is full-time intramural studies and part-time extramural studies. In the standard plan at RTU there are 2 terms per academic year, the duration of each term is 20 weeks — 16 study weeks and 4 examination session weeks. After the most recent changes, the study programme will be implemented in Latvian and English.

The modernisation process for the study programme was carried out in line with European experience in the development of interdisciplinary curricula and in line with the Bologna Process. It is in line with European educational standards and has been adapted to the current requirements of scientific research institutions and the industry.

The content of the study programme and its implementation are based on the existing laws and regulations of the Republic of Latvia, the principles of doctoral education recommended by the European University Association, the EQUAL Guidelines for Doctoral Programmes adopted in May 2016, and in line with the strategic development aims of RTU and the Faculty of Electrical and Environmental Engineering (FEEE) and the UN Sustainable Development Goals in higher education.

The programme is unique in that it conducts research in areas related to various aspects of environmental design, in line with the European Green Deal and other initiatives. On average, out of the 1-2 PhD students who start their studies each year, at least one PhD student defends their thesis.

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

For the analysis regarding students, statistical data for the reporting period 2014/2015 – 2020/2021 were used, see Appendix 5.

As can be seen, the number of graduates of the Study Programme is variable, but the dynamics of enrolled students ranges from 1 to 10. While in the period from 2014/2015 to 2017/2018, 7 to 10 PhD students were matriculated in the first year of each academic year, the number of matriculated students dropped in the academic year 2018/2019, which can also be explained by the reduction in the number of study places funded by the state budget (see table “Student enrolment dynamics and distribution in study courses by study year”, Appendix 5) as well as by the time-consuming nature of the research (students’ inability to combine doctoral studies with work and family life). Considering that before the changes made on 30 April 2021, the only implementation form of the Study Programme was that of full-time studies and the Study Programme was not implemented in English, the statistical data do not contain information about extramural and foreign students.

The dropout rate for study programmes has remained fairly stable throughout the reporting period. The most frequent reasons for dropping out are related to failure to keep up with studies and expulsion as well as personal reasons (lack of finances, change of place of living (moving abroad) and other reasons). There are also cases where students do not resume their studies after an academic leave. There were no cases of matriculation becoming the reason for expulsion during the reporting period.

The study programme is focused both on the Latvian and foreign labour market needs for specialists in the field of electric power, therefore, starting from the academic year 2021/2022 it will also be offered to foreign students and will be implemented in two languages, namely, Latvian and English, in full-time (intramural) and part-time (extramural) forms of studies.

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

The relevance of the study programme to labour market needs and scientific trends is demonstrated by the high and steadily increasing demand for PhD holders in all areas of the economy. In response to climate change and the desire to become independent from imported fossil fuels, there is a pressing need to increase the share of electricity obtained from renewable energy sources, which is one of the reasons why electricity grids are currently being transformed into smart grids. The study programme carefully takes this factor into account as a characteristic and important global trend in the electricity sector today, in addition to the industry's demand for qualified electric power professionals to provide the companies operating in the sector with the necessary workforce in the field of electricity generation and supply and the related field of energy construction. At present, there are no analogous study programmes in Latvia.

The PhD study programme is implemented in accordance with the Law on Higher Education Institutions (adopted on 2 November 1995), the Law on Scientific Activity (adopted on 19 May 2005), the Law on Education (adopted on 29 October 1998), the Cabinet of Ministers Regulation "On the Procedure of and Criteria for Awarding a Doctoral Scientific Degree" (adopted on 31 December 2005), RTU Constitution, the resolutions of RTU Senate and RTU Regulation for Doctoral Studies. The programme is implemented in compliance with the main directions of RTU research and is aimed at preparing a new generation of academic staff and scientists in accordance with the Cabinet of Ministers Order No. 331 "Guidelines for the Development of Education for 2014–2020". The compliance of the Study Programme with the State Education Standard is reflected in Appendix 6.

The Study Programme was established on 30 April 2001 (RTU Senate Meeting Minutes No. 458). Its content and the division of study courses into terms (half-years) had not been changed since then, except that, according to the decision of RTU Senate of 28 June 2010 (Minutes No. 542), it was decided to shift from a 3-year study model to a 4-year study model. Thus, in the 4th year of the Study Programme, an additional 48 Latvian credits have been added for the research paper (dissertation), thus increasing the total number of Latvian credits from 144 to 192.

The Study Programme has been designed in accordance with the national higher education standard and other regulatory acts. It was reaccredited on 30 June 2010 with accreditation certificate No. 023-1909 until 31 December 2016. Based on the high evaluation of the Ministry of Education and Science and foreign experts in the academic year 2012/2013, it was ranked in the highest group, and as a result, according to Accreditation Certificate No. 54, the Study Programme/study field was accredited for the time period from 29.05.2013 till 28.05.2019.

The development of the doctoral study programme is guided by the European Qualifications Framework, the Bologna Process and other regulatory acts.

The Study Programme offers students with a professional or academic master's degree in engineering, natural sciences, mathematics, computer science, or other related field, obtained at an accredited education institution, the opportunity to continue studies.

To enrol privately financed foreign students to the Study Programme, additional requirements have been set regarding the necessary minimum knowledge of English (Table 1). In compliance with Part 1 of Article 15 of the Law on Higher Education Institutions and the RTU Senate Decision of the meeting of October 28, 2019 (minutes No. 633, "Regulations Regarding Enrolling Foreigners to Study Programmes and Study Programme Parts Linked to RTU Department of International Cooperation and International Students in 2020", https://www.rtu.lv/writable/public_files/RTU_par_arzemnieku_uznemsanas_noteikumu_rtu_starptautiskas_sadarbibas_un_arzemju_studentu_depart._piesaistitajas_stud._programmas_un_programmu_dalas_2020._gada_apstiprinasan.pdf, site language: Latvian), foreign nationals, when applying for studies, must submit a document issued by an international testing institution during the last five years, attesting that the foreigner's mastery of the language in which the corresponding study programme is implemented corresponds at least to the B2 level. This requirement is waived if the foreigner has obtained secondary or higher education in the language in which the corresponding study programme is implemented.

The volume of the study programme is 192 Latvian credits, with a duration of 4 years (full-time studies) or 5 years (part-time studies). On average, there are 20 contact hours per week and 16 study weeks per term. PhD students master compulsory, field-specific and free elective study courses in the field of power and electrical engineering and are able to deepen their knowledge of a foreign language on professional, scientific and research topics.

PhD studies are mainly implemented in the form of practical classes, at which the doctoral student independently conducts research assigned by the instructors. In the introductory classes, the study course is introduced, and the assignments are formulated. The doctoral student concludes each study course with a 20–30-page-long report, which is submitted to the attestation committee. In the second phase of the studies, scientific research is conducted within the framework of an individual PhD thesis.

1. The **aim** of the study programme is to prepare internationally competitive specialists of the highest qualification for academic and scientific work at universities and scientific research centres, as well as for organisational work at public and private institutions in the field of power and electrical engineering, capable of dealing with scientific research and innovation tasks in the field, namely:

- management of the efficiency, reliability, stability, and risks of power systems;
- development of methods and tools for the operation of power facilities;
- power supply systems, distribution networks and their reliability;
- planning and optimisation of power supply systems;
- research and optimisation of smart lighting systems;
- specific features of the operation of electricity producers in the overall power system and at the conditions of an electricity market;
- optimal control technologies applicable to the energy market as well as to generation, transmission, distribution, consumption, and energy saving;
- expertise in energy demand and saving, techniques of efficient use of energy in construction, manufacturing, the primary sector, and the transport industry;
- development and integration of various control systems and models of energy efficiency, etc.

1. Nowadays, one of the main tasks of higher education systems around the world is to support student employability and to adapt the entire education ecosystem to make education in this aspect the most effective part of society, and a substantial one.

The **main tasks** of the study programme are as follows:

- To train qualified specialists in the field of power and electrical engineering by providing them in-depth theoretical knowledge, as well as ensure skills acquisition through scientific and research work;
- To develop PhD students' knowledge of technical innovation methods and smart technologies;
- To develop PhD students' scientific discussion skills;
- To provide PhD students with the knowledge and skills for carrying out pedagogical work;
- To develop PhD students' foreign language skills to the level required for international scientific communication;
- To promote the conduct of internationally significant research, presentation of research

results and participation of doctoral students in international and local conferences.

As a result of mastering the Study Programme, the graduate (planned results):

- Is able to independently evaluate and select research methods corresponding to power and electric engineering fields, has given new understanding to the existing knowledge and its applications in practice, implementing an original study of a considerable size, part of which is at a level of internationally citeable publications;
- Is able to communicate on the subject of their field of scientific activity with the scientific community and society as a whole;
- Is able to independently improve their scientific qualifications, implement scientific projects, direct research or development tasks;
- Is able, by independent critical analysis, synthesis, and evaluation, to address important research or innovation problems;
- Has a good command of research methodology and modern research methods.

Overall, the aims and tasks of the Study Programme as well as the planned learning outcomes (i.e., knowledge, skills, and competences) are closely interlinked (see the Figure). The probability of reaching them is very high because the education content is based not only on scientific logics of knowledge and academically structured tasks but also on tasks and projects that are aimed at the professional practice of the future graduates.

The following main lines of action are identified for the implementation of the study programme:

- To establish closer links between universities and the industry at national and international level;
- To optimise and modernise teaching methods;
- To improve the competences and skills of the academic staff involved in the teaching process.

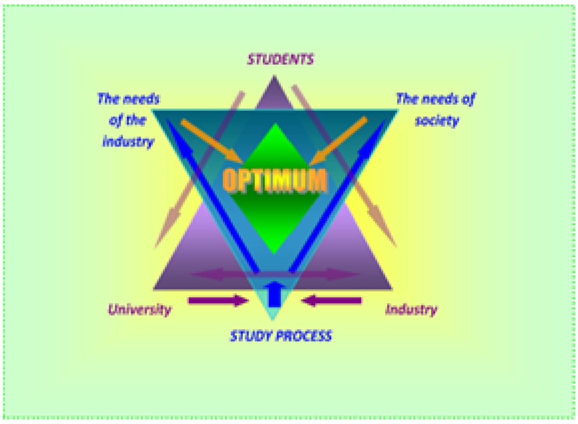

Figure. The concept of the Study Programme

The main contribution of the study programme will be related to sustainable development and excellence. Particular attention will be paid to management and strategy planning, a process approach, the development of products and services, the improvement of the money flow and the financial activity indicators, the improvement of effectiveness in all the spheres of activity, and to increasing the satisfaction level of the students, the cooperation partners, and the employees.

III. A SWOT analysis of the study programme, shows that, from a formal point of view, it has more strengths and opportunities than weaknesses and threats. The SWOT analysis with a detailed description of indicators is to be found in the characterization of the study direction.

Strenghts (S):

- Provision of the study courses with e-resources (the ORTUS portal)
- The multifaceted array of study courses within the study programme
- Study courses with content that is important for a wide range of specialists
- A large share of young academic staff (71.4% of the staff are under 50 years of age)
- Qualifications of the academic staff, which ensure the theoretical and research potential (100% of the staff hold a doctoral degree in Engineering)
- Involvement of experienced professionals in the field into the implementation of various study courses of the Study Programme
- Involvement of the professional community and the students in discussions about the content of the Study Programme
- Students interested in obtaining good-quality education
- Good technological equipment for the study process
- Good provision with infrastructure and library services
- The Faculty of Electrical and Environmental Engineering provides wireless access to the Internet.

Weaknesses (W):

- Lack of financial opportunities for inviting guest lecturers
- More varied study method forms are needed in the study courses
- A large workload of academic staff in academic and organisational work, leaving little opportunity to conduct research
- Full amount of computer software licensing.

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master’s and doctoral study programmes, 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 relevance of the Study Programme to the needs of the labour market and scientific trends is demonstrated by the high and steadily increasing demand for PhD holders in all areas of the economy.

The Study Programme is aimed at meeting the demand for specialists operating in the field of electric power systems and networks, as well as power utilities in the local and international labour markets. It is envisioned for the potential/existing employees of electric power engineering and electrotechnical enterprises who are willing to obtain or deepen their theoretical knowledge, as well as develop their research skills in electric power engineering.

The process 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 drawing up the application regarding the development of a new study programme to the procedure of closing down the study programme. The Procedure has been harmonised with the normative acts valid in the country regarding the licensing of study programmes and making amendments to them.

The current priority of the development of the global power engineering industry is the designing of smart energy systems (SESs), which results in an intersectoral approach being introduced, integrating the achievements of electric power technologies and information technologies. Besides, the global aim of building SESs is all-encompassing and contains a number of sub-aims related to effective power supply to buildings and adaptive control of the power systems of different countries. All of these sub-aims 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 Programme to maintain its relevance in the long term, reacting to changes in the demand of various industries, it is necessary to review the curriculum of the study programme at least once a year to remain in line with the engineering trends, taking into consideration recommendations of external experts, the requirements of the labour market, the recommendations of the study programme Advisory Board, etc. Updating of the study course syllabi should be organised in work groups uniting the head of the study programme, academic staff, invited employees and PhD students.

Thus, in 2021, considering the recommendations of experts from the power industry and the Study Field Council, the opinions of graduates, as well as the requirements of the labour market, significant changes were made to the study programme, including a change in the title, the form of implementation (the study programme will also be implemented on part-time basis) and the language (additionally, studies will be implemented in English), the development of new study courses, as well as the modernisation of the content of existing study courses (the courses of the updated Study Programme include issues related to the implementation of the global and national research and innovation strategy in research for the transformation of the economy, the Smart Specialisation Strategy (RIS3)). The administration of the Study Programme is planning to continue to continuously improve the implementation of the study processes, considering the suggestions made by students, alumni, and the industry.

In addition, it should be noted that the Study Programme has been redesigned and will be implemented in close cooperation with industry representatives who are members of the Latvian Association of Power Engineers and Energy Constructors (LEEA), whereas students also participate in the improvement of the study content together with the academic staff by filling in questionnaires at the end of each term and evaluating the content of the study courses mastered in that term and the quality of their implementation. Since the study programme was developed by considering the opinion of experts in the field and the requirements of the labour market and was based on the national education standard in the relevant field of higher education, it is able to identify the needs of the power industry and offer the application of smart technologies for economical and efficient use of electricity, integrating the knowledge acquired in the training process in the field of modern power systems. The areas of specialisation provide the academic basis for doctoral studies and for independent work in related fields through scientific and applied research. In addition, the Study Programme has been designed for employees of power and electrical engineering companies who wish to deepen their theoretical knowledge and acquire and develop research skills in the field of electric power engineering.

Much attention will also be paid to the continuous improvement of the study process and the assurance of the quality of materials during the implementation of the study programme.

Multistage assessment will be carried out to achieve the best results. All changes are discussed and approved by the Commission of the Study Field “Power and Electrical Engineering and Electrical Technologies” and submitted to the Faculty Council for approval. The doctoral students of the Study Programme actively participate in the feedback process with industry experts and the public by taking part in various publicity events, such as round table discussions, industry seminars, TV shows and radio interviews.

The doctoral degree (PhD) is awarded to graduates of the programme if they have defended a doctoral thesis which is an original, complete piece of research of fundamental importance in the field of power and electrical engineering, as evidenced by the fact that the PhD candidates:

- Have at least one anonymously peer-reviewed scientific publication in a journal indexed in SCOPUS with a Source Normalized Impact per Paper (SNIP) or indexed in Web of Science, with a certain Impact Factor (IF) indicator;
- Have anonymously peer-reviewed scientific publications in scientific journals or conference proceedings, indexed in SCOPUS or Web of Science;
- Have conducted research within a scientific research project;
- Have delivered reports at international scientific conferences or seminars;
    - Have used modern methods of data analysis and processing within the research.

Graduates of the study programme usually demonstrate considerably better results than the above benchmarks.

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

The content of the study programme and its implementation are based on the existing laws and regulations of the Republic of Latvia, RTU internal regulatory acts, the principles of doctoral education recommended by EUA (European Universities Association), as well as considering RTU and FEEE strategic development goals and the United Nations Sustainable Development Goals (SDGs) in higher education. The structure and content of the study programme are focussed towards the achievement of its main aims and tasks, i.e. the preparation of young specialists not only for processing large information flows, but also for creative approaches to industry development and problem solving in line with the problems and challenges of the industry, which will make the programme graduates competitive in the industry and in rapidly evolving scientific fields. All these outcomes are achievable by mastering all the study courses. Therefore, the aims staked out in the course descriptions are closely linked to the overall outcomes of the study programme, while the courses are interlinked and complement one another in order to achieve the intended outcomes upon completion of the programme. The connection of the courses to the learning outcomes of the programme is reflected in the course mapping (see Appendix 7).

The study programme is designed to ensure sequential development of knowledge, skills and competences, based on individual and group work as well as continuous communication between doctoral students and their scientific advisers. For successful achievement of the programme outcomes, a specific sequence is followed in the planning of the implementation of the study courses. The implementation of the study programme will contribute to:

- Latvia moving towards a technologically oriented and knowledge-based society;
- Providing higher education in line with the national concept, http://www.aip.lv/informativie_zinojumi_5.htm (in Latvian);
- A focus on the development of innovative engineering sectors;
- Creating opportunities for the deployment of science-intensive technologies in nationally important and high-value-added sectors.

The graduates of the study programme acquire competences corresponding to the level of international achievements in the field of power and electrical engineering, which correspond to the upper limit of knowledge, which, through independent critical analysis, synthesis and evaluation, allows to deal with significant research or innovation tasks.

The study programme will be implemented in full-time intramural and part-time extramural studies, mainly in the form of practical classes and seminars, where the student independently conducts research assigned by the instructor. It covers all the main research areas of RTU FEEE Institute of Power Engineering:

- Management of the efficiency, reliability, stability and risks of energy systems;
- Development of operational methods and means for energy facilities;
- Development of innovative electric machines,apparatus and devices;
- Power supply systems, distribution networks and their reliability;
- Planning and optimization of power supply systems;
- Characteristic features of the activity of electricity producers in the overall energy system and at electricity market conditions and others.

Doctoral students have special research laboratories with appropriate equipment, which have been funded by the European Union.

Students are involved in the learning process at all stages of their studies, thus ensuring the transfer of knowledge, experience and research results at various levels of studies. The results of the research conducted during the doctoral studies are integrated into the master and bachelor degree programmes in the relevant scientific fields, which ensures the integrity of knowledge transfer and research at all levels of studies. FEEE boasts the commercialisation (valorisation) of developments resulting from innovation and creativity, as evidenced by the increasing number of research, publications and start-ups.

Study course descriptions are collected in a unified RTU Study Course Register. The descriptions of the study courses included in the academic doctoral study programme “Smart Power Systems” are included in Appendix 8.

The study programme consists of the following groups of courses:

1. Compulsory study courses of the programme in the volume of 15 Latvian credits (LC);
2. Compulsory field-specific study courses in the volume of 21 LC;

B1. Compulsory elective specialisation study courses in the volume of 21 LC;

1. Free elective study courses in the volume of 6 LC;
2. Research work in the volume of 150 LC.

The total volume of the doctoral studies is 192 LC, which is completed in 4 (full-time) and 5 (part-time) years of study. It should be noted that not all doctoral students can successfully follow the study plan. Most often, after the second or third year of study, doctoral students choose to go on academic leave, during which they work individually to strengthen their knowledge in the specific research area.

The first four terms (five for part-time students) are dedicated to specialising study courses and doctoral seminars, which address current research topics in the field, where the doctoral students conduct and present their research, and where discussions take place under the guidance of experienced supervisors and local and international experts. The research work is supervised by a scientific adviser (in the first year, a general framework for individual research in the chosen field is established). At the end of the first year of study (at the middle of the second year for part-time students), at least one publication and/or one report at an international conference must have been written and published, and at the end of the second year of study (at the middle of the third year for part-time students), at least two publications and/or two international conference reports must have been written and published. The thesis is 30...40% ready at this stage.

The third (fourth for part-time students) year of study is devoted to research work, conducting the research, publishing the research results, and participating in knowledge exchange and mobility projects. Individual work of the PhD student is intensified, cooperation with the supervisor is ensured, as well as regular opportunities to meet other PhD students for transfer of experience and knowledge. Work on scientific publications continues and the international cooperation of the young scientist is developed. The thesis is up to 70% ready at this stage.

During the fourth (fifth for part-time students) year of study, the final phase of the research is provided, preparing for submission to the Promotion Council. Work on scientific publications continues, the international cooperation of the young scientist is developed. The fourth academic year ends with the submission of the PhD thesis to the Promotion Council.

The study programme plans for full-time (intramural) and part-time (extramural) students are included in Appendix 9.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The study process is organised in such a way as to promote the independence of PhD students, while ensuring the guidance and support of the scientific adviser (mentor). A study process organised in this way fosters mutual respect and promotes the development of all the parties involved in the study process. At the same time, an impartial handling of suggestions and objections is ensured.

The curriculum and its courses are non-student-centred, taking into account and respecting the varied student contingent, their prior knowledge, skills and experience, and the diversity of the PhD students' needs, thus tailoring an individual learning path for each student. Independent studies of PhD students are essential. A description of how this is done is included as a compulsory part of the course description. Students' ability to study independently is purposefully developed in all the study courses and within the framework of their research work. Students acquire research skills by continually working with literature and Internet resources, conducting scientific research, preparing publications, reports at conferences, etc.

The procedure for assessing students' knowledge, skills, and competences at RTU is determined by the decision of the Senate "On the Regulation for Assessment of Learning Outcomes" of 27 May 2017, which corresponds to the basic principles and procedures for assessment of education defined in the Regulations of the Cabinet of Ministers of the Republic of Latvia for the corresponding study level. A summative assessment system is used for the assessment of students' achievements, where the final grade is formed from several components.

The volume of the full-time studies is 48 LC per academic year and 40 academic hours per student, the volume of part-time studies is 38–40 CP per academic year and 40 academic hours per student. The pedagogical methods of implementation of study courses, as well as the methods of assessment, are selected by the academic staff responsible for the study course, according to the specific nature of the course content and the study programme, as well as the needs of the students.

In accordance with the decisions of RTU Senate, a summative assessment of achievements is used. PhD students are introduced to the assessment criteria and methods of the relevant study course at the beginning of the study course. The assessment results are designed to give students an insight into the extent to which they have achieved the expected learning outcomes.

All courses are assessed by at least three examiners (PhD-level experts in the field), forming the Programme Examination Committee. The composition of the Committee is reviewed and renewed at the beginning of each academic year, taking into account current developments in the field, the achievements of the academic staff during the academic year, and feedback from students. The members of the Committee are familiar with the methods of testing and examination and receive support to improving their skills in their area of competence (in accordance with RTU Staff Development Policy). The assessment is consistent, equally suitable to all students, and is implemented in accordance with the procedures approved by RTU, including the Scientific Commission of the Faculty of Electrical and Environmental Engineering. As at all levels, PhD students are familiar with RTU procedures for handling student appeals.

PhD students are familiarised with the assessment criteria and methods at the beginning of the study course. The specific assessment criteria for each study course must be presented to the students during the first study class and are published in the e-learning environment of RTU intranet, ORTUS. The assessment results are designed to give students an insight into the extent to which they have achieved the expected learning outcomes. The pedagogical methods, the course structure and the assessment methods are selected by the academic staff responsible for the course, according to the course content and the specific nature of the programme, as well as the needs of the students.

Students receive feedback, which usually provides advice on the study process and on ways to improve their research skills.

The implementation of the study programme includes different ways of delivering the course content. Academic staff work with students in small groups or individually, which allows for the use of varied pedagogical and andragogical teaching methods appropriate to the circumstances, facilitating the advancement of research skills and preparing high-level specialists in the areas of smart power system power supply, electrical networks and systems and/or electrical machines and apparatus.

Clearly defined aims, tasks and assessment criteria of study courses are an integral part of the courses already at the stage of course design and the start of learning. Thus, at the beginning of the study course, students know both the content of the course and the expected requirements for successful completion of the course, as well as the assessment criteria. This facilitates future cooperation between academic staff and students and prevents the occurrence of problematic situations. The achievement of the aims and learning outcomes of the study courses and the programme is ensured through regular seminars and discussions among the academic staff on the learning outcomes and the basic principles of quality assurance.

Starting from academic year 2021/2022, the study programme will be implemented in four alternatives: full-time intramural form and part-time extramural form in Latvian and English, in compliance with the requirements formulated in the regulatory acts, the basic principles of study organisation established by RTU and fulfilling all the requirements of the study courses. The course descriptions of the Study Programme contain a set of relevant knowledge, skills and competences, and the system for their assessment, and define learning outcomes for the achievement of which credits are awarded, which are not dependent on the implementation alternative.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

The study programme does not include an internship, but practical knowledge in research is strengthened by the PhD students' active involvement in both local and international projects and contract work.

Almost all PhD students are involved in research projects at national and/or international level (see Statistics in Section 4.4.).

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

The main aim of the Study Programme is to educate and train internationally competitive specialists of the highest qualification standard for academic and scientific work at universities, scientific research centres, as well as for organisational work at public and private institutions in the field of power and electrical engineering. Consequently, when admitting PhD students for their studies, the scientific advisers of theses ensure that the thesis subjects are in line with the EU research interests, as evidenced by the participation of many PhD students in various international projects (e.g. H2020, Erasmus+, etc.). The subjects of the theses (the fields of research) are selected at the time of application for admission to the programme, upon approval by the head of the programme or the study field. The theses defended in the reporting period are summarised in Appendix 10 of the Study Programme Characterisation.

The evaluation of the PhD thesis in accordance with the Cabinet of Ministers Regulation No. 1001 of 27 December 2005 "Procedures and Criteria for the Conferral of a Doctoral Degree in Science (Promotion)", carried out by the Promotion Council, review by three reviewers and the public defence of the PhD thesis ensure the interlinkage between the learning outcomes of the PhD study programme and their achievability. In academic year 2014/2015, about 15% of the publicly defended PhD theses were oriented towards the Latvian market, while 85% were internationally oriented (see Appendix 10). Most of them serve as the basis for research projects or even become the basis for several monographs.

The PhD thesis developed by the PhD student is publicly presented at a meeting of the Doctoral Council of the field of Power and Electrical Engineering. The members of the Council, having read the assessment provided by the thesis reviewers and considering the course of the public presentation, take a decision by secret ballot on the award of a doctoral degree (PhD) in the field of Electrical Engineering, Electronics, Information and Communication Technologies, in the sub-field of Electrical Power Engineering.

As 70–75% of the programme graduates undertake employment at higher education institutions or provide guest lectures, the results of the research carried out in their theses are also incorporated in the study process, ensuring transfer and further use of knowledge.

At the beginning of PhD studies, each PhD student is assigned a scientific supervisor for the doctoral thesis, supported by the Doctoral Study Department and approved by an order of RTU Vice-Rector for Academic Affairs.

The subject of the PhD thesis is defined more specifically before the PhD thesis is publicly presented. The subject must be relevant to the specifics of the Study Programme as well as dedicated to the study of a topical issue in smart power engineering, e.g:

1. Adoption of smart grid technology by a wide range of consumers, which is a problem at the society level;
2. Implementation of smart grid technology, which is a necessary component to develop the future grid into a more sustainable and efficient energy system;
3. Development of fundamentally new energy management and operation models to plan, support and test energy system modes at the national and European level, instead of the existing models, as the latter do not fully respond to all the new challenges of smart power engineering (i.e., the decentralisation and variability of electricity supply, the need for flexibility, integration of energy systems, introduction of innovative technologies and interaction between an increasing number of independently operating agents at the conditions of liberalised markets, etc.).

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

In order to analyse the study directions and obtain feedback, the RTU Department of Doctoral Studies conducts an annual survey among doctoral students and doctoral programme graduates with the aim to assess the process of doctoral studies and the quality of the support provided to doctoral students at Riga Technical University, https://estudijas.rtu.lv/course/view.php?id=52172 (in Latvian). Doctoral students from all the faculties, including those from the Study Programme, participate in the survey.

At the end of any study year, every doctoral student who is involved in active studies can fill in the survey form regarding that study year, which requires registration in the ORTUS portal. The survey form consists of three parts:

1. Assessment of the mastering of the doctoral study programme and the progress in developing the doctoral thesis (11 questions + comments);
2. Cooperation with the supervisor of the doctoral thesis (6 questions + comments);
3. Cooperation with the Department of Doctoral Studies (7 questions + comments).

The results of the surveys among the graduates of the doctoral programme reflect the positive aspects of programme implementation and the necessary improvements.

According to the survey results, students have an overall positive perception of the study process and the work of the instructors. Thus, the following positive aspects are particularly highlighted:

- The attitude of the record-keeping staff and the administration towards the students is supportive and positive;
- Good relations among students themselves and between students and the programme administration;
- The academic staff are professional and able to answer students' questions in a comprehensive manner;
- Good quality of classrooms and their equipment;
- Information on the study process and the course materials is easily accessible.

Feedback is also ensured by means of reports required every term (for first-year students, at least twice per study term; for the rest of the doctoral students, at least once per study term, with the reports presented at the meeting of doctoral students of the Institute of Power Engineering of RTU Faculty of Electrical and Environmental Engineering). This kind of Study Programme implementation mechanism makes it possible to ensure that the study results are achieved. The monitoring system regarding the progress of doctoral students is as follows: two times per term, the doctoral students, according to a previously compiled schedule, report on their progress in the development of the doctoral thesis, presenting their results to a commission (the commission consists of at least four doctors of the Institute of Power Engineering of the FEEE). The students' progress is assessed according to the following criteria: mastery of the compulsory study plan; progress in the development of the doctoral thesis (methods, results); progress in the development of scientific publications; progress in participation at conferences; pedagogical activity.

The system of study quality monitoring and assurance introduced at RTU in 2008 provides for regular (every year in the middle and at the end of the autumn and spring terms) electronic surveys of students on the study content and the quality of the work of academic staff, using the ORTUS environment.

The survey includes questions on the availability of course-specific literature, instructor evaluation criteria, the culture and quality of work, respect for students' rights during the classes, time spent on independent work and study discipline. The final part of the survey is intended for students' suggestions and proposals for improving the quality of the course and the instructor's work. The questionnaires are filled in anonymously so that the answers given could not influence the attitude of the instructor towards a particular student or group of students and so that the aim of obtaining an objective evaluation from the students could be achieved.

At the same time, it should be noted that the surveying has not completely achieved the desired result: students fail to fill in the survey forms citing lack of time, preferring direct communication with the management of the Study Programme and the implementers of study courses, voicing their wishes and suggestions for improving the study process. The programme administration uses all of these in the improvement and fine-tuning of the study process.

All in all, it has to be pointed out that the level of knowledge and practical skills obtained during the study process is high. This is proved by the very high evaluation of the doctoral theses developed within the Study Programme, both in Latvia and internationally: almost every year, at the competition organized by JSC "Latvenergo" and the Latvian Academy of Sciences, the annual awards "For Achievements in Power Engineering for Young Scientists" go to a graduate of the Study Programme (for example, in 2020, there were five graduates who received this award, https://latvenergo.lv/lv/jaunumi/preses-relizes/relize/latvijas-zinatnieki-sanem-gada-balvas-energetika, in Latvian), one graduate of the Study Programme has received the very prestigious award of the VGB PowerTech e.V. association in the nomination for special achievements in research with practical application, for his scientific thesis and the publication developed during the writing of the doctoral thesis, etc.

However, based on the feedback of students and employers on the disadvantages of the Study Programme, the need for such development and modernisation of the study process should be mentioned that will enable the pursuit of excellence and the future international competitiveness and export of higher education in Latvia.

One of the consequences of these disagreements is that companies and organisations should interact more actively with universities and make specific demands regarding the development of courses and of the higher education policy in general. However, many business structures only enter into dialogue with universities at the recruitment stage. It is then no doubt too late to meet the expectations.

It is also important to note that this two-way study process will result in a well-trained, motivated and future-oriented engineering expert and enterprises will support such graduates and provide information on career opportunities and funding support/scholarships during their education.

Emphasising that the level of training of qualified electrical energy specialists is essential to provide the enterprises operating in the sector with the necessary workforce, both in the areas of electricity generation and supply, and in the related field of energy construction, the Study Programme was developed and modernised with the following priorities:

- The relevance of the programme to labour market requirements, based on national education and occupational standards in the relevant field of higher education and qualifications;
- Encouraging students' creative expression, with the main criterion being students' scientific work oriented towards topical problems relevant to society and the sector;
- Feedback from employees and the public on the learning outcomes, in order to educate and train qualified professionals in electric power engineering and to provide the sector with the workforce it needs, both in electricity generation and supply and in the related field of energy construction.

In fine-tuning the Study Programme, the curriculum has been carefully designed to take into account a number of key global development trends specific to the electric power engineering sector, including the development and deployment of renewable energy generation technologies, the digitisation of power system operation and technological troubleshooting, the increase in distributed electricity generation and microgeneration, the modernisation of in-building electric networks and digitisation of consumption management, electro-mobility, etc.

Another important aspect that justifies the importance of developing new and improved study programmes is the expected development trends at the regional level, which are related to the expected change of the power transmission system management model in the Baltic States as they discontinue synchronous operation with the Russian and Belarusian transmission systems and integrating for synchronous operation with the electric power systems of the European Union countries.

In order to better assess the feedback from employers and industry organisations in the sector of electric power engineering, the FEEE has asked the Latvian Association of Power Engineers and Energy Constructors (LEEA) to provide its views on issues related to the content and quality of the Study Programme. The response of LEEA is given in Appendix 11

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

Within RTU study programmes, there is mobility of knowledge, in the form of exchange of experience at both the local and international levels, which is possible mainly due to the ERASMUS (European Community Action Scheme for the Mobility of University Students) mobility programme. Every doctoral student has the opportunity to participate in this mobility, and the knowledge acquired during it is recognised within the content of the Study Programme. Mobility of this kind makes it possible to form closer relationships with professionals at other higher education institutions and the communication of knowledge and skills to students provides them with new career opportunities to continue full-fledged activity in science and in the academic environment.

At RTU, there is a stable and comprehensible recognition system for study courses mastered during mobility. Before leaving, the student obtains individual approval from the Study Programme director regarding the list of study courses at the foreign HEI which will be equated to the study courses planned in that term at the student’s home institution. If any changes occur during the mobility programme, these are approved electronically. Upon returning from the exchange programme, the student’s courses mastered at the foreign institution are recognised on condition that their assessment is positive, which is proved by the documents issued by the foreign HEI.

When analysing the statistical data for 2014–2020, it should be noted that students of the PhD programme “Power and Electrical Engineering” of the Faculty of Electrical and Environmental Engineering underutilised mobility opportunities. Thus, during the whole reporting period only two students studied for one term at a foreign university within a student exchange programme: one within Erasmus+ and one within the Inter-Academic Network Erasmus Mundus II. The main aim of the internships was to broaden their knowledge in the field of research activity.

Information on the dynamics of outgoing mobility is provided in Appendix 12.

The low participation of the students is mainly due to the fact that they are all working people who have limited opportunities to participate in study or traineeship mobility for several months, and/or their family situation prevents them from making use of long-term mobility opportunities. As the study programme has so far been implemented only in Latvian, incoming mobility opportunities for international students have been limited.

Upon objectively assessing the current situation, it can be concluded that PhD students do not make sufficient use of mobility opportunities. In order to ensure the transfer of international experience and research practice and their integration into the research process, the programme administration and the academic staff should encourage and support PhD students to more actively engage in mobility, i.e., develop an action plan to improve the dynamics of student mobility in the next reporting period.

The modernised Study Programme will be developed in the international dimension — measures are being planned and cooperation agreements are being signed to maintain contacts and promote cooperation with institutions in the EU and beyond, thus ensuring the international accessibility and visibility of the Study Programme, supporting the implementation of the Study Programme and study courses in foreign languages, attraction of foreign students, establishing sustainable cooperation with foreign higher education institutions through joint study programmes and student exchanges. It is envisaged that this will help increase the proportion of students participating in mobility programmes, thereby broadening their knowledge and competence horizons, improving their communication skills and foreign language proficiency. It is also planned to involve more international students within the mobility programme.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

The implementation of the study programme will mainly take place at 12/1 Azenes Street, at the premises of the Faculty of Electrical and Environmental Engineering, which is part of the RTU Kipsala Campus (further referred to as the Campus).

The Study Programme will be implemented by means of the infrastructure, the research basis, and the material and technical facilities of RTU Faculty of Electrical and Environmental Engineering, 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 library. The students and the academic staff also have access to other RTU infrastructure elements: canteens and cafes (which are to be found at each RTU building complex), photocopying units, student hotels, RTU sports and recreation centres, a swimming pool, etc. Vending machines with drinks and snacks are in place.

Owing to a high level of digitisation, the available infrastructure and material and technical facilities for the implementation of the Study Programme make it possible to increase the University’s competitiveness, improve the quality and efficiency of its work, as well as to improve information availability by integrating IT solutions into the administrative, academic and research processes of the University and providing the students as well as the administrative and academic staff with modern, reliable, secure and unified IT infrastructure and quality IT services.

To ensure easy and effective identification of IT users, an IT user identity management system has been introduced; as a result, each IT user has a unique electronic identity that is valid in all information systems. In addition to the above, a user session management system is ensured in the IT systems, which means that there is no need for IT users to re-authenticate when performing unified login to RTU information systems. It provides users the experience of using a unified integrated information system without having to memorise different identification data and re-enter them, implementing different IT application scenarios.

All IT users are provided access to the centralised portal, ORTUS (https://ortus.rtu.lv), which functions as a single digital gateway, combining information from all RTU information system components and providing users with an easy-to-use way of accessing the directory of all IT services in one place.

A centralised Study Management System is used for efficient administration of the study process. This system 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), drawing up of study agreements and enrolment of students in study programmes, the Register of Study Courses (its public part is available at https://info.rtu.lv/rtupub/disc2/list), designing of students' individual study plans, drawing up of orders, implementing of study courses and the study process, registering of grades, moving of students to the next study year, awarding of qualifications, administering of payments, student hostel information, gathering of information to issue diploma supplements, etc. This system is one of the main cornerstones in the administration of the RTU study process.

To ensure effective implementation of the study process, Moodle e-learning system is used, where all relevant information is compiled in an automated way (study courses, users, groups, access rights, etc.). This system ensures student-instructor communication. The academic staff members place various electronic materials, assessment tests, home assignments, information on a particular study course, etc. in the system. Students can also view their financial information on the ORTUS portal, as well as make requests for documents (references, transcripts of records, copies of study agreements, etc.).

Since 2007, more than 120,000 unique study course sites have been generated in the e-learning environment of RTU. Students can access electronic learning resources anytime and anywhere.

Digitisation of classrooms and schedules has been carried out to ensure efficient premise management and study planning (https://telpas.rtu.lv; https://nodarbibas.rtu.lv/). Every RTU student and academic staff member can access their schedule, which provides information on the venue, time, instructor, room, title, and type of class. In addition, for users' convenience, the system greatly facilitates planning and scheduling of classes, as well as optimises the use and efficiency of premises.

Electronic staff management and record-keeping systems, which cover the circulation of record-keeping and HR documents at RTU (https://docs.rtu.lv/), are also used to ensure efficient administrative work. Electronic document approval and e-signing functionality have been introduced, thus reducing print-based document circulation and significantly increasing document circulation speed. Since the autumn enrolment of 2019, electronic signing of study agreements has been ensured. Since 2016, RTU graduates have been receiving electronically signed transcripts of records.

In terms of quality assurance, a digital student survey system is used, with the help of which quality monitoring of study course and study programme implementation is conducted each term. Based on the results of the quality monitoring, regular measures are taken to improve study programmes and study processes.

To ensure additional convenience for RTU students, academic and general staff members, RTU is leasing Microsoft Windows and Microsoft Office software, which provides all IT users with access to the latest Microsoft software. RTU students can use the licensed Windows operating system and the

Microsoft Office productivity suite provided by RTU for study needs. All IT users have access to Microsoft Office 365 cloud computing platform with one terabyte of storage space available to each user and access to a variety of additional collaboration and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic and general staff have access to individual email accounts provided by the University.

To support research activities, RTU has developed a centralised Research Support System, which records all information on publications, patents, commercialisation applications, doctoral theses, RTU scientific journals, research staff, etc. The system provides access to information according to the OpenAccess principle (https://science.rtu.lv). RTU students and academic staff also have centralised access to research software.

RTU has high-speed fibre optic Internet and extensive wireless network infrastructure with over 400 access points, including the international Eduroam service. In addition, desk phones and mobile communications are provided for fast and easy communication.

To ensure stable and secure operation of the information technology infrastructure, continuous monitoring of the IT infrastructure and systems is performed, resulting in proactive incident control. Data backup is also ensured.

An Information Systems Security Policy has been developed and implemented with the primary goal of ensuring secure use of RTU information systems by establishing and maintaining a sufficient set of measures to reduce or prevent potential or actual harm. Implementation of the Information Systems Security Policy envisages security checks, monitoring of the data transmission network as well as preventive measures. Regular IT security and personal data protection training is organised for IT users. Automated security incident management and risk management have been implemented. Statistics demonstrate that the number of IT security incidents has dropped significantly 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 150,000 IT user applications.

The University library plays a major role in providing methodological and informational support to the students. The Scientific Library of RTU (https://www.rtu.lv/en/studies/scientific-library) is an academic library of national significance, which has obtained its status as a result of library accreditation. The Scientific Library of RTU provides the necessary information for the RTU study process and research activities, performs library, bibliographic and information services for RTU students, teaching staff, and employees. The library's collection includes 1.4 million printed documents and e-resources in the databases relevant to RTU fields. The library collection is located at the Central Library, the Study Literature Loan Department, the Chemistry Branch, the Transport Branch as well as at the study and research centres in Daugavpils, Liepaja, Cesis, and Ventspils.

In 2016, significant investments were made in the development of the library infrastructure, with the construction of an additional 2240 m^2 of space. The total area of the library premises is 6393 m^2, of which 3417 m^2 are for reader services. There are 713 workstations for library users. The library has four group rooms and six individual cubicles, a reading complex for rare books, and a conference hall. The library is accessible to users with reduced mobility.

To improve the work of the RTU Scientific Library and to ensure the availability of information needed for study and research work, a Library Council has been established, which decides on the replenishment of the library's collection with printed publications and subscriptions to the necessary databases. The Library Council has approved the "Policy for Acquiring Resources for RTU SL", which defines the basic principles of collection formation and development in accordance with the fields of RTU study and scientific activities.

When RTU provides funding for the library, the funding for information resources for each study programme is calculated. The collection is replenished according to the recommendations of the heads of study programmes and researchers, based on the allocated funding. Upon contacting the library's Collection Development Department regarding the replenishment of the collection, the desired titles can be ordered by means of the library's website, by filling in an order form, by filling in an application form, by phone (67089353) or by visiting the library at 5-105 Paula Valdena Street. The Scientific Library offers a guide to ordering titles and e-resources, which brings together the websites of various publishers and bookshops in Latvia and abroad.

Database subscription contracts are concluded both directly with the supplier and through the "Kulturas Informaciju Sistemu Centrs" (Cultural Information Systems Centre) state agency, which is the Latvian national representative at the international non-profit organisation EIFL (Electronic Information for Libraries). The EIFL Licensing Programme offers national libraries subscriptions to internationally recognised databases at significantly reduced subscription fees not offered to individual subscribers, thus saving financial resources for the libraries.

The database subscriptions maintained by RTU Scientific Library

(https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/abonetas-datubazes):

- ProQuest Ebook Central, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, EBSCOhost eBook Academic Collection, Wiley Online Library, SpringerLink, The International Monetary Fund.
- Databases financed by the Ministry of Education and Science available to RTU Scientific Library: ScienceDirect, SCOPUS (Elsevier), Web of Science.
- Latvian databases: LETA, Letonika, the Database of Latvian Standards (available only on the premises of the library).
- In addition, the RTU maintains subscription to the **IEEEXplore** database, which is in fact the most widely recognised intentional association in the world, and its character is directly linked to the scope of the Study Programme. Students have free access to this database; they may access both scientific articles and online courses. The most active students receive a grant for meeting the subscription fee, providing opportunity for implementing additional activities within the IEEE Latvia Student Branch.

Database usage at the Scientific Library of RTU has been growing since 2016. E-resource loans have increased from 75,391 to 525,194 items annually.

The new library premises have allowed to extend the range of services. Since the opening of the new premises in 2018, the number of visits to the library has increased from 103,825 to 235,600. The Central Library is open to users from Monday to Saturday. There is a 24/7 reading room. During the summer period, the Central Library is open every weekday with reduced opening hours. (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3).

The library sources are placed to ensure open access. The last copies of the older publications corresponding to the RTU profile are kept in the library repository. They are always available to the users.

The librarian on duty helps visitors find their way around the collection. Bibliographers (information specialists) provide more detailed information and advice. The library has a branch librarian service. (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija).

The library resource search is supported by the Primo Discovery search tool (https://www.rtu.lv/lv/studijas/biblioteka/vienota-informacijas-meklesana). It allows searching the library catalogue (https://kopkatalogs.lv/F/?func=find-b-0&local_base=rtu01), the subscribed databases, as well as databases created by the RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes) in one interface. Searching for information in the electronic joint catalogue (https://kopkatalogs.lv/F), it is possible to simultaneously obtain information on the resources available in 12 Latvian libraries. Both the electronic catalogue and the RTU portal ORTUS allow remote reservation of library resources, as well as remote access to the databases. Since the introduction of RFID technology, users can use five self-service book-dispensing/pick-up machines and check out books at the pick-up/sorting machine around the clock.

The library provides students, academic staff, and other stakeholders with various levels of individual consultations and group training in information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas). Publications not available in the library are delivered via an interlibrary loan or an international loan. Internet access is available throughout the library.

Considerable resources have been invested taking care of extracurricular activities for RTU students and their healthy lifestyle. RTU students have opportunity to participate in various extra-curricular activities — they can take part in various art groups and interest clubs, for example, choir “Vivere”, band “Bigbends”, folk dance ensemble “Vektors”, etc., or more than 20 sports teams, where each student has a chance to join a varsity team.

The resource base of the Study Programme includes textbooks, lab manuals, journal publications in Latvian, English, and Russian, equipment catalogues, normative documents in the field of electric power engineering, EU directives, international standards, etc. Students may receive methodological support at the Scientific Library of RTU, which stocks a sufficient number of books, journals, and other sources, and which has sufficient area at its disposal. In the UDK Section 621.3, Power and Electrical Engineering, there are more than 500 copies of learning aids: 147 titles in Latvian, 101 titles in Russian, and 203 titles in English.

Publications that are not available at the SL are provided by means of the inter-library loan system or the international loan system. In the whole SL, Internet accss is provided. There are copying, scanning, printing, and binding services as well as a self-service kitchenette.

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 to perform 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 organise 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 familiarised 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 for high-voltage networks. The laboratory is equipped with relay testing devices ISA T1000 and RTDS64; power system transient process computer simulation software is installed on the computers, and 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 of 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 Optimisation Department of the Institute of Power Engineering of the Faculty of Electrical and Environmental Engineering and its academic staff. In addition, the Department of Electric Machinery and Apparatus of the Institute of Industrial Electronics and Electrical Engineering as well as the Department of Language for Special Purposes of the Institute of Applied Linguistics is involved, which will ensure the study and methodological work as well as develop and renew the syllabi of study courses, ensure the implementation of appropriate study courses, and conduct other activities related to the study, methodological, and scientific work.

RTU funding from the general state budget is made up of the study base financing corresponding to the list of study programmes and the number of students; it is used to meet such expenses as utilities, taxes, infrastructure maintenance (including provision of data for the Student and Graduate Register), purchase of equipment and supplies, staff remuneration, and funding for research activities. The Study Programme is funded from both state budget and the funds of natural persons from tuition fees. The number of state-budget-funded positions in the doctoral programme are regulated within an annual agreement between RTU and the Ministry of Education and Science, therefore, the annual number of study positions is variable.

RTU has a decentralised budget. The revenue and expenditure of RTU are managed on the basis of principles approved by the Senate or determinedby the Vice-Rector for Finance with the powers conferred on him. Revenue may be allocated to the unit for the performance of certain work for which it is responsible, such as providing consultations, organising training, and those allocated to the unit as a result of calculation, on the basis of the planned amount of work and/or performance in previous periods (e.g., science support).

Each head of RTU organisational units is provided with remote access to operational financial information on the unit's budget, including the envisaged workload and the funding to be correspondingly allocatedin subsequent periods for the implementation of study programmes and study courses. The head of the organisational unit plans the work of the unit at the beginning of each financial or budget year, including remuneration issues for academic staff members who are subordinate to the head of the unit, and develops a procurement plan for the following year in compliance with the implementation and development of the study programme or study course, etc.

In addition to the state subsidies, the academic staff of the department also apply for EU projects which, in the event of receiving funding, allow attracting additional financing, thereby improving the material base of the laboratories, and enable new teaching aids to be developed.

Comprehensive information on the resources and their provision is shown in the Table and criteria 3.1–3.3 of Section II.

Table. Costs of the study programme

	State budget subsidy, €	*Tuition fees of local students, €*	*Tuition fees of foreign students, €*	*Total funding to the study programme, €*	*Costs per 1 student, €*
2019/2020	*166 526.17*	-	-	*166 526.17*	*13 215.13*
2018/2019	*182 320.19*	-	-	*182 320.19*	*12 689.04*
2017/2018	*144 554.67*	-	*2 451.22*	*147 005.89*	*12 121.97*
2016/2017	*139 310.26*	-	*3 743.73*	*143 053.99*	*11 598.06*
2015/2016	*115 493.66*	-	*3 473.95*	*118 967.61*	*11 598.06*
2014/2015	*141 326.60*	-		*141 326.60*	*11 598.06*
2013/2014	*154 090.00*	-		*154 090.00*	*11 598.00*

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

Among Latvian HEIs, the University of Latvia and the Latvia University of Life Sciences and Technologies can be mentioned as the most significant cooperation partners in the implementation of the PhD study programme. The cooperation takes place in the implementation of PhD and post-doctoral studies, participation of RTU FEEE academic staff in the work of doctoral councils and in the organising of scientific conferences and seminars. PhD students are involved in research projects.

Currently, RTU, along with other BALTECH universities in the Baltic States (Vilnius Gediminas Technical University, Vilnius, Lithuania, Kaunas University of Technology, Kaunas, Lithuania, and Tallinn Technical University, Tallinn, Estonia), is included in the NORDTEK university network of Nordic and Baltic countries. There are 20 universities operating in the NORDTEK network.

The main cooperation partners for the implementation of the PhD programme among foreign universities are the Gheorghe Asachi Technical University, Iasi, Romania, the Technical University of

Košice, Slovakia, the Democritus University of Thrace, Greece, Kaunas University of Technology, Lithuania, etc. (the list of cooperation universities is provided in Section 5.1).

All these institutions have high competence and experience in specific training and practice in the field of electricity and smart energy, starting with power system analysis, operation and monitoring of the power system, stability and control of the power system, modelling and monitoring for the economic model of a local energy system. All the cooperation universities share scientific and informational resources, ensure exchange of knowledge and experience, organise summer schools, intensive study programmes, doctoral and/or academic staff traineeships, project implementation, joint publications, and other events. This is mentioned in more detail in the study field report.

The objective of the study programme to acquire skills, through the use of modern research methods, to perform high-quality scientific research and provide consultations in energy and electrical engineering will be achieved through the development of PhD papers, by practical and laboratory work, which is to be performed in close cooperation with other institutions and enterprises.

Capacity to independently advance their scientific qualifications and capacity to manage research or development tasks at companies, institutions and organisations where extensive research knowledge and skills are required, are interlinked with the objective of the study programme to acquire the skills to manage and develop sustainable development processes in the industrial and energy sectors or at the level of scientific institutions and to promote the introduction of scientific research in manufacturing and the administration of public and private companies. This competence will be developed both by working on the subject of the thesis and by performing practical and laboratory work in the framework of study courses in close cooperation with companies, as well as by working on applications and initiatives for new projects, jointly with their scientific supervisors or a group of scientists.

Objectively speaking, the sharing of resources could be more intensive because, for example, the capacity of using infrastructure, software, databases, etc. can be doubled.

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

Within the framework of the Faculty and the Institute of Power Engineering, targeted measures are taken for changes in the composition of the academic staff to have a positive impact on the development and quality of implementation of the study programme, as well as on its compliance with the requirements specified in regulatory acts. For example, renewal of academic and research staff is actively going on, building a new generation of researchers and academic staff, actively involving young researchers in research projects. This helps to ensure logical development of staff and the improvement of clear career competences. Cooperation with leading experts of the industry or research also ensures growth. Each researcher participates in at least one international project and, once in every 2 years, in professional growth seminars/events.

Compared to the composition of academic staff corresponding to the reporting period, it is necessary to note the reduction of the overall number of study courses as well as the reduction in the average age of the academic staff with attraction of young doctors. As can be seen from the Table, the Study Programme is characterised by a large proportion of young academic staff (71.4% are below the age of 50) and the qualifications of academic staff, which ensure theoretical and research potential (100% with a PhD degree). The academic staff of the upgraded Study Programme includes 14 Doctors of Science, of which at least seven are experts approved by the Latvian Council of Science in the relevant science sector or sub-sector in which the study programme intends to confer a scientific degree.

Table with indicators characterizing the academic staff of the Study Programme: (before and after the changes made on 31 May, 2021):

No.	Indicator	Before the changes		After the changes	
		Number	**Proportion**	**Number**	**Proportion**
	Academic position:				
1.	Professors	9	90.0%	4	28.6%
1.1.	Associate professors	1	10.0%	4	28.6%
1.2.	Assistant professors	-	-	4	28.6%
1.3.	Leading researchers. Researchers	-	-	2	14.2%
	Total:	**10**		**14**	
2.	Scientific degree:				
2.1.	PhD	10	100%	14	100%
	Total:	**10**		**14**	
3.	By age:				
3.1.	31–39	3	30.0%	4	28.6%
3.2.	40–49	1	10.0%	6	42.8%
3.3.	50–	6	60.0%	4	28.6%
	Total:	**10**		**14**	

In addition, it should be noted that the qualifications of the academic staff are continuously improved, as is their methodological and scientific material. For example, with this aim, the study direction “Power, Electrical Engineering and Electrical Technologies” has been involved in the European Social Fund project “Strengthening the Academic Staff of Riga Technical University in Areas of Strategic Specialisation” No. 8.2.2.0/18/A/017.

A full list of the academic staff of the study direction, indicating the programmes they are involved in, is attached in Appendix to Section II.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The qualifications of the academic staff implementing the Study Programme complies with the requirements specified in Article 39 of the Law on Higher Education Institutions, as well as the indicators and regulations specified in Chapter IV of the Law on Higher Education Institutions.

The implementation of the Study Programme is ensured by RTU academic staff from a number of structural units — professors and lecturers holding a PhD degree, each of them being an expert within a field. All the members of the academic staff have considerable experience in research project development and implementation, which will provide young researchers with the opportunity to develop their ability to independently propose their research idea, to plan, structure and manage large-scale research projects in power and electrical engineering, including international ones.

If necessary, academic staff from foreign partner HEIs is invited to ensure the implementation of the Study Programme and industry professionals are involved for the practical classes. The study process will involve 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, which is attested by their Curricula Vitae (Appendix to Section II.). The themes of seminars and classes are offered taking into account the results of RTU staff surveys, as well as current trends at foreign universities. Information on seminars organized over the years is available at https://www.rtu.lv/en/studentservice/career-centre. For participation in seminars, employees receive professional development certificates issued by RTU Department of Further Education. The qualifications of the academic staff are continuously improved, as is the methodological and scientific material authored by them. Academic staff have the opportunity to advance their professional knowledge and obtain valuable experience at some foreign university (using Erasmus, COST or project mobility opportunities), which is in line with the development strategy of the European Higher Education Area, as well as undergo internship at enterprises.

According to the tasks of the study programme, the primary criteria by which academic 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.

The following elected academic staff are involved in the implementation of the compulsory and professional specialisation study courses of the Study Programme:

Aleksandrs Dolgicers, Dr.Sc.Ing. Associate Professor of the Institute of Power Engineering of the Faculty of Electrical and Environmental Engineering, Acting Head of the Power Systems Control and Optimisation Department of the FEEE Institute of Power Engineering. Organisational activities: member of RTU Senate and the Council of the Faculty of Electrical and Environmental Engineering, participates in organising committees and programme committees of international scientific conferences, Chair of the Master's Theses Defence Commission of the Power Systems Control and Automation Department (now — the Power Systems Control and Optimisation Department) of the Institute of Power Engineering.

Mr. Dolgicers' research is concerned with relay-based protection and automation. He has more than 20 scientific publications, 2 patents, and has been, or currently is, involved in 8 projects.

Antons Kutjuns, Dr.Sc.Ing., Assistant Professor at the Faculty of Electrical and Environmental Engineering of Riga Technical University. He has been delivering lectures, laboratory classes and practical classes at RTU since 2007. Academic work experience at RTU since 2006, when he obtained a doctoral degree in Power Engineering. Professional work experience in the field of power engineering since 2000, while employed at JSC Augstsprieguma Tikls.

Scientific activity and research since 2003 (the beginning of doctoral studies), with specialisation in the investigation of energy reliability, issues of evaluating reliability criteria, and issues of developing models for evaluating reliability criteria at the conditions of an electricity market. He has participated in 17 scientific conferences and 3 scientific projects and research programmes. All in all, Mr. Kutjuns has published 41 scientific articles. He is a member of the Latvian Association of Power Engineers and Energy Constructors (LEEA).

Jevgenijs Kozadajevs, Dr.Sc.Ing., Assistant Professor. Professional experience: long-term scientific and academic work experience at a university since 2008. Mr. Kozadajevs' academic work experience corresponds to ten years at a HEI. His scientific work experience exceeds 12 years. The research is mainly concerned with emergency protection and automation of a power system as well as the analysis of the causes of emergencies and their solutions. Since 2016, he has been actively involved in the power supply and power supply management of residential houses. This is proved by participation in scientific projects, research programmes, international scientific conferences as well as research papers and articles. The students are taught the theory of management, automated control systems, and develop basic skills according to the following task: to design and apply automated control systems by solving various technical problems. The study process integrates the most recent and topical scientific research and its results as well as the topical issues in other countries. Mr. Kozadajevs actively participates in contract work.

Olegs Linkevics, Dr.Sc.Ing., Associate Professor, Researcher. Professional experience: 12 years of academic and scientific work at Riga Technical University, Faculty of Electrical and Environmental Engineering (formerly: Faculty of Power and Electrical Engineering), 26 years of administrative work experience at the Department of Research and Development of JSC Latvenergo, the Latvian national energy enterprise. More than 17 years of scientific activity and research (including the doctoral thesis), with specialisation in the simulation of the operation of power plants and microgrids by developing optimisation models and algorithms, proved by a h-index of 6 and more than 30 Scopus-indexed publications, participation in international scientific conferences, national research programmes, Horizon 2020 projects as well as contract work with enterprises in the field. Since 2016, he has been an expert of the Latvian Council of Science. He has been a member of the Technical Council of the VGB Power Tech e.V. (www.vgb.org) Association since 14 September 2015 and member of the Thermal & Nuclear Working Group of the EURELECTRIC association (www.eurelectric.org) since 2010. He obtained the Annual Award 2008 named after Professor Alfreds Vitols for young scientists for achievements in power engineering. He has teaching experience with local (in Latvian) and foreign (in English) students as well as students of the extramural department. The study materials are continuously improved, considering topical material and scientific research, as well as attending training and further education courses.

Tatjana Lomane, Dr.Sc.Ing., Researcher. Ms. Lomane has a long-term scientific and academic work experience at RTU since 1990. Her academic work experience is 45 years at a higher education institution. Also, Ms. Lomane has a scientific work and research experience of more than 45 years. The main research areas are emergency protection and relay-based protection of the power system, also based on the long-term employment at JSC Latvenergo, JSC Augstsprieguma Tikls and the Daugava cascade of HPPs (since 1971).

The students gain knowledge about designing the protection of electric power systems, the power system automation processes and their optimisation. The study process integrates the most recent and topical scientific research and its results, as well as the latest trends in other countries. Ms.

Lomane is actively involved in contract work.

In the study process, the students develop and improve their skills in conducting research, analysing results and programming, which ensures that the study results are achieved. In addition,

Ms. Lomane participates in professional and scientific conferences, expanding her knowledge about the most recent tendencies in the industry and in science.

Anatolijs Mahnitko, Dr.Sc.Ing., Professor of the Faculty of Electrical and Environmental Engineering. Professional experience: academic and scientific experience of more than 47 years at a higher education institution. More than 300 scientific publications in the field of power engineering, including 9 monographs, 4 textbooks, 12 study aids and 10 teaching aids. Over the last 3 years, 29 research papers have been published in internationally recognised periodicals or conference proceedings indexed in international databases. Organisational activity: Expert of the Latvian Council of Science, member of the Council of RTU Faculty of Electrical and Environmental Engineering. Active participation in editorial boards of scientific journals as well as organisational committees and programme committees of international scientific conferences. Within the study courses taught by Mr. Mahnitko, the students master knowledge about large energy systems and the basic principles of their development as well as the programming of automation processes and optimisation of electric power systems.

Anna Mutule, Dr.Sc.Ing., Associate Professor. Ms. Mutule has a long-term academic experience at RTU (since 2005) and scientific and administrative experience at the Institute of Physical Power Engineering (since 2001), where she has been the Head of the Smart Grids Research Centre since 2015. Anna Mutule's experience encompasses leadership and participation in international and state-financed projects, for example, EU-DEEP (FP6); ICOEUR, ELECTRA and SmartGrids ERA-Net SmartGen (FP7), Strongrid (Nordic Energy research), CloudGrid (ERA-Net Smart Grid Plus), ITCity (ERA-Net LAC) as Project Coordinator, PANTERA (H2020). Ms. Mutule has extensive experience in the development of study materials and laboratory classes, using the MATLAB environment. Her research is aimed at planning of power systems, local energy systems, use of renewable energy sources, energy efficiency solutions and smart grid technologies; the research results are incorporated into the study course "Control of Electric Networks and Systems and Planning of Their Development". Anna Mutule is a member of the Latvian Association of Power Engineers and Energy Constructors (LEEA); since 2007, she has been an expert of the Latvian Council of Science in the field of power engineering and since 2019, she has been a member of the Engineering and Technologies Expert Commission of the Latvian Council of Science; member of IEEE PES, founder and chairperson of WIE AG of the IEEE Latvia section; since 2018, member of the managing committee of the European Energy Research Alliance Joint Programme on Smart Grid (EERA JP SG), working in the development of position/opinion documents of the SP5 Flexible Transmission Network sub-programme.

Lubova Petricenko, Dr.Sc.Ing., Senior Researcher and Assistant Professor at RTU Institute of Power Engineering. Expert of the Latvian Council of Science. Professional experience: Pedagogical work of more than 10 years, scientific supervision of bachelor, master, term and engineer papers, lectures on "Design of a Power Supply System", review of scientific publications and graduation papers. Research activities conducted for more than 6 years, specialising in power system modelling, design and optimisation, as evidenced by her participation in scientific projects (H2020 project RealValue, EnergoPlanT (Optimum planning of an energy-intensive manufacturing process and optimisation of its energy consumption depending on changes in the market price)) and research agreements (EC Joint Research Centre and Latvian Ministry of Economics), participation in a post-doctoral research support project (subject: "Electrical network design methods and appliances, with account of smart technologies and market conditions"), participation in international scientific conferences (over 15) and publications (around 50).

Romans Petricenko, Dr.Sc.Ing., RTU Institute of Power Engineering, Assistant Professor at the Faculty of Electrical and Environmental Engineering, Leading Researcher. Scientific work and research conducted for over 10 years, specialising in the analysis of control and automation of smart power systems, the assessment of rational operation of the power system, the development of mathematical models of power systems (in Latvia and the Baltic States) and models of their components (Daugava hydropower plants (HPPs), thermal power plants (TPPs), nuclear power plants (NPP)), participation in a post-doctoral research support project (subject: "Methods, algorithms and techniques for control and automation of smart power systems"). Participation in international conferences (over 15) and scientific publications (around 50). Pedagogical work since 2011, scientific supervision of bachelor, master and PhD theses, review of scientific publications and graduation papers. Responsible Contractor in the regional project of JSC Latvenergo "Development of an Energy Plant Operational Mode Optimisation Programme" during the period 2013–2016. As a result, an optimisation computer program in Matlab for Daugava HPPs and Riga TPP-1, TPP-2 was developed. The method of artificial neural networks (ANN) was used in the implementation of the computer program, linear and non-linear models of the Daugava cascade were used. Water inflow and electricity price forecasting models were developed, algorithms for determining the optimal structure of forecasting models were provided and verified. During the post-doctoral project, the cooperation with Kaunas Technological University resulted in the development of a mathematical model enabling the determination of the optimal operation of Kruonis PSHPP (pumped-storage hydropower plant) together with the planned building of floating photovoltaic (FPV) plants in the PSHPP reservoir. Also, technical and economic calculations were carried out. Profound studies of the electricity tariff formation systems in Latvia and Lithuania.

Andrejs Podgornovs, Dr.Sc.Ing., Professor. Mr. Podgornovs has a doctoral degree in the field of Electrical Engineering, the sub-field of Electrical Machinery and Apparatus. More than 15 years of experience in higher education: provision and management of the study process, research, performance, and management of international and local contract work. Active work with students of all study levels; supervision of more than 25 qualification papers. Several nominations for RTU Student Parliament awards for academic staff. Andrejs Podgornovs develops his professional experience by participating in international projects and contract work for governmental bodies and commercial enterprises in Latvia. Chairman and active participant of the Standardisation Technical Committee "Electrical Power Engineering" of the Latvian State Standard Institution since the foundation of the Committee in 2012.

Antans Sauhats, Dr.Habil.Sc., Professor, Leading Researcher. Professional experience: academic work experience of over 30 years at a higher education institution. Scientific work and research conducted for over 30 years, specialising in issues related to the operation of power system relay-based protection and automation, development and modernisation of power system risk assessment methods, algorithms and control systems, and many other issues. A. Sauhats has a considerable experience in the management of, and participation in, a number of national and international projects in the field of power and electrical engineering. Director of the Institute of Power Engineering of the Faculty of Electrical and Environmental Engineering of Riga Technical University. Corresponding Member of the Latvian Academy of Sciences. Chairman of the Doctoral Council RTU P-05. Author of 412 scientific publications, 75 of which have been published in 2015–2021 (Hirsch Index 12). Scientific supervisor of 35 defended PhD theses, 12 of which have been defended during the last six years.

Andrejs Utans, Dr.Sc.Ing., Associate Professor, Leading Researcher. Professional experience: 10 years of academic work at a higher education institution. More than 20 years of scientific and research activity, specialising in the development of power system relay-based protection and automation operation algorithms and the implementation of their apparatus part. Solid experience in the modelling of power system operating modes and analysis of emergency situations. Long-term experience working with real-life relay-based protection and automation devices. Participation in a number of scientific projects, research programmes, as well as participation in local and international scientific conferences.

The students master knowledge about the introduction and use of the newest technologies and about power system monitoring and control problems. The study process includes discussion of state-of-the art, microprocessor-based smart electronic devices, and examples of their use in the power industry. The study process develops and improves the students' theoretical knowledge and their practical skills in investigating the functionality of a smart electronic device, which ensures that the desired study results are achieved. In addition, Mr. Utans participates in various local and international courses and scientific conferences, expanding his knowledge about the most recent technological achievements in the power industry.

Ivars Zalitis, Dr.Sc.Ing., Researcher. Professional experience: 1.5 years of academic experience in leading laboratory classes for bachelor and master level students in relation to the modelling of faults in electrical systems and their stability. In parallel, Mr. Zalitis has made improvements to the laboratory work about directional earth fault protection within the course "Principles of Protective Relaying of Electric Power Systems" and the laboratory work about fault location within the course "Automation of Electric Power Generation and Transmission at Electrical". More than 4 years of scientific work experience at a university, specialising in the computer modelling of electrical systems and analysis and synthesis of relay-based protection and automation algorithms, which is evidenced by participation in a number of international conferences (for example: 12th IEEE PES Powertech Conference, IEEE EEEIC 2017, RTUCON, etc.) and publications both in the proceedings of scientific conferences and in a scientific journal, as well as three patents of the Republic of Latvia.

Inga Zicmane, Dr.Sc.Ing., Leading Researcher, Professor at the Institute of Power Engineering of RTU Faculty of Electrical and Environmental Engineering. Professional experience: 20 years of academic work experience at a higher education institution. Almost 20 years of scientific work and research. Her research is concerned with the quality of education, evaluation of the sensibility of electric power systems, transient processes, stability of power systems, local power networks, renewable energy sources. Ms. Zicmane has more than 60 scientific articles, one monograph, 2 study aids; also, she is the author or a co-author of 6 sets of methodological guidelines and has participated in the implementation of the tasks of 8 scientific projects of different scale.

Organisational activities: expert of the Latvian Council of Science, member of RTU Council of Professors in the field of Electric Engineering and Electronics, member of the Doctoral Council "RTU P-05", RTU Senate, the Study Quality and Programme Commission of RTU Senate, and RTU Arbitration Committee. Participant of organising committees and programme committees of international scientific conferences. Vice-Chairperson of the Master's Theses Defence Commission of the Power Systems Control and Automation Department (now — Power Systems Control and Optimisation Department) of the Institute of Power Engineering (since 2018), member of the Editorial Board of the journal "Электротехнические и информационные комплексы и системы" (ISSN 23075864), thematic editor of the journal "Sustainability" (IF 2.576, ISSN 2071-1050), long-term reviewer of several journals.

In order to enhance her professional qualification and improve her professional skills, Inga Zicmane completed traineeship at JSC "Augstsprieguma tīkls" (200 hours) in 2020, having supplemented her knowledge on the latest tendencies of the industry.

Students learn static, dynamic and resulting stability issues of electric power systems, practical methods for stability calculations, as well as measures to improve stability, electromechanical transient processes, methods for calculating stability, and modern measures to improve stability. They also model stability calculations in practice.

The Curricula Vitae of the academic staff in Europass format are provided in Appendix II.

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

The academic staff of the Study Programme perform regular scientific research and prepare scientific publications on the research results (see Appendix II). In total, 296 publications have been prepared during the reporting period, of which 247 are included in Scopus, 198 in WoS and 225 in other databases. It has to be noted that publications of the academic staff of the Study Programme have been quoted 715 times.

A summary by years (Table 1, 2) demonstrates that the number of publications of the academic staff of the Study Programme is sufficient to ensure high-quality implementation of the study process.

Table 1

Year	**Database**		
	SCOPUS	WOS	SpringerLink, IEEE_Xplore, pārējās / others
2014	21	7	19
2015	39	37	35
2016	29	28	29
2017	49	37	40
2018	46	46	48

2019	37	32	30
2020	24	10	22
2021	2	1	2

Table 2

Year	**Type of publication**			
	Scientific Monograph	Scientific Monograph Chapter	Article in Conference Proceedings or Conference Abstract	Journal Articles
2014	-	3	26	12
2015	1	1	41	4
2016	-	2	28	5
2017	-	1	43	8
2018	-	-	45	7
2019	-	-	34	3
2020	-	-	16	8
2021	-	-	2	-

The best monographs and publications of the academic staff with detailed substantiation are presented below:

1. Oboskalov, V., Gerhards, J., Mahņitko, A. Structural Reliability of Electrical Power Systems. Rīga: RTU Press, 2015. 202 p. ISBN 978-9934-10-722-1. Available from: doi:10.7250/9789934107221

Reasoning: The monograph is devoted to the evaluation of the structural reliability of complex electric power systems (EPSs). The general approaches applied to the calculation of reliability of complex technical systems are also discussed, special features of EPS are determined and basic methods for determining structural reliability indices are examined. The procedures of probabilistic simplification of the failure processes are considered in detail for the power supply systems of the consumers' nodes. The mathematical models of these simplifications are developed characterising two types of failures. The proposed simplification procedures are used in computer calculations and modelling. The monograph can be used as a textbook by the students of "Electrical and Power Engineering" programs of higher education institutions within the course "Reliability of EPS". It may also be of interest to researchers and engineers working in this field.

2. Sauhats, A., Čuvičins, V., Bockarjova, G., Žalostība, D., Antonovs, D., Petričenko, R. Detection and Management of Large-Scale Power System Disturbances. In: Critical Information Infrastructures Security: 9th International Conference, CRITIS 2014: Revised Selected Papers. Lecture Notes in Computer Science. Vol. 8985, Cyprus, Limassol, 13-15 October 2014. Cham: Springer International Publishing Switzerland, 2016, pp.147-152. ISBN 978-3-319-31663-5. e-ISBN 978-3-319-31664-2. ISSN 0302-9743. e-ISSN 1611-3349. Available from: doi:10.1007/978-3-319-31664-2_15

Reasoning: The chapter in scientific monograph is dedicated to the main problems of device realisation, application and testing. Recent blackouts of major power systems (PSs) clearly demonstrate the topicality of the blackout problem. Detailed analysis of blackouts allows to conclude that there is a long list of dangerous incidents that under unfavourable conditions lead to rapid shutdown of a significant number of vital power system elements: power plants, power lines, transformers, and consumers. Power supply of vast geographical regions can be broken. To prevent such situations, special types of automation are employed. In particular, for prevention and elimination of generators asynchronous operation mode automatic devices controlling the angles between two simulated voltages can be applied. Dangerous mode of operation can be eliminated using the short-term splitting of power system, followed by automatic restoration to normal operating conditions. To restore normal operation under-frequency load shedding automation is used widely. The use of these types of automation transforms severe emergency into a short transient process. To implement the above automation, GPS and fibre optic communication channels can be used.

3. Antans Sauhats, Hasan H. Coban, Karlis Baltputnis, Zane Broka, Roman Petrichenko, Renata Varfolomejeva. Optimal investment and operational planning of a storage power plant. International Journal of Hydrogen Energy, 2016. Field-Weighted Citation Impact: 4.229, cited: 15

Reasoning: This paper is published within one of the main journals in the field. This paper presents a stochastic approach for optimised short-term scheduling and long-term investment planning of storage power plants. A cost-benefit analysis is performed for two technologies – pumped storage (currently relevant in the Baltic region) and hydrogen storage (as an emerging technology). Liberalisation of electricity markets and dissemination of renewable energy sources leads to the variability of electricity prices, intermittency of generation and thus the necessity to develop new electrical energy storage systems for integration of renewables.

4. Sauhats, A., Utāns, A., Antonovs, D., Svalovs, A. Angle Control-Based Multi-Terminal Out-of-Step Protection System. MDPI Energies, 2017. Field-Weighted Citation Impact: 3.045.

Reasoning: This paper is published in the leading journal in the field with SNIP factor 1.34, and it has 7 citations in Scopus. The paper covers a topical problem — protection, which is used in blackout protection and cybersecurity protection. It describes a new structure and approaches proposed and patented for the effective power system's out-of-step automation and the recognition of island regime. Examples of equipment and software have been manufactured and tested.

5. Zalitis, A. Dolgicers, J. Kozadajevs. An adaptive single-pole automatic reclosing method for uncompensated high-voltage transmission lines. Electric Power Systems Research, 2019. Field-Weighted Citation Impact: 2.856.

Reasoning: This paper is published in the leading journal in the field with SNIP factor 1.412. The novelty and contribution of the paper relates to the proposed method that has a robust inner autoreclosing logic. This method is feasible and scalable due to separate calculations of the whole network regime and a detailed line model regime. These factors should facilitate the development and implementation of the proposed method.

6. Sauhats, A., Zemīte, L., Petričenko, Ļ., Moškins, I., Jasevičs, A. Estimating the Economic Impacts of Net Metering Schemes for Residential PV Systems with Profiling of Power Demand, Generation, and Market Prices. MDPI Energies, 2018. Field-Weighted Citation Impact: 2.743.

Reasoning: This paper is cited 14 times in Scopus and is published in the international peer reviewed journal with SNIP factor 1.34. This article analyses the influence of supporting scheme variants on the profitability of a projected investment of residential photovoltaic systems. The focus of the paper lies in evaluating the feasibility for the power system of solar power generation technologies to achieve a balance between energy generation and support costs in a more efficient way. The case study is based on a year-long time series of examples with an hourly resolution of electricity prices from the Nord Pool power market, in addition to the power demand and solar generation of Latvian prosumers. Electric energy generation and the consumption of big data from more than 100 clients were collected. Based on these data, we predict the pro-cesses for the next 25 years, and we estimate economic indicators using a detailed description of the net metering billing system and the Monte-Carlo method. A recommendation to change the current net system to a superior one, taking into account the market cost of energy, concludes the paper.

Results are applicable for the Northern European countries. The results are used to implement new Horizon 2020 projects.

7. Ivanova, A. Sauhats, O. Linkevics. District Heating Technologies: Is It Chance for CHP Plants in Variable and Competitive Operation Conditions? IEEE Industry Applications Magazine, 2019. Field-Weighted Citation Impact: 2.743.

Reasoning: This paper is published in the international peer reviewed journal with SNIP factor 1.629, cited 6 times and aims to solve the problem related to increasing big CHP in energy market. The novelty of the paper relates to the general algorithm that is developed to technical-economic justification of technologies, which is directed to increase the flexibility level of CHP plants. It is adapted to three technologies (air cooling, electric boiler and heat storage system) as a result three methodologies for certain technologies are achieved. The mathematical description of transient modes, general algorithm to technical-economic justification of technologies are approbated on the example of Latvian site conditions and Riga CHP–2 operation patterns. Developed approach and general algorithm and its implementation to different technologies can be adapted to other cogeneration power plants, which operate in variable running conditions. Developed algorithm has practical application. They are the installation of thermal storage tank and gas turbine modernisation (OpFlex solution) at production unit Riga CHP–2 and the installation.

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

During the last six years, the attracted scientific funding of the Institute of Power Engineering in implementing scientific and research projects, as well as in performing contractual works, was in the amount of minimum EUR 7.3 million.

As can be seen, based on the implementation of the projects of the national research programme in energy and the projects of the Latvian Council of Science (LCS), the scope has been significantly expanded and five projects under Horizon 2020 have been implemented as well. It has provided an opportunity to ensure the maintenance and promotion of research base, skills, and competences, as well as developed strong cooperation networks, both with local and European companies and research institutes. For example, close cooperation has been established with RINA, Fraunhofer and the EC Joint Research Centre (JRC), which significantly increases the scope, quality, and involvement of research in the European science area. This shows that the competences and scientific performance of the staff have been appreciated and recognised on a wider scale and offers higher opportunities to participate in Horizon Europe and other programmes. PhD candidates are also widely involved in the projects of the National Research Programme (NRP) and the Latvian Council of Science Programme, by carrying out research on the subject of energy in conformity with the goals and objectives of each project.

The attracted funding within the framework of H2020 projects is EUR 1.4 million or 19% of the attracted science funding, other financing from international or structural funds are EUR 1.6 million or 22%, funding of the National Research Programme and the Latvian Council of Science is EUR 4.2 million or 57%, contractual research — EUR 100,000 or 2%.

In addition, it should be noted that the entire academic staff (100%) have been involved in project implementation/execution during the reporting period as project managers or participants (i.e., major contractors, sub-project managers, leading researchers, etc.), as indicated in the academic staff CVs (Appendix II). PhD students of the Institute of Power Engineering have also been attracted to the implementation of projects.

The most important projects and contract work along with sources and sizes of funding are shown in Appendix 13.

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

The academic staff involved in the programme regularly organise conferences in Latvia and abroad, are members of different editorial boards and perform other research activities, the results of which are included in the implementation of the study programme and in the preparation of young scientists. The overall assessment of academic staff is reflected in the information provided by Section II, Chapter 3, Criteria 3.5 to 3.6 of the Study Direction Report and the CVs of the academic staff.

The research directions comply with the national priorities and are linked to RIS3 specialization areas. The results of each research project are integrated into the study process.

1. Academic staff participate actively in mobility activities. Whereas the number of students within the framework of mobility remains consistently low, the number of academic staff participating in mobility activities is increasing rapidly, e.g.:
2. Foreign visiting academic staff who have used the mobility opportunities:
    - - Assoc. Prof. Papanikolaou Nikolaos Petros (Greece) 21.05.2018–25.05.2018. Guest lecture on future challenges in the field of power engineering;

- - Prof. Petrescu Camelia-Mihaela (Romania) 15.06.2019–20.06.2019. Guest lecture "Electric Circuit Theory and Applications";
- Prof. Nina Davydenko (Ukraine) 01.02.2020–30.06.2020. The means for energy performance improvement of complex electric power systems and complexes;
- Prof. Dimitar Bogdanov (Bulgaria) 23.09.2018–29.09.2018. Course of lectures “Smart Power Systems”;
- Lecturer Veremiichuk Yurii (Ukraine) 12.11.2018–16.11.2018. Course of lectures “State and Prospects of Development of the Energy of Ukraine”;
- Gudzius Saulius (Lithuania) 29.10.2019–29.10.2019. Presentation on the course “Smart Power Engineering”.

It should be noted additionally that Prof. Gudzius and Assoc. Prof. Papanikolaou, following the results of an open competition (on recruitment of foreign academic staff within the selection stage of the “Strengthening the academic staff of educational institutions in strategic specialisation” sub-measure 8.2.2), started working at RTU in 2019 and continue to do so at the moment, being involved in the implementation of study courses for bachelor programme students.

2. RTU academic staff who have used mobility opportunities:

- Prof. Inga Zicmane 17.09.2018–21.09.2018 (Greece). Presentation on the course “Modern Electric Power Systems”;

- Assoc. Prof. Kristina Berzina (Greece) 17.09.2018–21.09.2018. Presentations on the course “LV/MV Power Systems, Smart Houses, Lighting”;

- Prof. Inga Zicmane 14.09.2019–21.09.2019 (Slovakia). Presentation on the course “Modern Electric Power Systems”;

- Assoc. Prof. Kristina Berzina (Slovakia) 14.09.2019–21.09.2019. Presentations on the course “LV/MV Power Systems, Smart Houses, Lighting”;

- Assoc. Prof. Tatjana Lomane (Slovakia) 15.09.2019–19.09.2019. Presentations on the course “Smart Protection and Control of Power Systems”;

- Dr. Romans Petricenko. 04.11.2019–04.12.2019. Kaunas University of Technology (Lithuania);

- Assistant Professor Lubova Petricenko 04.11.2019–04.12.2019. Kaunas University of Technology (Lithuania);

- Assistant Professor Lubova Petricenko 04.01.2020–25.01.2020. Kaunas University of Technology (Lithuania);

- Dr. Romans Petricenko. 04.01.2020–21.01.2020. Kaunas University of Technology (Lithuania);

- Assistant Professor Lubova Petricenko 06.04.2021–09.06.2021 and 08.02.2021–31.03.202. Ondokuz Mayis University (Turkey), etc.

As a result of the visits of the academic staff, scientific publications have been prepared and published, project applications have been prepared, transfer and integration of knowledge in study courses have been provided. For example, Lubova Petricenko and Romans Petricenko, during their mobility period, in active cooperation with masters and PhD students of Kaunas University of Technology and KUT Professor Saulius Gudzius, conducted research on floating solar panels, obtained data on the technical data of Kruonis PSPP for the purpose of optimising its work planning. As a result, the scientific publication “Profitability Study of Floating PV and Storage Pumped Hydropower Plant” was submitted and presented at the international scientific conference European Energy Market 2020 (https://eem20.eu/).

1. The academic staff of the study programme is involved, at both national and international level, in scientific research in the field of their competence and integrate the obtained information, experience and the latest research methods into the study process. The academic staff of the study programme are actively involved in scientific research in basic directions such as:

- Management of the efficiency, reliability, stability and risk of energy systems (I. Zicmane, A. Dolgicers, A. Mahnitko, L. Zemite, T. Lomane, A. Utans, I. Zalitis, J. Kozadajevs);

- Development of operational methods and means for energy facilities (L. Petricenko);

- Development of innovative electric machines, electrical apparatus and device (A. Podgornovs);

- Power supply systems, distribution networks and their reliability (A. Kutjuns, O. Linkevics);

- Planning and optimization of power supply systems (A. Mahnitko, L. Petricenko);

- Characteristic features of the activity of electricity producers in the overall energy system and at electricity market conditions (A. Mutule, L. Petričenko) and other.

III. In the implementation of their study courses, the academic staff of the study programme use the results of their research, as well as that of other researchers, thereby ensuring that students are provided with updated knowledge. During the reporting period, the academic staff were involved in a variety of scientific research activities, including participation in international scientific conferences in Latvia and abroad, for example:

- International Conference on the European Energy Market (EEM);

- IEEE PowerTech (PowerTech);

- IEEE International Conference on Environment and Electrical Engineering and IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe)

- RTUCON conference and other.

A full list of the publications, patents, and studies of the academic staff for the reporting period is provided in Section II.

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study programme is designed to ensure a sequential development of knowledge, skills and competences based on individual and group work and continuous communication between PhD students and their supervisors. The study programme also includes a mechanism for mutual cooperation between academic staff, which facilitates the development and interlinkage of study courses.

To achieve the learning outcomes of the study programme, the interconnection of the study courses and their logical, sequential layout in time is of great importance. In order to stimulate mutual learning by members of the academic staff as well as transfer education innovations and good practice and strengthen their sense of belonging to the profession and their motivation, the Study Programme ensures cooperation of academic staff within the department, the faculty, the university and internationally.

The improvement of study courses takes place regularly on the basis of suggestions made by students, industry development trends, the latest research, scientific activities, and innovation results. During the implementation of the study courses, regular meetings of academic staff take place in which they exchange experience on the subjects of study courses, as well as their discussions allow developing and improving the content of studies by mutual agreement on subjects, accents, responsibilities and compliance with the regulatory requirements. The process of co-ordinating study courses involves the entire academic staff engaged in the study course, thereby ensuring that the subjects covered under the study programme are continually improved and updated in close mutual cooperation. The objectives and results of the study courses and the programme within the framework of the Programme are achieved by organising regular academic staff seminars and discussions on the results of studies and the basic principles for quality assurance. Thus, it can be said that there is a mechanism for mutual cooperation between academic staff, which promotes the development and interlinkage of study courses.

The study programme is designed to ensure a sequential development of knowledge, skills and competences based on individual and group work, continuous communication between PhD students and their supervisors. The link between the courses is indicated in Clause 2.2 of Article 2 of Part 3 of the Study Programme Accreditation Self-Assessment Report.

The following measures are used to improve the content and quality of the Study Programme, as well as to ensure cooperation between academic staff and exchange of experience and information related to study work:

- Academic staff meetings (minimum once during a term);
- Scientific commission meetings (minimum once in two months);
- Doctoral Council meetings (when required, but minimum four times a year);
- Doctoral seminars;
- PhD attestations within the framework of the organizational unit and the faculty (twice a year);
- Academic conference (once a year);
- Seminars, conferences, think tanks and other measures.

In total, 16 members of academic staff with a PhD degree are involved in the implementation of the PhD study programme, of which 37.5% or 6 persons are scientific supervisors of the PhD theses of the PhD students studying at the study programme and 62.5% or 10 persons participate in the implementation of the Programme as academic staff.

The number of students during the last six academic years was 7 on average, thus there are an average of two students per one member of the academic staff in the study programme.

In view of the fact that the Study Programme includes academic staff from other RTU organisational units, guest lecturers and foreign guest lecturers, the ratio of students to academic staff may also be assessed in the context of the study field and the faculty.

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	Pielikums_5_REDN Statistika_EN.docx	Pielikums_5_REDN0 Statistika_LV.docx
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	Pielikums_6_REDN Atbilstiba_AL_EN.docx	Pielikums_6_REDN Atbilstība_AL_LV.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Pielikums_7_REDN kartejums.xlsx	Pielikums_7_REDN kartejums.xlsx
Curriculum of the study programme (for each type and form of the implementation of the study programme)	Pielikums_9_REDN0 plānojums_LV, EN.docx	Pielikums_9_REDN0 plānojums_LV, EN.docx
Descriptions of the study courses/ modules	Pielikums__8_Studiju kursu apraksti.pdf (1).zip	Pielikums__8_Studiju kursu apraksti.pdf (1).zip
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	Pielikums_14_Diploma_paraugs REDN.docx	Pielikums_14_Diploma_paraugs REDN.docx
Description of the Study Programme - Other mandatory attachments		
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	Par iespēju studējošiem turpināt studijas_DSP.edoc	Par iespēju studējošiem turpināt studijas_DSP.edoc
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	Apliecinajums - Par zaudējumu kompensaciju.edoc	Apliecinajums - Par zaudējumu kompensaciju.edoc
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.	Apliecinājums - Svešvalodu prasme.edoc	Apliecinājums - Svešvalodu prasme.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.	Apliecinājums - LZP eksperti doktora programma.edoc	Apliecinājums - LZP eksperti doktora programma.edoc
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education	Apliecinājums - AL 55. pants par prof. skaitu akadēmiskas programmas.edoc	Apliecinājums - AL 55. pants par prof. skaitu akadēmiskas programmas.edoc
Sample (or samples) of the study agreement	Sample_of_study_agreements.zip	Studiju līgumi.zip
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.	Nr_05_RTU_Dokt_250__stud_ATZINUMS_tulkots.docx	Augstakas_izglitibas_padomes_atzinums.docx

Computerised Control of Electrical Technologies (42522)

Study field	*Power Industry, Electrical Engineering, and Electrical Technologies*
ProcedureStudyProgram.Name	*Computerised Control of Electrical Technologies*
Education classification code	*42522*
Type of the study programme	*Professional bachelor study programme*
Name of the study programme director	*Leonīds*
Surname of the study programme director	*Ribickis*
E-mail of the study programme director	*Leonids.Ribickis@rtu.lv*
Title of the study programme director	*habilitētais doktors*
Phone of the study programme director	
Goal of the study programme	*The aim of the study programme is to provide professional Bachelor education in computerised control of electrical technologies, corresponding to the 5th professional qualification level (electrical engineer), and to prepare students for professional Master studies in different subfields of electrical engineering, which would allow them to pursue a Doctoral degree.*
Tasks of the study programme	*Tasks of the study programme: - To provide knowledge in mathematics and physics for solving practical electrical engineering problems; - to learn how to use computer technology skilfully and efficiently both for solving problems and for developing automation systems; - to learn to solve practical electrical engineering problems at project level; - to give an understanding of the design, basic operation, automation and robotics of electrical and electronic equipment; - to learn how to solve electrical and electronic automation and robotisation problems at project level; - to give an understanding of the electrical aspects; - to give an idea and knowledge of work organisation, social issues and economic principles; - to strengthen foreign language skills.*

Results of the study programme	*Graduates of the study programme: - are able to apply theoretical knowledge in mathematics and physics to solve practical electrotechnical problems; - are able to use computer technology effectively for solving electrical engineering problems and for developing automation and robotic systems; - are able to solve practical electrical and electronic engineering problems at project level; - are able to demonstrate an understanding of the design, operating principles, automation fundamentals and robotics of electrical equipment; - are able to solve automation and robotisation tasks at project level in electrical engineering; - are able to demonstrate an understanding of the electrogenic aspects; - are able to demonstrate an understanding of the organisation of work, social and economic principles; - are able to acquire professional literature in a foreign language. Graduates of the study programme obtain a Professional Bachelor Degree in Electrical Engineering, which allows them to continue their studies at the professional Master level, as well as receive a Qualification of Electrical Engineer corresponding to the 5th professional qualification level.*
Final examination upon the completion of the study programme	*The Qualification paper - Bachelor Paper with a project part.*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*General or vocational secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 5 years - latvian

Study type and form	*Part time studies*
Duration in full years	*5*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*

Admission requirements (in English)	*General or vocational secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 5 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*General or vocational secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Bachelor Degree in Electrical Engineering*
Qualification to be obtained (in english)	*Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

The study programme is planned to be implemented in full-time intramural form and part-time extramural form in Latvian, as it has been implemented so far, as well as in full-time intramural form in English. Each of these forms of study has a different duration but the same number of credit points.

During the reporting period (June 2017), the following changes were implemented in the professional Bachelor study programme "Computerised Control of Electrical Technologies":

Changes in the obligatory Part (A):

1. To change the volume of the part from 90 CP to 97 CP, the volume of the block of study courses of general education (A.1.) – from 14 CP to 12 CP, the volume of the block of study courses of professional specialisation (A.3.) – from 40 to 49 CP;
2. To exclude the study courses:

- *Introductive Course in Speciality – 1 CP* (code EEL100),
- *Economics – 2 CP* (code IET103),
- *Basics of Communication – 2 CP* (code HPS120),
- *Computer Studies (basic course) – 3 CP* (code DIP101),
- *Computerization of Mathematical Tasks in Electrical Engineering – 3 CP* (code EEM208),
- *Mechanics – 2 CP* (code MMP169),
- *Electrical Transport Adaptive Systems Basics – 3 CP* (code EEI353),
- *Electrical Measurements – 3 CP* (code DAI201),
- *Power Electronics – 3 CP* (code EEP334),
- *Electrical Machines – 5 CP* (code EEM305),
- *General and Occupational Safety – 1 CP* (code IDA419)
- *Electric Supply – 2 CP* (code EEA416),
- *Programming Technologies (study project) – 3 CP* (code EEI345),
- *Computer Studies (special course in industrial electronics) – 2 CP* (code EEI211);

3. To include the study courses:

Part A.1.

- *Introductive Course in Speciality – 2 CP* (code EEI727)
- *Innovative Product Development and Entrepreneurship – 6 CP* (code SDD700);

Part A.2.

- *Numerical Methods for Computerization of Tasks in Electrical Engineering 2 CP* (code EEM732);

Part A.3.

- *Electrical Measurement Basics – 3 CP* (code EEI726),
- *Power Electronics – 4 CP* (code EEI729),
- *Electrical Machines – 4 CP* (code EEM212),
- *Programming Technologies (study project) – 2 CP* (code EEI348),
- *Basics of Embedded Systems – 3 CP* (code EEI725),
- *Embedded Systems (course project) – 2 CP* (code EEI724),
- *Modern Production Technologies – 5 CP* (code EEI355),
- *Control and Regulation of Electrical Drives – 6 CP* (code EEP202),
- *Electron Devices – 3 CP* (code EEE202);

4. To move the study courses:

- *Mathematics – 9 CP* (code DMF101) from Part A.1. to Part A.2.,
- *Chemistry for Engineers – 2 CP* (code ĶVĶ115) from Part A.2. to Part A.1.,
- *Programming Technologies in Industrial Electronics – 3 CP* (code EEI481) from Part A.2. to Part A.3.,
- *Civil Defence – 1 CP* (code ICA301) from Part A.3. from Part A.1.,
- *Basics of Labour Protection – 1 CP* (code IDA700) from Part A.3. to Part A.1.,
- *Theory of Circuits - 5 CP* (code EEE215) from Part A.3. to Part A.2.

Changes in compulsory elective study courses, Part (B):

5. To change the volume of the part from 26 CP to 25 CP, the volume of the block of study courses of professional specialisation (B.1.) – from 20 CP to 17 CP, the volume of study courses in humanities and social sciences (B.2.) – from 2 CP to 4 CP.

6. To close the following professional specialisations:

Industrial Electronics and Electrical Technologies,

Road Transport,

Railway Automatics and Computerised Control;

7. To exclude the study courses from professional specialisations *Road Transport* and *Railway Automatics and Computerised Control*;

8. To include the study courses within the block of courses of professional specialisations Part (B.1.):

- *Basic Signal Theory - 3 CP* (code EES225),
- *Basics of Automation of Production Processes – 3 CP* (code EEP473),
- *Electrical Micromachines - 3 CP* (code EEM306),
- *Basics of Electric Power Engineering – 3 CP* (code EES263),
- *Application of Computers in Automation of Technological Processes – 2 CP* (code EEP341),
- *Electrical Apparatuses – 3 CP* (code EEM231),
- *Application of Computers in Electrical Equipment Design – 2 CP* (code EEP342),
- *Automated Electrotechnological Processes – 2 CP* (code EEP408),
- *Programming Languages – 3 CP* (code EEI352),
- *Electric Supply - 2 CP* (code EEA416),
- *Electrotechnological Equipment – 5 CP* (code EEA311),
- *Mechanics – 2 CP* (code MMP169),
- *Computer Studies (special course in industrial electronics) – 2 CP* (code EEI211).

Changes in the Internship, Part (D):

9. To change the volume of the part from 26 CP to 20 CP;

10. To exclude the study course Practical Placement – *26 CP* (code EEI010);

11. To include the study course *Practical Placement – 20 CP* (code EEI728).

In May 2021, by Decision of RTU Senate No…, the study programme was updated, envisioning the following changes

Changes in the obligatory Part (A):

1. To change the volume of the part from 97 CP to 98 CP, the volume of the block of study courses of general education (A.1.) – from 12 CP to 13 CP, the volume of the block of study courses of professional specialisation (A.3.) – from 49 CP to 46 CP;
2. To exclude the study courses:

In Part A.2.:

- *Probability Theory and Mathematical Statistics* – 2 CP (code DMS212);
- *Numerical Methods for Computerization of Tasks in Electrical Engineering*– 2 CP (code EEM732);

In Part A.3.:

- *Fundamentals of Electrical Drives* – 4 CP (code EEI212);
- *Programming Technologies (study project)* – 2 CP (code EEI348);
- *Electron Devices*– 3 CP (code EEE202);

3. To include the study courses:

In Part A.1.:

- *Environment and Climate Roadmap* – 1 CP (code VAS038);
- *Fundamentals of Graphics Communication* – 2 CP (code BTG701);

In Part A.2.:

- *Computerization of Mathematical Tasks in Electrical Engineering* – 3 CP (EEM208);

In Part A.3.:

- *Theory of Electrical Drive Systems* – 5 CP (code EEI710);
- *Electro-Magnetic Compatibility in Industrial Electronic Equipment* – 2 CP (code EEP581);
- *Scientific Seminar in Industrial Electronics* – 2 CP (code EEP301);
- *Electric Supply* – 2 CP (code EEA416);

4. To move the study courses:

- *Chemistry for Engineers – 2 CP* (code ĶVĶ115) from Part A.2. to Part A.1;
- *Programming Technologies in Industrial Electronics – 3 CP* (code EEI481) from Part A.3. to Part B 1 for specialisation Computerised Control of Electric Transport*;*
- *Basics of Embedded Systems* – 3 CP (code EEI725) from Part A.3 Part B.1. for specialisation *Industrial Electronics and Robotics*;
- *Embedded Systems (course project)* – 2 CP (code EEI724) from Part A.3. to Part B.1. for specialisation Industrial Electronics and Robotics;
- *Mechanics* – 2 CP (MMP169) - from Part B.1. Part A.2.;
- *Basic Signal Theory* - 3 CP (EES225) from Part B.1. Part A.3.;

Changes in compulsory elective courses, Part (B):

1. To change the volume of the part from 25 CP to 24 CP, the volumes of courses of professional specialisation (B.1.) – from 17 CP to 16 CP;
2. To change the title of a professional specialisation *Industrial Electronics and Electrical Technologies* for *Industrial Electronics and Robotics;*
3. To exclude the study courses from professional specialisation *Industrial Electronics and Robotics*;
4. To include common study courses in Part B 1 within professional specialisation *Industrial Electronics and Robotics* (B.1.):

- *Application of Computers in Electrical Equipment Design* - 2 CP (code EEP342);
- *Effective Lighting* - 2 CP (code EEI701);
- *Electric Drive of Robots* - 2 CP (code EEP352);
- *Intelligent Electronic Equipment in Robotic Systems* - 3 CP (code EEI358);
- *Autonomous Robotic System (course project)* – 2 CP (code EEI720);

5. To exclude the study courses from professional specialisation *Computer Control of Electrical Transport*:

- *Algorithmization and optimization methods in industrial electronics* - 3 CP (code EEI288);
- *Artificial neural networks technology basics in electrical transport* - 2 CP (code EEI388);
- *Fuzzy logic technology basics in electrical transport* - 2 CP (code EEI387);
- *Genetic algorithms basics in electrical transport* - 2 CP (code EEI488);
- *Artificial immune systems and algorithms basics in electrical transport* - 2 CP (code EEI487);
- *Intelligent Agents Technology in Electrical Transport* - 3 CP (code EEI563);
- *Microprocessor Control Technology of Unmanned Vehicles* - 3 CP (code EEI389);
- *Electrical Transport Embedded Systems Basics* - 3 CP (code EEI498);
- *Electrotechnological Equipment* - 5 CP (code EEA311);
- *Mechanics* - 2 CP (code MMP169);

6. To include the study courses in the professional specialisation *Computer Control of Electrical Transport*:

- *Control and design of smart electrical transport* - 3 CP (EEI781);
- *Automated Electrotechnological Processes* - 2 CP (EEP408);

7. To supplement Part B.1. with the third specialisation *Electromechanical Transformers and Equipment;*

8. To include common study courses in Part B 1 within professional Electromechanical Transformers and Equipment:

- *Electrical Micromachines* - 3 CP (code EEM306);
- *Electrical Apparatuses* - 3 CP (code EEM231);
- *Application of Computers in Electrical Equipment Design* - 2 CP (code EEP342);
- *Electrical Machines Designing Calculation* - 2 CP (code EEM410);
- *Contactless Electrical Machines and Basics of Designing* – 4 CP (code EEM729);
- *Electrical Machines of Automatic Systems* - 2 CP (code EEM427).

The following changes are made related to the improvement of the study process and its quality, taking into account the recommendations of the industry companies and associations, as well as technological developments, in order to provide up-to-date and sector-specific training.

1.2. Analysis and assessment of the statistical data on the students of the respective

study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

In the process of developing the study programme, the dynamics and trends of the number of students at different levels of the study programme "Computerised Control of Electrical Technologies" were analysed and taken into account. The table below shows that since 2013 the number of students has remained approximately at the same level, with a tendency to increase slightly in the period of 2016-2018. This could be due to the changes made in 2014 to the certification requirements for professionals in construction and power engineering: the specialists under discussion were required to obtain an engineering diploma that could only be acquired by completing the professional study programme. In addition, there was also the trend towards a shift to a full-time form of studies in the final year instead of part-time studies. The statistics on the students of remote studies is summarised in Table 2, where there is a slight decrease during these years, when some of the students change from remote to full time in person studies during the last years.

Table 1. Student number dynamics at RTU study programme

“Computerised Control of Electrical Technologies” (budget funded positions)

Full-time (data as per October 1)

Academic year	1st year	2nd year	3rd year	4th year	TOTAL
2013/2014	39	28	33	28	128
2014/2015	41	36	23	38	138
2015/2016	46	36	29	38	149
2016/2017	40	40	23	39	142
2017/2018	48	42	19	31	140
2018/2019	46	30	23	26	125
2019/2020	35	29	27	23	114
2020/2021	43	20	27	21	111

Table 2. Student number dynamics at RTU study programme

“Computerised Control of Electrical Technologies” (tuition fee paying) part-time extramural

Academic year	1st year	2nd year	3rd year	4th year	5th year	TOTAL
2013/2014	39	29	9	17	8	65

2014/2015	18	26	13	8	11	76
2015/2016	21	20	16	10	11	78
2016/2017	16	19	14	14	15	78
2017/2018	23	11	12	10	17	73
2018/2019	19	10	4	5	17	55
2019/2020	25	5	10	3	9	52

Until now, no foreign students have been enrolled in the study programme.

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

The specific aim of the study programme is to provide professional Bachelor education in computerised control of electrical technologies, corresponding to the 5th professional qualification level (electrical engineer), and to prepare students for professional Master studies in different subfields of electrical engineering, which would allow them to pursue a PhD degree.

The main tasks are to provide knowledge of mathematics and physics for solving practical electrical engineering problems; to teach the skilful and efficient use of computer technology for both problem solving and the development of automation and robotic systems; and to teach practical electrical and electronic problem solving at project level; to give an understanding of the construction, basic operation and automation of electrical and electronic equipment; to teach how to solve automation and robotics tasks at project level; to give an understanding of the electrical aspects; to give an understanding and knowledge of work organisation, social issues and economic principles; to strengthen foreign language skills.

Students acquire the basic knowledge required for the Bachelor degree in the theoretical and practical principles of electrical technology, electrical equipment design, electrical automation and the practical design of automation and robotic systems. The programme is implemented in the field of electrical engineering, but with an in-depth study of information technology for application in computer-aided automation of electrical equipment. During the studies, a minimum of 4 months of internship is undertaken, as well as study projects are developed within 3 important study courses of the programme, thus enabling students to acquire practical design skills. The amount of knowledge, skills and competences acquired during the studies corresponds to the professional standard “Electrical Engineer” of the Republic of Latvia. At the end of the studies, a Bachelor Thesis with a project part is developed and publicly presented, resulting in the award of both the Bachelor degree and the Qualification of Electrical Engineer in accordance with the 5th professional qualification level (corresponding to the 6th level of the Latvian Qualifications Framework).

The public presentation of the qualification paper - Bachelor Paper with a project part - takes place at an open meeting of the State Examination Commission, where the students present their qualification paper and answer the questions asked by the members of the Commission, the scientific adviser, the reviewer and the attendees. The State Examination Commission appointed by Rector of RTU in 2017 consists of 5 members: representatives of the Institute of Industrial Electronics and Electrical Engineering, representatives of industrial companies and the Chairman of the Commission Aļnis Kaļāns (Ltd. EK Sistēmas.). The volume of the qualification paper is 50 pages with descriptions and calculations, as well as 2 A1 drawing sheets with diagrams and solutions. The final evaluation of the qualification paper is expressed according to a 10-point grading scale following RTU Regulation on the Assessment of Learning Outcomes (27 May 2017, Minutes No 610).

After completing the study programme, graduates can continue their studies at the professional Master programme.

The professional Bachelor study programme admits students with general secondary education or 4-year vocational secondary education. Admission is based on the results of centralised examinations (CE) in mathematics, the Latvian language and a second foreign language; priority is also given to students with positive CE results in physics and chemistry.

Upon graduation, students receive a Professional Bachelor Degree in Electrical Engineering and a Qualification of Electrical Engineer. Graduates of the study programme can work as electrical engineers at any company, performing relevant duties in the operation, development and design of electrical technologies.

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master's and doctoral study programmes, 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 volume of the professional Bachelor study programme is 160 CP. It consists of study courses (128 CP), internship (20 CP) and a state examination (12 CP), which includes the elaboration and public presentation of a Bachelor Paper with a project part. The choice, scope and content of the study courses of the Bachelor programme, as well as the content and tasks of the internship have been developed in accordance with the professional degree and qualification to be obtained following the professional standard “Electrical Engineer”.

All changes to the programme have been designed to strengthen the relevance of the course content and its consistency with labour market needs and scientific trends. For example, in line with recent trends, the programme has included courses offering in-depth information on computerised control of technologies in areas such as web technologies, embedded system implementation, robotic drive systems, electromagnetic compatibility. The following courses have been added to the programme in recent years: “Electro-Magnetic Interoperability in Industrial Electronic Equipment”, “Basics of Embedded Systems”, “Embedded Systems (study project)”, “Web Technology and Web Programming in Electric Transport”, “Autonomous Robotic System (study project)”. The course “Scientific Seminar in Industrial Electronics” has been included in the programme with the aim of developing students' ability to work with modern scientific literature and to analyse and evaluate their results. The study course “Environmental and Climate Roadmap” on current environmental topics has also been included in the study programme.

Each student develops and publicly presents at least three projects during their studies. During the development of study projects, students get acquainted with the types of electrical technologies, carry out research on their principles of operation, analyse approaches to computerised control technologies, make technical and economic calculations.

In line with industry trends, as well as recommendations for improving the content of the programme, regular improvements are made to the study courses and programme content. In 2013/2014 academic year, the study course content was revised, existing courses were revised and updated, the latest academic approaches were integrated, experimental and laboratory stands and their execution methods were updated. Since 2015, individual study courses have been revised, updated with the most relevant topics, new academic staff have been recruited, and study courses and their materials have been digitised. For example, the study courses “Foundation of Electrical Engineering Theory” (EEE 223) and “Electrical Engineering and Electronics” (EEE 226) were digitised in 2020/2021 academic year. In line with the subject matter, the study courses are regularly updated and improved with various innovations, using practical results, measurements and experience gained by the Institute's staff in various internationally funded and implemented projects, such as H2020, FP7, ERDF. For example, the study course “Introductive Course in Speciality” (EEI727) was supplemented with practical assignments, the course “Fundamentals of Electrical Drives” (EEI212) was supplemented with laboratory work.

In 2017, the study course "Fundamentals of Electrical Drives" (EEI212) was revised and improved. The updated course covers the latest trends in the development of electrical drive systems.

To consolidate theoretical knowledge and gain practical experience in the sector, the internship in the volume of 20 CP is implemented, thus ensuring relevance to the needs of the sector and the labour market. A tripartite agreement is concluded among the university, the student and the employer. In accordance with the aims and tasks of the programme and the internship (in line with the professional standard and qualification to be acquired), the content of the internship includes familiarisation with the management structure and operating principles of the internship enterprise, the specifics of the industry and practical skills in the technologies used in the industry. The representatives of the enterprises with which the internship agreement has been concluded participate in the definition of the aims and tasks of the internship, as well as in the evaluation of the internship. The aim of the internship is achieved on the basis of the acquired knowledge, skills and competence.

The structure of the programme and all formal requirements comply with the requirements of the national laws and regulations and the decisions of RTU Senate.

To ensure that the content of the programme is as close as possible to the needs of the labour market, the State Examination Commission includes representatives from the industry. They give their suggestions on preferred research themes for students that are relevant to the labour market. In cooperation with employers' representatives, students develop their study projects and graduation papers. Employers positively evaluate students' performance in developing and publicly presenting their graduation papers, as well as highly assess the tasks completed during the internship, by inviting students to participate in projects or undertake employment at a company. The themes of graduation papers are individual and address a specific problem, and the quality of the work is also evidenced by regular prizes won in various competitions in the category of the Best Paper, for example, contest organised by JSC Latvenergo, as well as competition on the best graduation paper organised by the Latvian Association Electrical Engineers and Energy Engineers (LEEA), including JSC Augstsprieguma tīkls, Ltd. Schneider Electric Latvija and JSC Prysmian Group Baltics.

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

The study programme "Computerised Control of Electrical Technologies" has defined 8 learning outcomes to be achieved, which correspond to the professional standard "Electrical Engineer". The tasks set out in the course descriptions are closely linked to the overall programme outcomes. The content of the courses is fully in line with the learning outcomes (see Annex 8). The content of the courses is regularly reviewed and improved, which helps monitor and update the content, teaching methods and learning outcomes.

To ensure the interconnectedness of study courses and their modules, regular seminars are organised for the academic staff involved to improve them or to introduce new topics, in line with current industry and technology trends. During these seminars, the academic staff discuss the topics and the content of the lectures, including their sequential introduction in the subsequent courses, ensuring the necessary background knowledge and quality test requirements for their future successful completion. In addition, the assessment of the sector is derived from the trainee evaluation questionnaire at the end of the internship and recommendations for improving teaching methods/theoretical skills, as well as from the recommendations of the State Examination Commission and association experts.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

Various methods and modes of teaching are used in the study process, their choice is conditioned by specifics of every study course. General issues and theoretical aspects are discussed at the lectures, the lecture materials are available to the students in the electronic format, also in ORTUS e-learning environment. Practical assignments and classes are organized in the form of traditional labs using specialised equipment, as well as in the form of practical tasks, where students should demonstrate that they are able to integrate knowledge acquired within various study courses. The learning resources available to the students are updated, numerous books and learning aids are submitted to publishing, the existing study laboratories are modernised and improved. Several study courses are being gradually digitised. It is possible to deliver all study courses remotely in Microsoft Teams or Zoom environment.

The training process (lectures, practical and laboratory classes) will be based on new technologies such as modelling computer programs, computer projectors, micro-control kits, unified digital and analogue control plates, and other types of technology. The resources available to students were added and improved, several books and methodological aids were developed for publication, and existing training laboratories were upgraded and improved. Some technological equipment and computer programs were self-created, and some of them were purchased. The study programme will be implemented through project tasks, their public presentation and assessment. Students will be involved in various research projects.

Descriptions of study courses will be available at RTU website, in the Study Programme Register. Their description is based on the principles of Bloom's taxonomy, namely, including not only an annotation and a short description of the study course, but also providing information on the aims and tasks of the study course expressed in competencies and skills, defining the learning outcomes to be achieved and their assessment, as well as prerequisites for acquiring the study course.

Assessment of student learning outcomes is carried out in accordance with the “Regulation on the Assessment of Learning Outcomes” (approved at the Meeting of RTU Senate on 27 May 2017, Minutes No 610), which is available on Studies Regulations page of RTU web page (https://www.rtu.lv/writable/public_files/RTU_studiju_rezultatu_vertesanas_nolikums.pdf (in Latvian) English translation is Annex 04 in the zip folder "List of Internal regulations"). Pedagogical methods used in the implementation of study courses, as well as assessment forms and methods are selected by the instructors responsible for the study courses in compliance with course curriculum and specifics of the programme, as well as student needs. A member of academic staff should inform students about particular assessment criteria at the fist lecture/practical class.

The main advantage of the summative assessment system is that the final grade is made up of several components. Therefore, the students may contribute to their final grade working during semester. Criteria for assessment of the study courses and individual/home tasks are published on ORTUS e-study system beforehand. During semester, the assessment for each home task, test, report, presentation and any other task is ascribed certain weight in the final grade. Exam grade may not exceed 50% of the final grade. Academic staff may take into consideration and also assess student attendance. Assessment structure for the study course is determined by the academic staff themselves, abiding the resolution of RTU Senate that the exam grade may not contribute more than 50% to the final grade. Selecting assessment criteria and methods for evaluation of student achievements, specifics of each study programme and learning outcomes are taken into consideration.

The study program is implemented as full time studies and remote studies in Latvian and English, by following the requirements defined by laws and regulations, the core principles of organisation of studies set by RTU and by complying with all the study course requirements. Course description of the study program defines the set of compliant knowledge, skills and competences and their evaluation system, defines the study outcomes for attaining which credits are granted, which do not depend on the form of the program implementation: full time studies in person, half-time studies in person or remote studies. The procedure of evaluation of students’ knowledge, skills and competences is defined by Senate of RTU decision of 27 May 2017 "Regulation on the Assessment of Learning Outcomes”, which conforms to the core principles and procedure of assessment of education on the relevant study level defined by the Cabinet Regulations. The cumulative assessment system is applied in assessing students' achievement where the final grade consists of several components.

Full time studies consist of 40 CP per academic year and 40 academic hours of the student's work per week accounting for 1 CP. In order to satisfy the requirements defined in the program and every course, in comparison to full time studies, a longer time for completing the program and a lower number of credit points is set for half-time studies, in particular, less than 40 CP per academic year and less than 40 academic hours per week. Thus, as the study program is implemented in different types and forms of studies, only the number of in person (or contact) and independent work hours and the study methodology or instruction approach of courses differs. The teaching methods for implementation of study courses, as well as the assessment methods are selected by the academic staff responsible for the study course in compliance with the specifics of the content of the study course and the study program, as well as students' needs. As full time students have less practical experience in the field of study, the applied methods include study trips to the industry companies, visiting lectures by the industry professionals, etc. As regards half-time students, who have practical experience in most cases, the employed teaching methods consist more of lectures, practical assignments, group works, home assignments and research involving cases studies and their explanation from both the theoretical and practical perspective. Within the half-time in person and half-time remote study process the focus is on the independent work of students by using both the problem-based learning and case studies, as well as the professor's advisory role.

As stated above, in addition to theory classes in classrooms, students also participate in study trips to the biggest companies and organisations of the industry, for example, within the scope of the study course "Introduction to the speciality" the first year students visit Latvenergo AS, Sadales tīkli, Rīgas mašīnbūves rūpnīca, Getliņi and other companies. Organisation of study trips and study visits ensures the link between the content of the study program and the industry specifics, in addition to the knowledge of the theory students can relate it to daily situations in companies on the matters of both automation processes, energy saving and efficiency improvement, to analyse issues and to substantiate their view.

The student-focused education principles are considered during the whole implementation of the study process:

1. Involvement of students in the study process and content improvement. RTU has developed procedures providing for the student feedback on the quality of the study process (surveys, regular meetings of students with the program director and leading teaching staff, etc.). Thus, students have an opportunity to affect the study process. Students in the program are regularly involved in the program quality assessment, participate in the work of decision making bodies and advisory bodies.
2. Study outcomes. The assessment of the study courses of the program and the number of credits is related to study outcomes. The study outcomes of each study course are notified to students. Professors relate the course outcomes to the study program outcomes, as well as substantiate the necessity of acquisition of the information of the relevant course for mastering the profession of an electrical engineer.
3. Mobility. Within the study program "Adaptronics" mobility resources are used to improve the teaching process of the university, as the student-focused education is based on a powerful teaching process. Teaching staff of foreign universities is involved in the program implementation, thus benefiting not only students, but also the teaching staff involved in the program implementation by taking over the best practice.
4. Social dimension. When students study within this program, their study process is sufficiently flexible, providing an opportunity for students to combine studies with work starting from the second or third study year. Students of the day department also have an opportunity to change the form of studies to remote studies in order to combine studies and work. The fact

that the premises of the RTU library are available to students round the clock and also on weekends should be mentioned as another advantage.

5. Teaching methods. Various teaching methods are applied in the program implementation process. For example, study projects are developed, there are group works, the peer-to-peer method is applied in some study courses. Students can receive individual consultations from the academic staff in personal meetings or by communicating in the e-environment.
6. Study environment. During the program implementation there is cooperation between librarians and the academic staff aimed to improve the teaching and learning process. Both students and the teaching staff involved in the program have access to premises with relevant equipment appropriate for research and the learning process.
7. Development of the academic staff competences. The academic staff involved in the program have regular opportunities for improvement of their methodological and teaching skills. The process of development of the academic staff competences includes also discussions on application of the teaching and learning methods, including innovative teaching methods. For instance, within the scope of ERASMUS+ and NordPlus projects workshops on innovative teaching methods were organised with participation of colleagues from Latvia, Lithuania, Estonia and Finland.
8. Extracurricular activities of students. The program management supports the work of the students' self-government, thus allowing students improving their independence, providing opportunities for implementation of ideas, as well as to study additionally outside the scope of lectures. For example, students have an opportunity to implement their ideas in the laboratory of Latvenergo AS at the time most convenient for students. Everybody studying in the program is offered an opportunity to participate in extracurricular activities (sports teams, dance groups, choirs, debate associations, etc.). All the above attests that there is active study life and extracurricular possibilities for students.

Students studying in the study program are also involved in research work and studies on topics important for the field by participating in domestic and international conferences.

In order to advance professional pedagogical competences of the academic staff, courses and seminars on the newest pedagogical methods are organized regularly. Qualification advancement is provided at both the University and faculty level, organizing academic conferences and methodological seminars. The Centre for Academic Excellence has been established and successfully operates at RTU; it organizes various events aimed at professional advancement of academic personnel at the University level. All members of academic staff annually take part in the international scientific conferences in the areas of industrial electronics, power electronics and motion control, as well as robotics, automation, mechatronics and energy efficiency improvement.

The members of academic staff shall inform the students on the specific assessment criteria of the study course at the first lecture, they are also published in the e-page of the study course.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

The main tasks of the internship are fully in line with the objectives and learning outcomes of the study programme, as they are directly determined to apply and enhance knowledge, skills, and competencies acquired during studies:

- to use knowledge and skills acquired within the framework of the professional Bachelor study programme “Computerised Control of Electrical Technologies”,
- to introduce students to the activities of modern businesses; to introduce instructors - to the needs of businesses,
- to involve partners in the study process by organising internship outside the higher education establishment,
- to ensure cooperation with the leading companies in the industry.

As a result of Bachelor studies, the following knowledge is acquired, which must be applied during internship at companies operating in the field of electrical engineering and can be regarded as the main tasks of internship:

- the ability to apply theoretical knowledge to address scientific challenges;
- the ability to design and create new computer management systems for electrical equipment in all sectors of the economy;
- the ability to design and develop electronic equipment, semiconductor energy converters, and propulsion systems;
- the ability to use computers, to develop programs for automation of technological processes;
- the ability to rationally use and save electric energy;
- the ability to use information technologies – personal computers, the Internet, computing devices;
- the ability to search, analyse and process data.

Special internship tasks shall be set on a case-by-case basis for each student, according to the specialisation of internship company.

Students’ specific experience is considered for defining the internship task: for students of full time in person studies the internship mainly coincides with the beginning of their professional career, the first potential employment in the speciality is offered according to the student’s interests and its is viewed as the first step in the beginning of the professional career, thus the specifics of these students is related to starting independent employment, the motivation to continue employment at the place of internship. The internship tasks of students of half-time in person studies, half-time remote studies are mainly related to innovations at their existing jobs in the industry. The main motivation for students is improvement of qualifications, applying for higher ranking positions in the company, thus also the internship tasks are defined accordingly and are mainly related to introduction of innovative solutions at the current jobs of students, for example, upgrading of production lines, introduction of energy efficient technologies in the company, etc., however, the procedures of the internship did not differ from the formal point of view.

In 2019, according to the Senate decision, the internship organisation procedure at RTU was reviewed. As indicated in the internship organisation procedure, an internship coordinator at the department assists students in finding the company. If additional assistance is needed, it is possible to resort to the Career Support and Services Department, where a career adviser and a project manager help students find internship site, as well as through a variety of measures, to develop career management skills that can provide successful results during the internship process. Once a year, the Career Support and Services Department organises RTU Career Day, which also allows students to meet with business representatives and communicate on future opportunities. Detailed information on RTU Career Day is available at http://karjera.rtu.lv/projekti/karjeras-day-Archiv/.

An additional resource developed in 2015 is a home page where companies are invited to place job openings that are up to date for RTU students (https://ekarjera.rtu.lv/). Students have the opportunity to log in with the University username and keep abreast of current internships and job opportunities in their field.

RTU Development Fund provides additional support for practical skill promotion (https://www.rtu.lv/en/developmentfund). Hundreds of practical skill competitions are offered during the year, which are organised in cooperation with companies.

In addition, students can obtain information on internship places on the institute's website (www.ieei.rtu.lv), which includes a dedicated section with all the information on internship (http://ieei.rtu.lv/prakse.html). The internship companies also communicate with RTU internship coordinator, who in turn provides information to the trainees. In addition, students are regularly informed about ERASMUS+ exchange opportunities for internships at European companies, which are also regularly used (e.g., E.Grinfogels, A.Paugurs, O.Bormanis undertook internships at DAIMLER AG Sindelfingen, etc.).

Through RTU Alumni Association, contacts are maintained with graduates of the study programme, thus ensuring effective information circulation in attracting internships.

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

The themes of the graduation papers are chosen according to the newest trends of the sector, as well as the latest and most important developments in the market. Themes are often selected in cooperation with industry partners and developed under their leadership.

A majority of the best graduation papers of the students of the programme are developed in cooperation with the industry companies and organisations where the students worked.

Some of the graduation papers are developed in the framework of international research projects, where, for example, Oskars Bormanis and Artūrs Paugurs, as the most active students, were involved in the FP7 project AREUS, during which an innovative European industrial DC-microgrid and its robot braking energy recovery system were developed. The systems developed are now actually implemented at Daimler AG factory.

The best graduation papers, which were evaluated with a grade of 8, 9 or 10, were developed on the following themes:

Academic year 2013/2014

Creation of a Training Stand for the Linked Tank Management System with PLC Control, D. Ivančenko, scientific adviser: Dr.sc.ing., assoc. prof. V. Bražis;

Development of Autonomous Car Heating Control System Based on Microcontrollers and GSM, P. Metjolkins, scientific adviser: Dr.sc.ing., assoc. prof. M. Gorobecs;

Optimization of Railway Traffic Control at a Stairway Station Using the EBILOCK System, S. Osokin, scientific adviser: Dr.sc.ing., assist. prof. A. Potapovs;

Reconstruction and Automation of Switching Point 350, M. Vagalis, scientific adviser: Senior Laboratory Technician, M.sc.ing. V. Šults

Development of Robot Software with Real-Time Wireless Control System, T. Senaviratne, scientific adviser: Dr.sc.ing., assoc. prof. M. Gorobecs;

Application and Development of a Building Management System for Industrial Buildings with Increased Requirements to Indoor Climate, O. Irbītis, scientific adviser: M.sc.ing., researcher A.Avotiņš;

Development of Automatic Gate Control Using "ARDUINO" Development Platform and Bluetooth Technology, J. Vuškāns, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

2TE116 Series Diesel Locomotive Electric Drive Modernisation Using AC Electric Traction, E. Alberts, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Research and Development of a Solar Tracking System for Photoelectric Converters, I. Romanovs, scientific adviser: Dr.sc.ing., A. Stepanovs;

Development of an Automatic Air Purification System for the Switches of Lielvārde Station, V. Kuzņecovs, scientific adviser: Dr.sc.ing., assoc. prof., M. Miezītis;

Academic year 2014/2015

Lamination Press Automation and its Implementation, J. Francuzovs, scientific adviser: Dr.habil.sc.ing., prof. I. Raņķis;

Development of the User Interface for the Drive Demonstration Stand, M.Bērziņš, scientific adviser: M.sc.ing., researcher P.Suskis;

Research and Development of a Practical Model of Elevator Drive and Control Systems, M. Bogdanovs, scientific adviser: M.sc.ing., researcher P.Suskis;

Development of an Electronic Ballast for Intelligent Dimming Networks, J. Stegura, scientific adviser: Dr.sc.ing., prof. I.Galkins;

Development of a Control System for a Massage Machine, L. Laugalis, scientific adviser: Dr.sc.ing., leading researcher A. Suzdaļenko;

Alternative Energy System Facility and Grid Alignment Equipment, H. Marčuka, scientific adviser: Dr.sc.ing., prof. I.Galkins;

Modernisation of Textile Rewinding Machine, V. Tatarčuks, scientific adviser: Dr.sc.ing. A. Sokolovs;

Research and Experimental Development of the Cooling System of the SynJet LED Indoor Luminaire, J. Tīsis, scientific adviser: M.sc.ing., researcher A. Avotiņš;

Development and Optimization of a Wind Generator Network Alignment Converter, D. Berenis, scientific adviser: Dr.sc. ing., prof. I.Galkins;

Design of Wireless Transport Flow Control System Using Li-Fi Technology, I. Briedis, scientific adviser: Dr.sc.ing., assoc. prof. M. Gorobecs;

Implementation of PLC I/O Interface Based on "ARDUINO" Interlocking Platform, J. Magazeinis, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Development of Automation for Meat Cutting Machine Tool, R. Barbaniška, scientific adviser: Dr.sc.ing. A. Bikšis;

Development of an Adaptive Security System for a Car Garage with Microcontroller Control, Ģ. Podiņš, scientific adviser: Dr.sc.ing., assoc. prof. M. Gorobecs;

Development of Automated Control System and Algorithm for Water Ultrafiltration Plants Based on

SIMATIC S7 Series Controller, A. Barana, scientific adviser: Dr.sc.ing., assoc. prof. M. Gorobecs;

Development of Virtual Laboratory Works for PLC Programming Course, A. Suharevs, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Development of a Photovoltaic Panel Network in a Converter, R. Zīle, scientific adviser: Dr.sc.ing., prof. I. Galkins;

Development of Automatic Control of an Oil Curing Station, R. Ratniks, scientific adviser: M.sc.ing., assist.prof. A. Pumpurs;

Academic year 2015/2016

Wireless Sensor Network Exhibition and Testing with EDI Testbed, K. Kleinbofs-Prūsis, scientific adviser: M.sc.ing. R. Ruskulis;

Development of a Bionic Hand Prosthesis Drive, J. Cīrulis, scientific adviser: M.sc.ing., lecturer M. Vorobjovs;

Development of a Predictive Control Node for a Non-Inverting Step-Up-Step-Down Converter, E. Patmalnieks, scientific adviser: Dr.sc. ing., prof. I. Galkins;

Development of Voice Control Home Automation Using Bluetooth Technology, A. Sīlitis, scientific adviser: Dr.sc.ing., G. Zaļeskis.

Research and Development of a Tidal Wave Energy Converter, E. Lielmanis, scientific adviser: Dr.sc. ing., assoc. prof. J. Zaķis;

Speed Control System for Electrified Public Transport with Inductive Sensors and Video Recording, J. Šņore, scientific adviser: M.sc.ing., lecturer M. Vorobjovs;

Academic year 2016/2017

Development and Research of Electrical and Control Technologies for Adaptive Assistive Mobility Aids for Orthopaedic and Social Rehabilitation, A. Bubovičš, scientific adviser: Dr.sc. ing., prof. I. Galkins;

Design, Programming and Control of Stage Lights in Grandma2 Environment, L. Kokenberga, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Programmable RGB LED Driver Network with MODBUS Protocol, D. Palamarčuks, scientific adviser: Dr.sc. ing., prof. I. Galkins;

Development and Investigation of a Prototype Power Cable Communication (PLC) Device, D. Bovts, scientific adviser: M.sc.ing., researcher P. Suskis;

Development of a Wireless Elevator Control System for Inspection and Repair Work, T. Rutkovskis, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Development of an Embedded Motion Control System for a Two-Wheeled Self-Balancing Robotic Vehicle, M. Barkāns, scientific adviser: Dr.sc.ing., assoc. prof. M. Gorobecs;

Investigation of the Integration of Industrial Robots and Computer Vision Solutions for Industrial Process Automation, J. Ārents, scientific adviser: M.sc.ing., lecturer, A. Šenfelds;

Development and Research of Multipoint Power Metering System Nodes for DC Power Grids, E. Grinfogels, scientific adviser: Dr.sc.ing., assoc. prof., P. Apse-Apsītis;

Development of a Class D Audio Amplifier, K. Roga, scientific adviser: Dr.sc.ing. A. Stepanovs;

Development of a Remote Condition Assessment Device for Ductless Heat Networks, R. Grēbers, scientific adviser: researcher A. Paugurs;

Digital Control of Automotive Power Electronics, R. Poriņš, scientific adviser: Dr.sc.ing., assoc. prof. P. Apse-Apsītis;

Development of Fire Safety Microcontroller Control System with Intelligent Risk Prediction and Assessment, M. Sardiko, scientific adviser: Dr.sc.ing., assoc. prof., M. Gorobecs;

Academic year 2017/2018

Automatic Control System of the Flow Pasteuriser Based on Siemens PLC, J. Bērziņš, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Development of Microcontroller System for Optimization and Automation of Printing Process, A. Svjaščenkovs, scientific adviser: Dr.sc.ing., prof., M. Gorobecs;

Development of an Automated System for Heating, Ventilation and Lighting in Dormitories, V. Langenfelds, scientific adviser: M.sc.ing., lecturer M. Vorobjovs;

Microcontroller Control System Design and Software Development for Process Control in a Meat Smokehouse, E. Boltris, scientific adviser: M.sc.ing., researcher A. Avotiņš;

Development and Optimization of the Electric Drive Control Module for the Hockey Training Robot, K. Skrastiņš, scientific adviser: lecturer A. Šenfelds;

Research and Development of a Modern Security Alarm System for a Private House, M. Goldbergs, scientific adviser: Dr.sc.ing., assoc. prof. K. Vītols;

Selection, Calculation and Implementation of the Optimization Method for Energy Harvesting of Photovoltaic Sources, G. Mašinskis, scientific adviser: M.sc.ing., researcher P. Suskis;

Automation of an Underground Water Pumping Station, M. Šepelevs, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Research and Development of a Battery Pack Management System for an Electric Scooter, E. Poišs, scientific adviser: Dr.sc. ing., assist. prof. K. Vītols;

Visualization and Automation of the Technological Process in the Production of Phenol-Formaldehyde Resin, J. Lauskis, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

High-Precision Current and Voltage Monitoring System for Low-Consumption Equipment, D. Lapsa, scientific adviser: M.sc.ing., researcher P. Suskis;

Modernisation of a Glass Fibre Twisting Machine, O. Janševskis, scientific adviser: A. Vārna;

Development and Research of a Power Module with DC Drive and Ethernet Communication, R.Jarmuševičs, scientific adviser: M.sc.ing., researcher M. Vorobjovs;

Development of a Temperature Monitoring System for a Glass Melting Furnace, A.Sijāts, scientific adviser: Dr.sc.ing., prof. M. Gorobecs;

Application of Motion Sensors for Intelligent Lighting Systems, R. Viļums, scientific adviser: M.sc.ing., researcher A. Avotiņš;

Robot Control System Development with Neural Network and Machine Learning Algorithm, A. Ērciņš, scientific adviser: Dr.sc.ing., prof. M. Gorobecs;

Research and Development of a Fuel Consumption Reduction Device for Light Vehicles with the Integration of Photovoltaic Sources in the Body, A. Matkevičs, scientific adviser: M.sc.ing., researcher P. Suskis;

Research and Development of a Low-Power Wireless Sensor Network for Greenhouse Microclimate Monitoring, A. Manajenkovs, scientific adviser: M.sc.ing., researcher P. Suskis;

Academic year 2018/2019

Research and Development of Control and Automation System for Pressure Boosting Water Pumping Station, Austris Bogdanovs, scientific adviser: M.sc.ing., researcher A. Avotiņš;

Development of a Low Energy LoRa Data Transmission and Acquisition System, Miks Garjans, scientific adviser: M.sc.ing., researcher M. Stunda;

Robotic Removal of Aquatic Plants from Water Bodies, Rinalds Puriņš, scientific adviser: Dr.sc.ing., assoc. prof. I. Steiks;

Implementation of TIA Portal Software in the Festo Training Laboratory, Artūrs Leškovskis, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Automation of a Fish Farm Using Microprocessor Controllers, Jānis Vaits, scientific adviser: Dr.sc.ing., assoc. prof. A. Potapovs;

Development of a Centralized Operator Control System for an Industrial Robot, Uģis Āboltiņš, scientific adviser: M.sc.ing., lecturer A. Shenfelds;

Investigation of Energy Efficiency Options and Solutions for the Building of RTU Faculty of Power and Electrical Engineering, Aleksandrs Repins, scientific adviser: M.sc.ing., researcher A. Avotins;

Academic year 2019/2020

Development of a Control System for a Small Wind Turbine Taking into Account Battery Charge Level and Generator Rotation Speed, Kārlis Sondors, scientific adviser: Dr.sc.ing., prof. M.Gorobecs;

Analysis of Energy Consumption and Efficiency Proposal Development for the Building of RTU Faculty of Power and Electrical Engineering, Ričards Saulevičs, scientific adviser: M.sc.ing., researcher A. Avotiņš;

Research of Motion Adaptation Algorithms Based on KUKA KR600 Robot, Andrejs Stupāns, scientific adviser: M.sc.ing., lecturer A. Šenfelds;

Investigation of the Possibilities of Using Photovoltaic Solar Panels for Multi-Storey Buildings and Development of Practical Examples, Mārtiņš Tipovskis, scientific adviser: M.sc.ing., researcher A. Avotiņš;

Development of a System for Capturing and Storing Motion Dynamic Parameters, Pavels Maksimkins, scientific adviser: M.sc.ing., lecturer A. Šenfelds;

Image Shaper Node for Multifocal Head Mounted Display, Bogdan Zhukovsky, scientific adviser: Dr.sc.ing., prof. O. Krievs, K. Osmanis;

Research and Development of Smart Street Lighting Systems and Motion Sensor System, Sandris Kairo, scientific adviser: M.sc.ing., researcher A. Avotiņš;

Optimization of Port Terminal Lighting, Aivars Krūmiņš, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Development of Industrial Frequency Converter Test Bench, Kirils Vološins, scientific adviser: Dr.sc.ing., lecturer K. Kroičs;

Equipping a Food Storage with Consumption Control, Matīss Vaivodiņš, scientific adviser: M.sc.ing., researcher K. Vītols;

Research and Development of a Control and Work Visualization System for an Automatic Plywood Bundle Collection Line, Alans Haļenovs, scientific adviser: M.sc.ing., research assistant A. Bubovičs;

Development of a Temperature Sensor Using a Bipolar Transistor as a Sensing Element, Silvestrs Auders, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Investigation of Smart Street Lighting Systems for a Road Section in Stadiona Street in Aizkraukle, Aleksandrs Dudeničs, scientific adviser: Dr.sc.ing., researcher A. Suzdaļenko;

Automation of Lighting in a Production Shop, Andris Stivriņš, scientific adviser: M.sc.ing., assist. prof. A. Pumpurs;

Research and Development of Electrical Energy Balancing System, Skaidrīte Kriviša, scientific adviser: M.sc.ing., lecturer A. Šenfelds;

Development of a Control Panel for Smoke and Heat Removal System, Armands Krēmers, scientific adviser: M.sc.ing. A. Sīlītis;

Reconstruction and Automation of 20/0.4kv Network in Valmiera, Ivo Bērziņš, scientific adviser: M.sc.ing., A. Sīlītis;

Development of Automation of Internal Fire-Fighting Water Supply System for Opening of Electric Damper in Fire-Fighting Water Supply System, Uldis Kalniņš, scientific adviser: M.sc.ing. A. Sīlītis.

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

RTU Office of Vice-Rector for Academic Affairs regularly conducts student surveys on the ORTUS portal (during autumn and spring semester). The results of these surveys are available to the head of the study programme, as well as to the instructor of each study course. The head of the study programme and the instructor of the study course evaluate the results and make the necessary improvements. It can be concluded from the surveys carried out that students positively evaluate the study process and teaching methods used. The survey results are available at the ORTUS portal.

Student participation in the improvement of the study process is already being implemented and will take place in several ways. First of all, students will be regularly surveyed in ORTUS e-learning environment where, according to the results of the survey, the head of the study programme can assess the results and make the necessary improvements. For example, inclusion of study methodological materials in ORTUS, inclusion of additional materials in ORTUS, cooperation with foreign partners and use of their/ joint works in the study process, as well as the best practice of international partners. Secondly, one of the themes for the Bachelor Paper may be the upgrading of a new or existing laboratory workspace, particularly when it relates to the needs of businesses and new technologies, as well as the development of methodological material for teaching, for example, development of remote laboratory assignments based on ROBOTINO (more representative for the Master level), or, for example, the addition of material with new computer models, electrical circuits, their descriptions, etc. Thirdly, students, also through the Student Self-government of the Faculty, organise various activities, field trips to production companies, (for example, Inčukalns gas storage facility, Latvenergo production sites, Mežvidi etc.) competitions in the field of civil engineering, exhibitions, discussion clubs.

The results of student surveys show the high quality of the academic process and provide an opportunity to continuously improve both teaching methods and course content. The survey results are also taken into account in the process of electing academic staff.

The results of employer surveys as well as intern evaluations show that students are very well educated and trained for practical work at companies, that their theoretical knowledge and practical skills are at the highest level.

The results of the graduate surveys show that during the study process the future professionals acquired good theoretical knowledge and high qualification skills to be successfully employed in the industry, as well as a solid basis for further qualification and lifelong learning.

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

Students regularly undertake internships at technical universities abroad - in Aachen, Germany, Graz, Austria, etc. Cooperation with several foreign universities has been initiated, where, using the opportunities of ERASMUS+ exchange study programme, students of the study programme "Computerised Control of Electrical Technologies" successfully undertake internship, as well as successfully develop and present their Bachelor Papers. Students of the programme also actively participate in student exchange programmes. From Tables 3 and 4, it can be seen that as of 2014, 11 students participated in an exchange programme at different European universities for a whole semester and 4 students undertook traineeship.

Table 3. ERASMUS exchange programme within "Computerised Control of Electrical Technologies" study programme

No	Name, surname	Country	University	Period
1.	E. Vīndedzis	Austria	Graz University of Technology	03.09.2018 - 02.02.2019
2.	R. Puriņš	Poland	Wroclaw University of Technology	19.02.2018 - 05.07.2018
3.	M. Vaivodiņš	Portugal	Polytechnic Institute of Lisbon	05.02.2018 - 30.06.2018
4.	K. Timšāns	Germany	Rhine-Waal University of Applied Sciences	16.09.2016 - 03.02.2017
5.	E. Grīnfogels	Spain	Universidad Politecnica de Valencia	02.09.2015 - 29.01.2016

6.	R. Zīle	Germany	RWTH Aachen	29.09.2014 - 28.02.2015
7.	M. Celitāns	Germany	RWTH Aachen	29.09.2014 - 28.02.2015
8.	D. Berenis	Germany	RWTH Aachen	29.09.2014 - 28.02.2015
9.	J. Magazeinis	Germany	Rhine-Waal University of Applied Sciences	22.09.2014 - 06.02.2015
10.	A. Suharevs	Germany	Rhine-Waal University of Applied Sciences	22.09.2014 - 06.02.2015

Table 4. ERASMUS internship within "Computerised Control of Electrical Technologies" study programme

No	Name, surname	Country	Erasmus University	Laika periods
1.	A. Stupāns	Germany	UNIVERSITAET DUISBURG-ESSEN	31.08.2019 – 30.10.2019
2.	S. Krivиša	Germany	UNIVERSITAET DUISBURG-ESSEN	31.08.2019 – 30.10.2019
3.	P. Maksimkins	Germany	UNIVERSITAET DUISBURG-ESSEN	31.08.2019 – 30.10.2019
4.	R. Grēbers	Italy	University of Modena and Reggio Emilia	03.10.2016 – 24.02.2017

Recognition of study courses covered during mobility takes place according to the “Amendments to the Organisation Procedure of Erasmus+ Student Mobility” (Resolution of RTU Vice-Rector for Academic Affairs No. 01000-1.1/240 as of 29 October 2014) and “Regulation on the Recognition of the Courses Completed at Other Universities and RTU Study Programmes” (Resolution of RTU Vice-Rector for Academic Affairs No 02000-1.1/29 as of 4 April 2016). The recognition of ERASMUS+ mobility is carried out by the head of the study programme on the basis of the Transcript of Records submitted by the student after the ERASMUS+ mobility and a previously signed application for recognition of study courses.

For the successful study course recognition, students are required to carefully choose a partner higher education institution in accordance with students’ study program and study field. The study courses and the application form must be approved by the ERASMUS+ coordinator and by the head of the study program.

During the recognition process, the evaluation of the courses acquired during ERASMUS+ program is not converted to a 10-point grading scale; the successfully acquired courses at the partner higher education institution are marked as “recognized” instead of the evaluation, thus recognizing the obtained credit points. If the application for course recognition includes amendments to the study program and the student has been successful during the ERASMUS+ program, RTU Vice-Rector for

Academic Affairs draws up an order for individual amendments to the study program. Once the order has been issued, the study courses of the partner higher education institution are included in the RTU Study Register and amendments are made to the student's individual plan, including the courses acquired abroad. Amendments to the study program are made only at the expense of Part B, replacing the study courses with the study courses of the partner higher education institution.

It can be concluded that interest in mobility opportunities is high among both local and foreign students, and the level of students' knowledge is sufficient with the level of knowledge, skills and competencies of study courses implemented by other internationally recognized higher education institutions. Tables 3 and 4 show that during mobility, students study and pass tests and exams at the best European universities, such as RWTH Aachen or the University of Duisburg-Essen in Germany.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

Study programme “Computerised Control of Electrical Technologies”:

State budget subsidy to 1 students of professionals Bachelor study programme in academic year 2019/2020 constituted EUR 366,918.44, tuition fee - EUR 68, 442.00, total: EUR 435,360.44, EUR 4,405.04 per 1 student;

Table 5. Funding to the professional Bachelor study programme “Computerised Control of Electrical Technologies”

	State budget subsidy	Tuition fees of local students	Total funding of the study programme	Costs per 1 student, EUR
2019/2020	366918,44	68442,00	435360,44	4405,04
2018/2019	369925.02	90430.38	460355.40	4229.68
2017/2018	355046.56	80422.00	435468.56	4040.66
2016/2017	292164.58	84206.12	376370.70	3866.02

2015/2016	325307.15	65723.93	391031.08	3866.02
2014/2015	334044.70	54951.75	388996.45	3866.02
2013/2014	312290.00	48120.00	360410.00	3866.00

In order to improve the resource base, additional financing from contractual work conducted by the faculty units is attracted.

The study program “Computerised Control of Electrical Technologies” involves 32 lecturers in the study process. Lecturers of the Department of Electrophysics, Department of Industrial Electronics and Electrical Technology and Department of Electrical Machines and Apparatus of the Institute of Industrial Electronics and Electrical Engineering at the Faculty of Electrical and Environmental Engineering are involved in the implementation of the study program.

In addition to the academic staff of the Faculty of Electrical and Environmental Engineering, general staff are involved in the management of the study programme that undertake study support processes, such as the organisation of study process, the management of public and international relations, student records, technical support of study programmes, work related to the implementation of the study programme. Their duties also include the organisation of business correspondence, the circulation of information, including cooperation organisations in Latvia and abroad, the coordination of telephone calls, e-mails, and correspondence, planning the work schedule of the manager, administration of appointments. They may also carry out simple financial records, analysis, assessment, and control of documentation, as well as drawing up various types of activity related reports on behalf of the manager and solving problems or non-standard situations.

Successful cooperation has been developed with the staff of the relevant faculty of Tallinn University of Technology, which ensures the improvement of the professional skills of employees and the exchange of students and employees.

In Latvia, study programmes in Power, Electrical Engineering and Electronics are implemented at Latvia University of Life Sciences and Technologies and the Latvian Maritime Academy, and the academic staff of the Faculty of Electrical and Environmental Engineering and Power Institute are actively involved in these programmes, creating joint scientific projects. The joint projects are also implemented with the Institute of Solid-State Physics of the University of Latvia, the Institute of Physical Energetics of the Latvian Academy of Sciences, RTU Faculty of Mechanical Engineering, Transport and Aeronautics, as well as Faculty of Computer Science and Information Technology.

With ERDF funding to the field of Power, Electrical Engineering and Electronics, since 2014 the study process has been implemented in a new and modern building with an up-to-date building management system with embedded sensors, climate control systems, energy-efficient lighting, etc., which also serve as a means of research. In parallel, existing and new laboratories have been upgraded:

- Power Electronics Training Laboratory;
- Electrical Propulsion Training and Research Laboratory;
- Manufacturing Automation Training and Research Laboratory;
- Computer Management Training and Research Laboratory;
- Microelectronics and Sensor Training and Research Laboratory;
- Energy Efficiency Training and Research Laboratory;
- Electronic Equipment Training Laboratory;
- Electrical Engineering Fundamentals Laboratory;
- Electrical Engineering and Electronics Training Laboratory;

- Research Laboratory of Semiconductor Converters;
- Industrial DC System Laboratory (AREUS Demo Lab);
- Creative Laboratory;
- Scientific Research Laboratory in Electromechatronics

These laboratories have a brand-new infrastructure – furniture, network voltage links, blackboards, projectors, etc. In addition, the following training facilities have also been purchased: oscilloscope (RigolDS1052D, total number: 10 pcs), oscilloscope (Rigol DS4012, total number: 2 pcs), power measurement keys (Rigol RP1001C, 7 pcs), differential keys (RigolRP1025D, total number: 2 pcs), multimeters (u1233a, total number: 16 pcs), solar meter (solar-100), power parameter analysers (CIR-E3, number: 14 pcs), power units (EX752M - PSU, total number: 8 pcs), power units (QL355TP - PSU, PROG, TIPLE, 35V, 5A, 5V, 5V, 1A), total number: 2 pcs, power units (TTI - CPX400s - PSU, total number: 2 pcs), two power units (EA-PS 2042-20b - PSU), transformer (VELLEMAN sr-1000), accumulator-screwdriver/drill-machine (Festool), portable optical meter (Konica MINOLTA LS110)). New test benches have also been created for students' practical work: microelectronics, electron devices, propulsion system “lift drive” bench.

Within the FP7 project framework AREUS, a unique laboratory has been set up: a 600 V DC power supply network consisting of an industrial 21 kW robot KUKA Quantec Prime, a 55 kW active rectifier, two power benches capable of emulating electricity consumption of any robot, super condenser, and lithium-ion energy storage systems and other equipment. The Faculty of Electrical and Environmental Engineering has a compact solar storage system at its disposal; the storage system is with lithium-ion batteries and a charge-level control system; local, interlinked autonomous power supply systems with 3.6 kW wind generators and 6.6 kW solar panels; inverter electricity for grid transfer or lithium-ion storage systems for energy storage. In parallel, special programmable DC power units have also been purchased, which are capable of simulating solar panels or hydrogen systems with a power of 2 · 15 kW, 2 · 5 kW, 2 · 3 kW, fuel cell research set Ballard Nexa with a power of 2 1.2 kW and 8 kW.

Electro-mechatronics laboratory has the latest equipment installed, with EGSTON COMPISO - Power Electronic Test Bench (up to 200kW) based on Power Hardware-In-the-Loop (P-HIL) unique for the Baltics, which lets students conduct real-time experiments for their theses, using Matlab Simulink, and modelling different scenarios for operation of AC or DC networks and their components (solar panel park, wind farms, storages, transformers, switches, etc.), develop new control algorithms power electronics converters, etc. This laboratory is also equipped with the Physical motion simulator based on KUKA KR 600 R2830 passenger, BEC Gondola control and safety system unique to the Nordic countries.

This laboratory is also equipped with the Physical motion simulator based on KUKA KR 600 R2830 passenger, BEC Gondola control and safety system unique to the Nordic countries. Students Skaidrīte Kriviša, Pāvels Maksimkins, Andrejs Stupāns and other conduct research within their graduation papers and in order to design various auxiliary systems, which will allow tracking movement trajectory parameters both in the open air (e.g., electrical scanners, e-cars, etc.) and virtual environment (BEC simulators).

For industrial process studies, the FESTO mini plant MPS and FMS complex, the compact water-level control work station FESTO Compact-Workstation, EMCO Concept Turn 105/EMCO Concept Mill 105 equipment kit are available.

Digital oscilloscope YOKOGAWA DLM6054-F-HE-L16/P4, oscilloscope (Rigol DS1052D – 10 pcs; Rigol DS4012 – 2 pcs), digital oscilloscope TEXTRONIX, Fluke, Rigol, etc. are available for signal measurement. In 2017, a fine BNC-type oscilloscope power key Ultra mini CWT015 was purchased to measure the current running through the legs of a transistor.

For the measurement of lighting parameters, the Avantes spectrometer, the solar meter (SOLAR-100), the portable optical meter (Konica Minolta LS-110), the infrared temperature meter Rayngер ST60 ProPlus are available.

To determine energy performance parameters, electricity parameter analysers (CIR-E3 – 14 pcs), power analyser set N4L PPA5530-3 Phase (5 pcs), network analysers AR5 and AR5L, Fluke network analysers, etc. are used.

Variable AC and DC power sources, as well as other sources are used for the development of various converters, such as diesel generator SDMO DX 6000TE, solar panels, wind generator, hydrogen fuel cells, power units (EX752M – PSU, 8 pcs), direct voltage laboratory power unit (EA-PSI 9360-120 3U), direct voltage electronic load (EA-ELR 9150-30 3U) and electronic load for DC Electro Automatic ea-el3400-2, direct voltage laboratory supply unit (EA-PS 8032-10 T).

Electronic Technology Management System Development Platform dSPACE, Matlab/Simulink R14 modeling programme, simulation programme PSIM Profesional 8.0, Synopsys Analog Simulation and Modeling Synopsys Advanced TCAD individual license, license OrCAD PCB Design University Edition, software PSIM-JMAG, etc. are also available.

Prototyping equipment for PCB plates is used such as LPKF ProtoMat S64 PCB prototyping equipment, LPKF ContacRS PCB metalizing plant, HAWK 3D axis microscope, automatic multi-layer PCB press (4-8 slice plate development) LPKF multi-press; and electrical coil (throttle) rolling stand are available with Jovil Manufacturing SMC-2 equipment.

In 2017, owing to the financial support of Latvenergo JSC shareholder, equipment was supplemented in Latvenergo Student Creative ILboratory by purchasing a programmable 6 kW three-phase AC power unit, electro-automatic EA-ACP3P 520-16.8-6000-20U f 45-450.

All the equipment and laboratories mentioned above have been successfully used in the study process, students’ research, and in the development of graduation papers.

The infrastructure and technical support available for the implementation of the study programme, thanks to a high level of digitization, provide an opportunity to increase the competitiveness, quality, and efficiency of the University, as well as the availability of information, by integrating information technology (IT) solutions into the University's administrative, study and research work processes, providing students, administrative and academic staff with modern, reliable, secure and integrated IT infrastructure and high quality IT services.

To ensure easy and efficient identification of IT users, an IT user identity management system has been introduced; as a result, each IT user has a unique electronic identity that is valid in all information systems. In addition to the aforementioned, a user session management system is ensured in IT systems, which means that there is no need for IT users to re-authenticate when logging in to RTU information systems. It gives the experience of using a unified integrated information system without having to memorize different identification data and re-enter them, implementing different IT application scenarios.

All IT users are provided access to the centralised portal ORTUS (https://ortus.rtu.lv), which functions as a single digital gateway, combining information from all RTU information system components and providing users with an easy-to-use way of accessing the directory of all IT services in one place.

The Centralised Study Management System is used for efficient administration of the study process, which ensures digital provision of the study life cycle, incl. Electronic Register of Study Programmes (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub), drawing up learning agreements and enrolment of students in study programmes, Register of Study Courses (its public part is available at https://stud.rtu.lv/rtu/discpub/list?english=true), designing student's individual study plans, drawing up orders, implementing study courses and study process, registering grades, recognising study courses, awarding qualifications, administering payments, hostel information, gathering information to issue diploma supplements, etc. This system is one of the main cornerstones in the administration of RTU study process.

To ensure effective implementation of the study process, Moodle e-learning system is used, where all relevant information is compiled in an automated way (study courses, users, groups, access rights, etc.). This system ensures student-instructor communication. The academic staff members place various electronic materials, assessment tests, homework assignments, information on a particular study course, etc. in the system. Students can also view their financial information on the ORTUS portal, as well as make request for documents (references, transcripts of records, copies of a learning agreement, etc.).

Since 2007, more than 130,000 unique study course sites have been generated in the e-learning environment of RTU. Students can access electronic learning resources anytime and anywhere.

Digitisation of classrooms and schedules has been carried out to ensure efficient premise management and study planning (https://telpas.rtu.lv; https://nodarbibas.rtu.lv/). Each RTU student and academic staff member can access their schedule, which provides information on the venue, time, instructor, room, title and type of lecture. In addition, for user's convenience purposes, the system greatly facilitates lecture planning and scheduling, as well as optimises the use and efficiency of premises.

Electronic Staff Management and Record-keeping Systems, which cover the circulation of record-keeping and personnel documents at RTU (https://docs.rtu.lv/) in Latvian, are also used to ensure the efficient administrative work. Electronic document coordination and document e-signing functionality have been introduced, thus reducing print-based document circulation and significantly increasing document circulation speed. Since autumn semester of 2019, students have been provided with electronically signed learning agreements. Since 2016, RTU graduates have been receiving electronically signed transcripts of records.

In terms of quality assurance, a digital student survey system is used, with the help of which the quality control of study courses and study programmes is implemented each semester. Based on the results of quality control, regular measures are taken to improve study programmes and the study process, in general.

For additional convenience of RTU students, academic and general staff members, RTU leases Microsoft Windows and Microsoft Office software, which provides all IT users with access to the latest Microsoft software. RTU students can use the licensed Windows operating system and the Microsoft Office productivity suite provided by RTU for study needs. All IT users have access to Microsoft Office 365 cloud computing platform with one terabyte of storage space available to each user and access to a variety of additional collaboration and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic and general staff have access to the University's email system.

To support research activities, RTU has developed the Centralised Research Support System, which records all information on publications, patents, commercialisation applications, Doctoral Theses, RTU scientific journals, research staff, etc. The system provides access to information according to Open Access principle (https://science.rtu.lv). RTU students and academic staff also have centralised access to research software.

RTU has the high-speed fibre optic Internet and extensive wireless network infrastructure with over 400 access points, including the international *Eduroam* service. In addition, desk phones and mobile communications are provided for fast and easy communication.

To ensure a stable and secure operation of the information technology infrastructure, continuous monitoring of the IT infrastructure and systems is performed, resulting in proactive incident control. Data backup is also ensured.

The Information Systems Security Policy has been developed and implemented with the primary goal of ensuring the secure use of RTU information systems by establishing and maintaining a sufficient set of measures to reduce or prevent potential or resulting harm. Implementation of the Information Systems Security Policy envisages security checks, data transmission network monitoring, as well as preventive measures. Regular IT security and personal data protection training is organised for IT users. Automated security incident management and risk management have been implemented. Statistics demonstrate that the number of IT security incidents dropped significantly 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.

The University library plays a major role in providing methodological and information support to the students. The Scientific Library of RTU (https://www.rtu.lv/en/studies/scientific-library) is an academic library of state significance, which has obtained its status as a result of library accreditation. The Scientific Library of RTU provides the necessary information for RTU study process and research activities, performs library, bibliographic and information services for RTU students, teaching staff, and employees. The Library's collection includes 1.4 million printed documents and e-resources in the databases relevant to RTU fields.

In 2016, significant investment was made in the development of the library infrastructure, with the construction of an additional 2240 m2 of space for the Central Library. The total area of the library premises is 6393 m2, of which 3417 m2 are for reader services. There are 713 workstations for library users. The library has four group rooms and six individual cubicles, a Western reading room and a conference room. The library is accessible to users with reduced mobility.

To improve the work of the Scientific Library of RTU and to ensure the availability of information needed for study and research work, the Library Council has been established, which decides on the replenishment of the library's collection with printed publications and subscriptions to the necessary databases. The Library Council has approved the "*RTU SL Collection Completion Policy*", which defines the basic principles of collection formation and development in accordance with the fields of RTU study and scientific activities.

When RTU provides funding for the library, the funding for information resources for each study programme is calculated. The collection is replenished according to the recommendations of the heads of study programme, researchers, and the allocated funding. The desired titles can be ordered by contacting the Library's Collection Development Department, ordering on the Library's website, filling in the order form, filling in the application form, by phone 67089353 or by visiting the Library at Paula Valdena 5-105. The Scientific Library offers a guide to ordering titles and e-resources, which brings together the websites of various publishers and bookshops in Latvia and abroad.

Database subscription contracts are concluded both directly with the supplier and through the "Cultural Information Systems Centre" state agency, which is the Latvian national representative of the international non-profit organisation EIFL (Electronic Information for Libraries, http://www.eifl.net/). The EIFL Licensing Programme offers national libraries subscriptions to internationally recognised databases at significantly reduced subscription fees not offered to individual subscribers, thus saving financial resources of the libraries.

The database subscriptions maintained by RTU Scientific Library

(https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/abonetas-datubazes):

- *ProQuest Ebook Central, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, EBSCOhost eBook Academic Collection, Wiley Online Library, SpringerLink, The International Monetary Fund, IEEEXplore.*
- Databases financed by the Ministry of Education and Science available to RTU Scientific Library: ScienceDirect, SCOPUS (Elsevier), Web of Science.
- Latvian databases: LETA, Letonika, the Database of Latvian Standards (available on the premises of the Library).

Database usage at the Scientific Library of RTU has been growing since 2016. E-resource loans have increased from 75,391 to 525,194 items.

The new library premises have allowed to extend the range of services. Since the opening of the new premises in 2018, the number of visits to the library has increased from 103,825 to 235,600. The Scientific Library of RTU is open to everyone. The Central Library is open to users from Monday to Saturday. There is a 24/7 reading room. During the summer period, the Central Library is open every weekday with reduced opening hours. (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3).

The library sources are housed in an open-access collection. The last copies of the oldest publications corresponding to the RTU profile are kept in the library repository. They are always available to the users.

The librarian on duty helps visitors find their way around the collection. Bibliographers (information specialists) provide more detailed information and advice. The library has a branch librarian service. (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija).

The library resource search is supported by the Primo Discovery search tool (https://www.rtu.lv/lv/studijas/biblioteka/vienota-informacijas-meklesana). It allows searching the library catalogue (https://kopkatalogs.lv/F/?func=find-b-0&local_base=rtu01), the subscribed databases, as well as databases created by the RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes) in one interface. Searching for information in the electronic joint catalogue (https://kopkatalogs.lv/F), it is possible to simultaneously obtain information on the resources available in 12 Latvian libraries. Both the electronic catalogue and the RTU portal ORTUS allow remote reservation of library resources, as well as remote access to the databases. Since the introduction of RFID technology, users can use five self-service book-dispensing machines and check out books from the pick-up machines around the clock.

The library provides students, academic personnel and other stakeholders with various levels of individual consultations and group training in information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas).

Publications not available in the library are delivered via an interlibrary loan or an international loan. Internet access is available throughout the library. The library has copying, scanning, printing, binding services and a self-service dining room.

During the reporting period 99 textbooks and 15 electronic books totally amounting to 114 study materials were purchased for the program acquisition.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

Both academic personnel and instructors with industry experience take part in the implementation of the study programme. Student survey results demonstrate high evaluation of academic personnel. Table 6 given below presents information on the changes in the composition of the academic staff involved in study programme implementation by position. It may be observed that the number of professors, associate professors and assistant professors amounts to 33. Industry specialists as also involved in the study process in the capacity of invited guest lecturers, supervisors of graduation papers, and members of the Viva Voce Examination Committee.

Table 6. Changes in the academic personnel in 2013 – 2020

	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020
Professors	7	9	8	8	8	9	13
Acting Professor	1	1	2	2			
Associate professor	4	4	2	3	4	4	8
Acting associate professor	2	3	3	4	3	1	
Assistant professor	4	7	8	9	6	10	11
Assistant professor at the professional programme	2	2	1	1	1	1	1

Acting assistant professor						1	
Acting lecturer	1			3	5	2	2
Lecturer	2	2	2	2	4	6	7
Assistant						1	3
Acting assistant					2	1	1
Total	23	28	15	32	33	36	46

Generally, the structural unit has sufficient resources for ensuring excellent quality and development of the study process, including in remote studies. Teaching staff is usually recruited from amount Ph.D students, experienced researchers, therefore if is possible to ensure good generation succession, for example, Prof. Raņķis became emeritus, and Assoc. Prof. J. Zaķis took over the management of study subjects. Following passing away of Prof. Ļevčenkovs, his former Ph.D student M. Gorobecs assumed full scope of his duties in the study program. Development of laboratories and high quality study materials available on the study platform had positive impact for students, which is attested by surveys.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The implementation of the study programme is ensured by the academic staff of the Institute of Industrial Electronics and Electrical Engineering of RTU Faculty of Electrical and Environmental Engineering - professors and lecturers with Doctoral and Master degrees, each of whom are experts in their field.

If necessary, lecturers from foreign partner universities will be invited to ensure the implementation of the study program, as well as industry professionals to give practical lectures. Collaborating partners from Tallinn University of Technology, Aachen Technical University, Duisburg-Essen University and Aalborg University will provide face-to-face and remote lectures and practical/ laboratory classes.

According to the aims of the study programme, the primary criteria for the selection of academic staff are (a) knowledge of the latest technologies and participation in scientific and research projects in their fields, (b) pedagogical skills relevant to current trends in the field, and (c) experience in academic courses to foreign students in English.

In order to ensure the quality of the study content, the academic staff involved in the implementation of the programme regularly improve their professional and academic knowledge at methodological seminars, conferences (national and international), as well as in scientific and research work (see List of publications of academic staff for the reporting period), participate in various scientific and methodological projects.

The involved academic staff actively benefit from international cooperation mobility programmes. For example, from 2014 to 2019, Prof. Ribickis visited the following universities: in 2014 - Moscow State Technical University, Chennai University, Delhi University, Autonomous University of Barcelona, University of Catalonia, Technical University of Valencia, Bordeaux University, Paris Tech University, Compiègne University, University of Florence, Lausanne Polytechnic University; in 2015 - Lausanne Polytechnic University, University of Moratuwa (Sri Lanka), University of Colombo (Sri Lanka), University of Antwerp, Holon Institute of Technology, Technical University of Wroclaw; in 2016 - Czech University of Life Sciences, Prague, Lodz University of Technology, Royal Institute of Technology, Sweden, Blackburn University; in 2017 - University of Malaga, University of Granada, University of La Laguna, University of Bergen, University of Porto, University of Ottawa, Polytechnique Montréal, Leiden University, Aalborg University, Muhammed V University in Rabat, Budapest University of Technology and Economics; in 2018 - Kumamoto University, University of Tokyo, Tokyo Denki University, Waseda University, Tallinn University of Technology, Palackas University, University of Madeira, University of Las Palmas de Gran Canaria, Kyungook National University, National Taiwan University of Science and Technology, WuFeng University, University of Duisburg Essen, University of Bucharest, LaSapienza University, University of Turku, Swiss Federal Institute of Technology, University of Bucharest; in 2019 - University of Trieste, University of Padova, University of Bergamo, Polytechnic University of Turin, University of Oulu, Albert Einstein University (Mexico), Monterrey Institute of Technology and Higher Education (Mexico), University of Peru, University of San Ignacio de Loyola (Lima), Catholic Pontifical University of Peru, Catholic University of Santiago del Estero, Tsukuba University (Japan), Shizoko University (Japan), University of the Azores, Alto University, Université Libre de Bruxelles, Vilnius Gediminas University, Mykolas Romeris University (Lithuania).

In 2013 and 2014, Professor Anastasija Žiravecka and Assistant Professor Svetlana Andrianova participated in the ERSAMUS+ staff mobility programme and visited the University of Ljubljana and Varna Technical University for an exchange of experience. In 2020, the head of the study programme Professor L. Ribickis, Professor A. Žiravecka, Researcher A. Avotiņš, with the Doctoral students involved in the academic process visited Aalborg University. Professor N. Kunicina visited Berlin University of Technology, Germany in 2014, Kaunas University of Technology, Lithuania in 2018. In 2019, Professor O. Krievs undertook internship at Ltd. EK Sistēmas within the ESF project SAM 8.2.2 – “Improvement of professional skills on the latest industrial automation technologies in academic year 2019/2020”. In 2018, he visited the Robotics Laboratory of the University of Duisburg-Essen and attended lectures (16 hours) on the use of industrial manipulator motion control software.

Mobility of academic staff, international scientific cooperation within projects, as well as publications ensure that the programme content changes and teaching methods are in line with the latest trends in the world, thus helping achieve the aims and learning goals of the study programme.

Professor Leonīds Ribickis holds a Doctoral degree in engineering. Alongside his academic, scientific and organisational activities, he is actively involved in Latvian and global scientific organisations, contributing to the development and improvement of the power and electrical engineering sector. He has more than 40 years of experience in higher education: study process management, scientific research, project management. Leonīds Ribickis is an academician of the Latvian Academy of Sciences and an expert in the field of engineering and technology - electrical engineering, electronics, information and communication technologies, as well as a member of RTU

Senate and the Council of RTU Faculty of Electrical and Environmental Engineering, Chairman of RTU Promotion Council in Electrical Engineering, Chairman of RTU Council of Professors in Electrical Engineering. He has co-authored more than 600 publications, including 21 monographs and 77 patents on the following topics: electrical engineering, electronics, electrical drives, technological process and motion control, industrial robot equipment; semiconductor power converters, power electronics equipment and their control systems; energy efficiency of electrical equipment, smart DC networks; electric transport and e-mobility; electromechanical converters, AC and special electrical machines; alternative energy systems. He supervises Bachelor, Master and Doctoral Theses in subjects related to electric drive systems, industrial electronics and control systems for power electronic converters. He managed and executed more than 50 international and national projects related to scientific research.

Professor I. Raņķis carries out scientific work in the field of design and optimisation of DC electrical drives for electric trains, industrial and public electric transport. Raņķis has worked with both full-time and part-time students, as well as delivered study courses to foreign students in English. He has also been a guest lecturer at Tallinn University of Technology and a trainee at the Royal University of Technology in Stockholm. He has supervised the internship of young lecturers of electrical engineering subjects at Vilnius Gediminas University and Riga Technical University. Raņķis has been active as a scientific adviser of students' qualification papers, i.e., engineering projects (50), Bachelor Papers (30), Master Theses (40). Prof. I. Raņķis has supervised 9 Doctoral Theses in engineering.

Professor I. Raņķis is active in the field of science. His research interests include the development and study of energy storage systems in active cooperation with various enterprises, the study of pulse regulation systems for AC electrical systems, and the study of the efficiency of the application of non-linear inductances.

In general, Prof. I. Raņķis purposefully improves his qualification, actively cooperates with young engineering specialists, is able to confidently help students overcome study difficulties and problems and promotes students' professional growth. He is a very effective member of the student learning system.

Professor Oskars Krievs holds a Doctoral degree in the field of power electronics and has 20 years of academic experience in electrical engineering and power electronics. During this period, O. Krievs has led or participated in 16 scientific projects, including two international ones. Since 2020, O. Krievs has been the Dean of the Faculty of Electrical and Environmental Engineering at RTU, and from 2011 to 2020 - Dean of the Faculty of Power and Electrical Engineering at RTU. Currently O. Krievs delivers 3 study courses in the field of electrical engineering, but in total he has developed or participated in the development of more than 10 study courses. To improve his qualifications, O. Krievs has participated in 36 international scientific conferences, as well as undertaken internships at the Polytechnic University of Turin (2007), University of Duisburg-Essen (2018) and Ltd. EK Sistēmas (2020). In 2019, O. Krievs received the award of the Latvian Academy of Sciences for the most significant achievements in science, and in 2017 - the annual award of the Latvian Academy of Sciences and JSC Latvenergo for significant contribution to the field of power engineering. Since 2019, O. Krievs has been a member of the Latvian Association of Power Engineers and Energy Constructors.

Associate Professor Viesturs Bražis holds a Doctoral degree in electrical engineering. He has 19 years of professional academic experience as a Research Assistant, Assistant Professor, Associate Professor and Senior Researcher. His research interests are in the field of energy storage system application. The research component of his work with students is ensured through participation in scientific conferences and publications. The practical and academic experience is fully relevant to the specific nature of the courses implemented.

Professor I. Galkins holds a Doctoral degree in Electrical Engineering, which he obtained in 2001 for his Doctoral Thesis "Design and Research of Matrix Converters". He has more than 20 years of experience in the participation and management of national and international projects. He is currently leading or has led from 2001 to 2021 more than 10 projects with a total budget of around 2 million EUR. Several years of research experience - author of 3 books and 88 articles related to power electronic converters, electrical drives and electrical devices for orthopaedic applications, as well as 6 patents. I. Galkins' h-index in SCOPUS database is 11, his 88 articles have been cited 364 times. He conducts research in the field of power electronics, including lighting and medical electrical equipment. He has been the scientific adviser of 6 successfully developed Doctoral Theses in the field of electrical engineering and the reviewer of 4 Doctoral Theses. He has several years of experience in the field of education as well as in the management of the study process. He has developed and delivered 15 study courses. He has supervised 36 graduation papers. He is the chairman of IEEE - Professional Electrical Engineers Society, a joint chapter of IEEE Latvia IAS/IES/PELS. He is an expert of the Latvian Council of Science in Electrical and Power Engineering. He is the Editor-in-Chief of RTU Scientific Journal on Electrical, Control and Communication Engineering.

PhD student, Research Assistant Aleksandrs Bubovičs has obtained a professional Master degree in engineering (M.sc.ing.) in 2018 and now continues his studies at RTU Doctoral study programme "Computerised Control of Electrical Technologies". Since 2016, he has been working at the Institute of Industrial Electronics and Electrical Engineering and since 2017 he has been involved in the implementation of the study process. From 2017 to 2019, he worked as a Lecturer at Ltd. IQTC Management (an exclusive and authorised partner of TÜV Rheinland Akademie in the Baltic States), where he taught courses "Electrical Safety for Non-Electrical Engineering Personnel" (EuP - Elektrotechnisch unterwiesene Person), "EE", "GWO BTT Electrical Module". He has participated in several international and national research projects, has authored and co-authored 13 scientific publications, and applies his experience in academic work environment.

Associate Professor Andrejs Potapovs holds a Doctoral degree in electrical engineering and automation. He has more than 10 years of professional experience in higher education. The research component of his work with students is ensured by regular exhibition and presentation of research papers, as well as by participation in more than 15 international research projects. Academic knowledge is regularly improved by attending various RTU pedagogical qualification improvement courses. During the classes, students are actively involved in various practical assignments, providing an opportunity to apply the theoretical knowledge learned in practice.

Lecturer Kaspars Kroičs holds a Doctoral degree and a Master degree in electrical engineering. He has more than 10 years of experience in electrical and electronic engineering. He also has more than 5 years of scientific experience in power electronics and electrical drives, which are the main topics of the course "Control and Regulation of Electrical Drives". He is the author of more than 40 publications indexed in the Scopus database and has participated as a Researcher in more than 5 practical studies. K. Kroičs has attended RTU pedagogical qualification improvement courses, online training courses on the Coursera platform and gained international experience within the ERASMUS programme.

Anastasija Žiravecka, Dr.sc.ing., Professor. She publicly presented her Doctoral Thesis in 1999 at Riga Technical University. She has worked as an Assistant Professor, Associate Professor since 2005, and as Professor since 2014 at the Institute of Industrial Electronics and Electrical Engineering. Author of more than 90 scientific publications and textbooks related to electrical drives and their control, power electronics, energy saving. Participated in and managed local and international research and training projects - TEMPUS, ERASMUS+, ERDF. In 2014/2015 she participated and coordinated the development of the new professional Bachelor study programme "Adaptronics", in 2019/2020 she coordinated the development and licensing of the new professional Master study programme "Adaptronics". In addition, she publicly presented her Master Thesis in English Philology in 1998. She participates in, as well as coordinates the work with foreign students.

Research Assistant and Lecturer Ģirts Staņa has a Master degree in electrical engineering and has completed his Doctoral studies as a candidate for a scientific degree at study programme "Computerised Control of Electrical Technologies" of RTU Faculty of Electrical and Environmental Engineering. He has two years of academic experience at RTU, working with students in practical classes. Currently he continues to work on the Doctoral Thesis and scientific publications, participates in research projects. Participated and presented research findings at scientific conferences in different countries, improving his knowledge of the latest trends in the field.

Associate Professor **Gundars Ašmanis** has a Doctoral degree in electrical engineering. He has more than 12 years of experience working as a Radio Engineer, Quality System Manager, Leading Researcher and Technical Director at an internationally accredited electromagnetic compatibility testing laboratory of the Latvian Electronic Equipment Testing Center. He has more than 12 years of experience working at Riga Technical University as a Research Assistant, Lecturer, Associate Professor, Researcher. He spent six months at the European Space Agency (ESA ESTEC) in the Electromagnetic Compatibility Testing Division, developing and testing power filters for the Columbus International Space Station scientific module. Gundars Ašmanis' qualification is appropriate for the implementation of the study course.

Associate Professor Ingars Steiks holds a Doctoral degree in electrical engineering. He has accumulated scientific experience as a Research Assistant, Researcher, Senior Researcher, Assistant Professor and Associate Professor over the past 15 years. Knowledge is actively developed both in international research projects and in the academic staff strengthening programme in the field of electrical engineering. The thematic areas include both power converter development and industrial automation, i.e., hardware and software. The development of research skills is further enhanced by the regular supervision of graduation papers at all levels of study.

Professor Nadežda Kuņicina holds a Doctoral degree in electrical engineering and has been elected Professor of Electrical Engineering, Electronics, Information and Communication Technologies (Electrical Engineering and Automation). She holds the Expert status of the Latvian Council of Science in Social Sciences - Educational Sciences until 6 January 2024 and in Engineering and Technology - Electrical Engineering, Electronics, Information and Communication Technology until 3 September 2023. Professor Nadežda Kuņicina conducts research in the field of electrical engineering, mainly related to improving the efficiency of electricity use in industrial electronics and electric vehicles. Nadežda Kuņicina has participated in the development of study programmes, such as Erasmus plus KA 2 Applied Curricula in Space Exploration and Intelligent Robotics Systems - APPLE (2017-20); Electrical Energy Markets and Engineering Education - ELEMEND (2017-21); Innovative Approach towards a Master Program on Smart Cities Technologies - SMARTCITY (2018-21); Development of Practically-Oriented Student-Centred Education in the Field of Modelling of Cyber-Physical Systems - CybPhys (2019-22), Knowledge Triangle for a Low Carbon Economy - KALCEA (2020-23). Within the projects, academic objects and methodological tools have been developed on the following topics: innovation in information and communication technologies; introduction to the specialisation in design of energy-efficient technologies; metrology and mathematical modelling; Internet of Things and smart electrical technologies; energy saving in electrical equipment; electrical processes and equipment in biotechnology; thermal energy, fundamentals of control theory; energy efficient technologies; fundamentals of industrial computer networks; automation theory; automation elements; non-traditional non-contact electromechanical converters; non-traditional energy converter systems and storage; methods of analysis and calculation of electronic circuits. Nadežda Kuņicina develops study materials within the following study courses: “Fundamentals of Industrial Computer Networks”, “Computerization of Mathematical Tasks in Electrical Engineering”, “Elements of Automation”, “Industrial Safety”, “Control Fundamentals of Critical Infrastructures”, “Design of Adaptive Systems”, “Linear and Non-linear Systems”.

Professor **Kārlis Ketners** studied at the Faculty of Electrical Engineering of Leningrad Electrical Engineering Institute from 1956 to 1962. He received a diploma of an electrician-engineer in the specialty of electrification of industrial enterprises and equipment. From 1962 to 1966, after graduating, he worked as a Design Engineer at Riga Semiconductor Factory. From 1966 to 1970, he received a Doctoral degree from Leningrad Electrical Engineering Institute. He bcame a Candidate of Technical Sciences with the Doctoral Thesis “Structural Modeling of Ship Power Systems for Calculations of Transition Processes with ECM (Electronic Computing Machine)” in 1970. In 1992, he obtained a Doctoral degree in electrical engineering in the process of nostrification of a scientific degree at RTU Habilitation Council H-0.5. Since 1970, he has been working at the Department of Electrical Machines and Apparatus. After the commencement of work at RPI - RTU, he published a scientific monograph “Algorithmization of Calculations of Transient Processes of Autonomous Electric Power Systems” – Riga: Zinatne, 1981, 166 p. (with co-authors V.M.Sendjurevs, I.A.Kozlova).

Elena Ketnere has a Doctoral degree in electrical engineering. She has more than 20 years of pedagogical experience. In 2015, she participated in pedagogical qualification development courses (pedagogical courses at Riga Teacher Training and Educational Management Academy). Currently she delivers lectures in "Electrical Micromachines" and "Principles of Electrical Machines", supervises Bachelor, Master Theses and engineering projects. During employment at RER plant, she participated (performed calculations) in redesign of the asynchronous motor into a synchronous jet engine, researched the calculations methodology of multi-speed asynchronous motors. The total number of publications is 51, including: 5 textbooks and 1 monograph.

Research Assistant Jānis Mārks holds a Doctoral degree in electrical engineering. He carries out scientific research work, participates in the development of scientific research project applications and publications. He has gained professional academic experience working as a Research Assistant for 5 years and has acquired practical skills as a project administrator and coordinator. Several years of scientific publishing have given him the skills to present the most relevant information on a given topic and to present new information in an easily understandable and structured way. During the development of the Doctoral Thesis, several numerical data processing methods have been reviewed and refined; as a result, the knowledge gained coincides with the subject matter of the study courses and provides an additional contribution to the study process.

Ansis Avotiņš, the Head of the laboratories and Researcher, has obtained a Master degree in electrical sciences (M.sc.ing.), studying at RTU study programme "Computerised Control of Electrical Technologies", and is currently working on his Doctoral Thesis. He has more than 15 years of experience in supervising student laboratory work in electric drives, student internships, as well as supervising Bachelor Papers and engineering projects. He is the author of 46 SCOPUS publications, and actively participates in industry associations (LATEA, LITAA, IEEE). He has completed 23 international and local scientific and academic projects, as well as more than 20 industrial contract works, which regularly allow getting acquainted with the latest technologies and participating in their development, gaining valuable know-how that can exchanged with students. He also participates in the management of the Student Creative Lab, which develops students' practical skills, makes them ready for internships and develops their skills in conducting research and analysing the results.

Associate Professor Aivars Pumpurs holds a Master degree in engineering (M.sc.ing.). After completing his studies, he has more than 15 years of practical work experience in manufacturing related to the development and operation of electronic and automation equipment. He has participated in several research projects and scientific conferences. He has more than 20 years of academic experience: delivering lectures, supervising laboratory work and graduation papers, and developing a number of study courses. He has completed his Doctoral studies and is currently working on his Doctoral Thesis. He continues to keep abreast of trends in automation processes, reading the latest literature and putting into practice the knowledge acquired in the process of training students, both in theory and in laboratory work.

Lecturer Agris Treimanis completed the Doctoral study programme "Computerised Control of Electrical Technologies", before that he had obtained a professional Master degree in electrical engineering and a Qualification of Electrical Engineer within the framework of RTU professional Master study programme "Computerised Control of Electrical Technologies". Since 2013, he has been giving lectures and supervising laboratory work of RTU undergraduate students within several study courses related to electrical engineering. He has a Bachelor degree in electrical engineering within the framework of the study programme "Power and Electrical Engineering". He obtained his Professional Qualification of Electrician at Liepaja State Technical College, where he also worked as an Instructor and Laboratory Assistant for 6 years.

PhD student, Researcher and Lecturer Armands Šenfelds holds a Master degree in electrical engineering from Riga Technical University and a Master degree in electrical engineering from RWTH Aachen University in Germany. He continues his Doctoral studies at RTU and carries out research work in the fields of robotic production systems, their energy efficiency and DC power supply system applications. Professional experience is related to the development of energy-efficient technological solutions for robotic applications in manufacturing, in cooperation with industrial partners Daimler AG, KUKA GmbH, Siemens AG. He is a member of the Institute of Electrical and Electronics Engineers (IEEE) and Deputy Head of the Latvian Section. Member of the Latvian Alumni Board of the Latvian-German Academic Exchange Service (DAAD). He is active in international research cooperation and exchange of study experience with universities in Germany (RWTH Aachen, Universität Duisburg-Essen, Stuttgart University), Denmark (Aalborg University) and the Baltic States.

Pēteris Apse-Apsītis hold a Doctoral degree in engineering. He has more than 50 years of industrial and scientific research experience in electrical engineering, electronics, ICT, automation, printing, papermaking, audio-visual arts and automotive technology in Latvia and abroad. In total, he has managed and implemented more than 300 projects, including international ones, for various equipment and systems. Author and co-author of several patents and dozens of scientific publications. He received the Annual Award 2018 named after Professor Alfreds Vitols from Latvenergo JSC and the Latvian Academy of Sciences. Expert of the Latvian Council of Science. Professor and Senior Researcher at the Institute of Industrial Electronics and Electrical Engineering, Riga Technical University.

Professor **Andrejs Podgornovs** has a Doctoral degree in electrical engineering, in the sub-field of electrical machinery and equipment. He has more than 15 years of experience in the field of higher education: provision and management of the study process, research, management of international and local contract work. He actively works with students of all study levels, under his leadership more than 25 qualification papers have been developed and publicly presented. He has been regularly nominated for the lecturer's award by RTU Student Parliament. He continues to improve his professional experience by participating in international projects and performing contract work for state institutions and commercial companies. Chairman and active participant of the Latvian Technical Standardization Committee “Electrical Energy” since its establishment in 2012.

Associate Professor Jūlija Maksimkina holds a Doctoral degree in electrical engineering, in the sub-discipline of electrical machinery and equipment. The development of research skills is ensured through the elaboration of the Doctoral Thesis, writing scientific articles. She has 18 years of professional academic experience as an Assistant, Lecturer, Assistant Professor. She delivers the following study courses: "Fundamentals of Electrical Engineering Theory", "Theory of Circuits", and "Electricity and Magnetism". Since 2017, she has been a responsible lecturer of the study courses "Fundamentals of Electrical Engineering Theory" and "Theory of Circuits", "Electrical Engineering and Electronics". She improves her knowledge by attending RTU pedagogical qualification improvement courses.

Associate Professor Jānis Voitkāns holds a Doctoral degree in engineering (Dr.sc.ing.). His professional experience of more than 40 years is related to electrophysics, electricity and magnetism, fundamentals of electricity and circuit theory, as evidenced by scientific publications and participation in international scientific conferences. The professional and academic experience is fully relevant to the specificities of the study courses delivered. The acquired knowledge and skills are successfully integrated in the study courses, ensuring the successful achievement of the learning outcomes by the students. In the classes, students are actively involved in practical activities, thus enabling them to apply the theoretical knowledge in practice.

Maksims Vorobjovs is a Lecturer and a Doctoral candidate. He has obtained a Master degree in electrical engineering, and has completed a study course “Pedagogy” during his studies. He completed Doctoral studies as a Doctoral candidate at the study program “Computerised Control of Electrical Technologies” of the Faculty of Electrical and Environmental Engineering. He currently continues to develop the Doctoral Thesis. He attends courses, seminars, scientific conferences to supplement knowledge about the latest trends in science and education. He has 8 years of pedagogical experience at the university, delivered courses related to electronics, electrical engineering and programming. He has independently mastered the techniques of creating e-learning courses, and this knowledge is applied in practice. Participated in scientific research projects as a researcher. Supervised 8 Bachelor Papers and engineering projects. Participated in several scientific conferences. Participates in several engineering and research projects.

Visiting Lecturer Dāvis Meike holds a Doctoral degree in engineering and is a Planning Engineer in the manufacturing industry. His Doctoral Thesis is on energy efficiency in industrial robotics. His research areas include highly automated manufacturing systems, power transmission in direct current (DC) grids and related technologies, consumption and flow optimisation, as well as general industrial automation. In these areas, D. Meike has coordinated both publicly co-funded international research projects and product development in the private sector. He is the author of more than 20 peer-reviewed scientific publications and patent articles.

Rahim Geidarov, Lecturer and Research Assistant, has obtained a Master degree in power and electrical engineering in 2016. Continues doctoral studies in power and electrical engineering. Specializes in electrical machines and apparatus. Since 2017, he has been working at RTU Department of Electrical Machines and Apparatus. Has also been working at RTU Study and Science Centre in Ventspils since 2018. As a Research Assistant, his job responsibilities include: writing scientific publications, conducting experiments, assisting senior researchers, and promoting science to students. The duties of a Lecturer include: delivering lectures and supervising laboratory work in disciplines related to electrical technologies. Until now, he has been a scientific adviser of several Bachelor Papers, as well as a consultant of engineering projects.

Associate Professor Svetlana Andrianova holds a Doctoral degree in energy and electrical engineering. She has 20 years of professional academic experience as a Research Assistant, Lecturer, and Assistant Professor. The research component of her work with students is provided by scientific conferences and publications. Professional knowledge and skills continue to improve by attending seminars and conferences organised by RTU, as well as seminars and conferences outside RTU. Acquired knowledge and skills are successfully integrated in study courses, ensuring successful achievement of learning outcomes by students.

Professor Mihails Gorobecs holds a Doctoral degree in electrical engineering and a Master degree in Information Technology. He has more than 15 years of academic and research experience. Since 2012, M. Gorobecs has been an expert of the Latvian Council of Science in the field of Electrical Engineering, Electronics, Information and Communication Technologies (i.e., in computer control of industrial processes, motion control and optimisation using artificial intelligence equipment and methods). His main research interests are embedded software engineering, computer control of transportation systems, embedded intelligent electrical devices, decision support methods in transportation systems, adaptive systems and methods, genetic and evolutionary algorithms, neural networks, fuzzy logic control methods, railway transport control, safety and optimisation methods, computer control of unmanned electric vehicles, mathematical and simulation modelling of systems. M. Gorobets has more than 10 years of experience in managing various international and national projects in the field of electric and railway transport. He is the author of several textbooks, methodological tools, and patents.

Associate Professor **Inna Buņina** has a Doctoral Degree. She has more than 15 years of experience in the field of higher education; she has been engaged in study process management, research, and quality assessment. She has worked as a Research Assistant, Assistant Professor, and Researcher. The qualification of engineer and work experience in the industry ensure the achievement of thorough learning outcomes. The acquired knowledge and professional skills are successfully integrated in the Bachelor study programs "Computerised Control of Electrical Technologies" and "Adaptronics". She improves her knowledge by attending pedagogical qualification improvement courses.

Associate Professor, Senior Researcher Aigars Vītols received his Doctor of Engineering degree in 2007 from Riga Technical University. While working for Siemens as a Sales Engineer, A. Vītols has participated in several Latvenergo substation modernisation projects, as well as in the organisation of the construction project of Riga City High Voltage Network Substation "Hanza" and has been involved in the supply and installation of the necessary structures and equipment, including international sales and operation of modern electrical equipment. A. Vītols is the author of 18 scientific articles in the field of electrical engineering and has participated and presented research results at 14 international scientific conferences in the aforementioned field. A. Vītols received the Best Paper Award in the subsection of Information and Communication Technologies (ICT) and Low-Power Electronics and Electrical Engineering. A. Vītols is the author of three Latvian patents, one of which is a patent entitled "Bidirectional Power Flow AC-DC Controller". Since 2007, he has been delivering study courses such as “Foundation of Electrical Engineering Theory”, “Theory of Circuits”, “Electrical Engineering and Electronics”, etc. Since 2010, he has been delivering the above courses to international students. A. Vītols has completed courses in Intellectual Property Protection in 2004 and since then he has been delivering the study course "Patents" at Riga Technical University.

Brakanskis Uldis conducts laboratory and practical classes within the study course “Electrical Machines” at the Department of Electrical Machines and Apparatus for part-time students of electrical engineering specialty. He leads practical classes and study projects of the study course “Electrical Machine Designing Calculation” as well as Engineering Projects (graduation papers) in the specialty of Electrical Machines. He participates in scientific contract work as a developer of calculating methodology at JSC RER. As the head of the laboratory, he ensures the technical performance of the Electrical Machine Laboratory and the computer room, and he is responsible for the conservation of the material and technical resources of the Department.

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

The academic staff involved in the implementation of the study programme participate in academic and scientific conferences. They are engaged in various projects and develop scientific publications. All academic staff participate in or lead various types of international and local research projects, such as ERDF, FLPP and others. Academic staff also participate in international ERASMUS+ projects, developing new courses and textbooks. The results of the projects are regularly reported in conference and journal publications and used in their pedagogical work - lectures, seminars, other activities with students, as well as in academic tools and monographs. Many of the graduation papers are written in the framework of the projects and on the scientific activities and results of the projects. The list of projects carried out is available in Annex 13.

Data on the involvement of the academic staff in scientific research are presented in the list of publications of the academic staff during the reporting period.

Prof. L. Ribickis was the Chair of the Organising Committee of the global conference EPE ECCE Riga 2018. He organised the five-day conference, which was attended by about 700 scientists.

Faculty of Electrical and Environmental Engineering hosts the annual RTUCON series of international scientific conferences, where scientists and students from different countries exchange research results in electrical engineering, generate prospective ideas and establish contacts for potential research. Typical conference participation is 100-200 participants from 20-50 countries. Currently (as of 2014) the conference is supported by the IEEE and IEEE IAS Societies. As of 2014, about 650 papers had been published in the IEEE Xplore database as well as in the SCPOUS and TR-WoS databases.

Another conference in the field of electrical engineering held at EVIF is POWERENG2015. The conference was sponsored by the IEEE and IEEE IAS Societies. 113 conference papers are available in IEEE Xplore, SCPOUS and TR-WoS databases.

There is a direct and indirect impact of the RTUCON conference series on the Faculty of Electrical and Environmental Engineering on the study process. The direct impact is realised through a dedicated working session on "Education in Engineering", which provides an opportunity for academic staff from several universities and countries to exchange methodological experiences in the field of engineering education. It also reflects the trend towards using the latest scientific developments in the academic work environment. In addition, RTUCON conferences support (special sessions and prizes) students presenting their research results. Finally, some instructors involve students in the conference, for example, through elaboration of papers in which students are invited to analyse and evaluate the achievements of other scientists for extra credit points.

The results of research and projects are integrated in the study courses and presented to students. For example, the results of the European international projects LITES, ERDF uMOL and ERDF SAVAS are used as lecture material, laboratory work and practical calculation tasks in the study courses "Energy Efficient Lighting", “Introduction to Specialisation”.

In addition, the AREUS Project Laboratory is used for this study course in addition to practical work in the course "Control and Regulation of Electrical Drives". Since 2016, Dr.sc.ing, Production Planning Engineer Dāvis Meike from Mercedes-Benz delivers the study course "Fundamentals of Industrial Robotics".

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

To ensure that the content of the study courses does not overlap, an annual review of the courses of the study programme takes place, as well as seminars in which the academic staff involved in the implementation of the programme present the course outline and academic methods to their colleagues and discuss improvements that would ensure a higher quality of the programme content and meet the current trends in the field.

Analysing the student-academic staff ratio within the study programme at the time of submission of the self-assessment report, the programme has one elected faculty member per 5 students and one specialist in the respective field per 23 students.

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	5.pielik_RECO studenti statistika_Eng.docx	5.pielik_RECO studenti statistika_LV.docx
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	6.pielik_Atbilstība VIS RECO0 ENG.docx	6.pielik_Atbilstība VIS RECO0_LV.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)	7.pielikums_RECO atbilstība profesiju standartam ENG.doc	7.pielikums_Elektroinzenieris_RECO_LV.doc
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	RECO kartējums _EN.xlsx	8.pielik_RECO kartējums_LV.xlsx
Curriculum of the study programme (for each type and form of the implementation of the study programme)	9.pielik_RECO plānojums EN.xlsx	9.pielik_RECO plānojums LV .xlsx
Descriptions of the study courses/ modules	RECO0_courses_ENG.zip	RECO0_kursu apraksti _LV.zip
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	RECO ENG.zip	RECO LV.zip
Description of the Study Programme - Other mandatory attachments		
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	Par iespēju studējošiem turpināt studijas_BSP.edoc	Par iespēju studējošiem turpināt studijas_BSP.edoc
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	Apliecinajums - Par zaudējumu kompensaciju.edoc	Apliecinajums - Par zaudējumu kompensaciju.edoc
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.		
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education		
Sample (or samples) of the study agreement	Sample_of_study_agreements.zip	Studiju līgumi.zip
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.		

Smart Power Systems (47522)

Study field	*Power Industry, Electrical Engineering, and Electrical Technologies*
ProcedureStudyProgram.Name	*Smart Power Systems*
Education classification code	*47522*
Type of the study programme	*Professional master study programme*
Name of the study programme director	*Aleksandrs*
Surname of the study programme director	*Dolgicers*
E-mail of the study programme director	*Aleksandrs.Dolgicers@rtu.lv*
Title of the study programme director	*doktors*
Phone of the study programme director	
Goal of the study programme	*Training of a new generation of graduates in the fields of electric power networks and systems, recording and monitoring of their operation modes, as well as stability and reliability, by actively implementing smart technologies, namely: • Optimal control technologies, applicable to the energy market, as well as to generation, transmission, distribution, consumption, and energy saving; • Expertise in energy demand and saving, techniques for efficient use of energy in construction, manufacturing, the primary sector, and transport; • Development and integration of various control systems and energy efficiency models.*
Tasks of the study programme	*The main task is to train qualified specialists for successfully solving future problems: • Monitoring and control of operation modes for all the participants of the energy generation, transmission, and consumption process (producers, traders, large and small consumers); • Quick reaction to changes in various parameters of the power system and reliable power supply in transmission and distribution networks, with a large share of produced wind and solar energy; • Achieving effective and modern decentralized control of a "distributed" power system; • Educational work among passive consumers (small consumers of renewable energy resources), converting them into active participants of the demand response process, as prosumers, to ensure effective implementation of the gains.*
Results of the study programme	*The study programme is planning to provide the students with in-depth knowledge in power and electric engineering during lectures, practical classes, laboratory work and internship, and to ensure skills in the fundamentals of scientific research work as well as to develop research skills and train highly qualified specialists in the field of smart power systems (including the specializations of power supply, control of electric power networks and systems, or electric machinery and apparatus) and to prepare the students for further doctoral studies*

Final examination upon the completion of the study programme	*At the end of the study programme, the students write a master's thesis (and an engineering design project if the student has graduated from an academic bachelor study programme.*

Study programme forms

Full time studies - 2 years - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*professional bachelor degree in electrical science and qualification of electrical engineer, or second-level professional higher education and qualification of electrical engineer*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Power and Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*professional bachelor degree in electrical science and qualification of electrical engineer, or second-level professional higher education and qualification of electrical engineer The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Power and Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years, 6 months - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*6*
Language	*latvian*

Amount (CP)	*100*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy or electronics and automatics, or comparable education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Power and Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years, 6 months - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*6*
Language	*english*
Amount (CP)	*100*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics, or comparable education The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Power and Electrical Engineering*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

The professional Master study programme “Smart Power Systems” (further referred to as the Study Programme) was developed and licensed in September 2020 within the project SAM 8.2.1.0/18/A/013 (Diminishing the Fragmentation of Study Programmes at Riga Technical University and Strengthening of Joint Use of Resources). It will be implemented, starting with academic year 2021/2022.

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 outdated study programmes will be closed down in 2022, namely, the second-level academic highest-tier (academic Master) programme and the second-level professional highest-tier (engineering) programme, replacing them with a joint and optimised professional Master study programme.

The programme modernisation process was implemented in accordance with European experience in the creation of interdisciplinary education programmes and harmonised with the Bologna Agreement. The developed study programme corresponds to the European educational standards; it is adjusted to the current requirements of the industry and diminishes the present fragmentation of study programmes by merging the academic Master programme and the professional engineering programme.

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 to ensure self-fulfilment of the students and improve their self-development and self-education skills. Therefore, the main goal was to develop a modern study programme, based on the transformation of the Master-level study programme for studies in the field of smart power systems, taking into account the demand for future specialists with a certain education profile in a labour market and ensuring the students with a higher level of flexibility, provided by exchange study trips to European partner universities with the possibility to obtain a professional Master degree.

The Study Programme has been supplemented with a professional qualification, “Leading Electrical Engineer”. Since at the moment of receiving the licence for the Study Programme (September 2020), a new professional standard (further — PS) “Leading Electrical Engineer” had not been developed yet, it was not possible then for the graduates of the academic Bachelor programme to join the studies. In January 2021, an application was filed with the National Centre for Education regarding the confirmation of a new PS “Leading Electrical Engineer” developed according to the suggestions and advice of the specialists within the field; on August 11, 2021, the Trilateral Cooperation Sub-Council for Professional Education and Employment (PINTSA) confirmed the new professional standard “Leading Electrical Engineer”. The corresponding minutes (No. 5) of PINTSA meeting have been published on the website of the Ministry of Education and Science: https://www.izm.gov.lv/lv/media/13082/download, In Latvian. The development of the professional standard makes it possible to lift the restrictions for the graduates of the academic bachelor programme to join the Study Programme.

Since the study programme “Smart Power Systems” has been formed to replace two study programmes implemented previously, it is planned to take over students from the existing programmes in the case if they do not manage to complete their studies by the beginning of academic year 2021/22. These students will be able to continue studies within the programme “Smart Power Systems” according to an individual plan confirmed by a decision of a meeting of the Power Systems Control and Optimization Department of the Faculty of Electrical and Environmental Engineering.

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

Since this Study Programme will replace the existing academic Master programme and the existing professional engineering programme, the analysis regarding the students was conducted on the basis of statistical data about the students of the above programmes, see Annex 5.

According to an analysis of these data, it becomes obvious that there is a sharp decrease in the number of students admitted to the Master studies (by an average of 15–20% a year). On the other hand, the number of students enrolled in the professional engineering programme is rather stable, even regardless of the unfavourable overall demographic situation in the country; in academic year 2019/20, their number had already exceeded the number of Master students (32 to 27), as compared to the ratio in academic year 2014/15 (31 to 52), which could be explained by more stringent requirements of the employment market regarding professional qualifications according to the professional standard.

The dynamics of the number of graduates are related to the number of students and its changes. For example, the number of graduates of the Master programme was 27 in academic year 2014/15 and 12 in academic year 2019/20, which coincided with a drop in the number of students enrolled.

The drop-out ratio in the study programmes is rather stable over the period under consideration. The most frequent reasons for dropping out are as follows: exmatriculation on account of underachievement in the study process; lack of finances; relocation (emigration) and choosing a different occupation. There are cases when students do not renew their studies after the academic leave. There are also some cases when enrolment has been the reason for exmatriculation.

Contrary to the previously discussed programmes, the Study Programme is aimed at meeting demand for power engineering specialists in local and foreign labour markets, thus it is also offered to foreign students and is implemented in two languages, Latvian and English.

1.3. Analysis and assessment of the interrelation between the name of the study

programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

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.

To be admitted to the Study Programme, applicants must have:

1. an engineer's degree or a comparable professional Bachelor's degree and/or 5th-level professional qualification in the subfield of Electric Power Engineering of the Power Engineering field;
2. an engineer's degree or a comparable academic Bachelor's degree in Electrical Engineering;
3. a degree of second-level higher professional education (Engineer) and/or 6th-level professional qualification in the subfield of Electric Power Engineering of the Power Engineering field.

The volume of the Study Programme is 80 credit points for graduates of the second-level professional (engineering) programme and the professional Bachelor programme (with already obtained professional qualification) and 100 credit points for graduates of the academic Bachelor programme. The duration of studies is two years and two and a half years, respectively. On average, there will be 20 classes per week, 16 weeks of classes per term.

The graduates of the programme obtain a professional Master's degree in Power and Electrical Engineering as well as the professional qualification of a Leading Electrical Engineer (the 6th-level professional qualification).

1. The ***aim*** 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.

Achieving the goals presupposes a close dialogue with Latvian energy enterprises, which influence successful implementation of the Study Programme, due to a number of reasons:

- Cooperation with energy enterprises ensures that the tasks of the students are fulfilled in accordance with the needs of the industry and are practically applicable, and that the implementers of the study process have updated the information and knowledge regarding the main operation problems faced by the power industry;
- A quick and precise reaction of the power industry, in the form of feedback and answers to the initial results and work performed within this close cooperation, will ensure initial access

to the learning outcomes;
- Energy enterprises are invited to offer themes for long-term research;
- The support from the power industry by obtaining data, models, or other information pertaining to the implementation of the Study Programme will have a greatly beneficial effect.

2. Today, one of the main tasks of the higher education system in the world is to support student employment and promote adaptation of the whole educational ecosystem so that education, in this aspect, should become the most effective and important sphere of society.

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.

The measure of task implementation results lies in the study results of the students and an independently written graduation paper with an important theoretical significance and a potential for practical use, which involves original results of a scientific study, demonstrates competences in independently obtaining, selecting and analysing information and using it, making decisions and solving problems in the field of electric power engineering.

3. ***The study results to be achieved:***

The Study Programme plans, in the form of lectures, practical classes, laboratory work and internship, to provide in-depth knowledge in electric power engineering and electrical engineering and ensure skills in the fundamentals of scientific research work, to develop research skills and prepare high-level specialists in the field of smart power systems (including electric power supply, electric network and system control, or electric machine and apparatus specialization) as well as to prepare the students for further studies at the doctoral level.

As a result of mastering the Study Programme, the graduate (***planned results***):

- Shows broad knowledge and understanding for work at electric engineering enterprises that generate, transmit and distribute electric power, manufacture electric equipment for the national economy, as well as at industrial enterprises, enterprises of agricultural production and processing; designing, research, consulting, service and transport enterprises that use modern process equipment with complex automated electric equipment, for successfully addressing future problems;
- Is able to organize maintenance and renewal repair work, reconstructory and unscheduled repairs, alignment and checking works for complex power equipment and its automatic control systems, examination, troubleshooting, technical operation and elimination of faults of complex electric devices and electric equipment;
- Is able to control and monitor construction design implementation works and designing, assembly (construction) of high-voltage, medium-voltage and low-voltage power transmission

lines and equipment, conduct feasibility studies, development of the engineering solution part of a construction project, monitor, plan and organize the work of other specialists.

Within the implementation of the study programme, the following main activity areas have been singled out:

- To establish closer ties between universities and the industry on a national as well as an international scale;
- To optimise and modernise study methods;
- To improve the competences and skills of the academic staff involved in the study process.

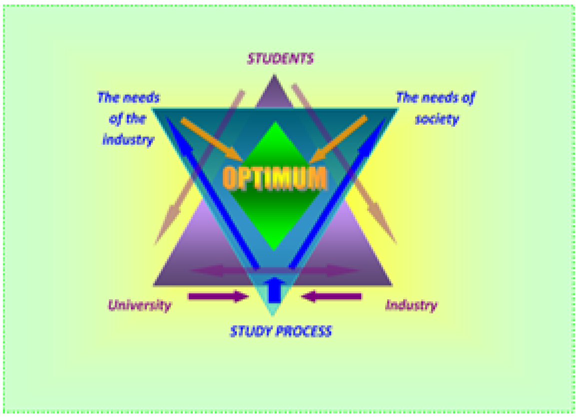

Figure. The concept of the Study Programme

Overall, the aims and tasks of the Study Programme as well as the planned learning outcomes (i.e., knowledge, skills, and competences) are closely interlinked (see the Figure). The probability of reaching the aims is very high because the education content is based not only on scientific logics of knowledge and academically structured tasks but also on tasks and projects that are aimed at the professional practice of the future graduates. Therefore, professional education makes it possible to approach the aim of the development of the education content when forming the content of the Study Programme, by creating integrated study courses that reflect a complete idea about professional work, where the main criterion for selecting education content is "knowledge about the activity".

The main contribution of the implementation of the Study Programme will be related to sustainable development and excellence. Particular attention will be paid to management and strategy planning, process approach, development of products and services, improvement of the money flow and the financial activity indicators, improvement of effectiveness in all spheres of activity, and increasing the satisfaction level of the students, the cooperation partners, and the employees.

4. The SWOT analysis of the Study Programme, which is summarized in the table below, shows that, from a formal point of view, it has more strengths and opportunities than weaknesses and threats. The SWOT analysis with a detailed description of indicators is to be found in the characteriz ation of the study field.

Strengths:

- Provision of the study courses with e-resources (the ORTUS portal)
- The multifaceted array of study courses within the Study Programme
- Study courses with content that is important for a wide range of specialists
- A large share of young academic staff (82% of the staff are under 50 years of age)
- Qualifications of the academic staff, which ensure the theoretical and research potential (96% of the staff have a Doctoral degree in Engineering)

- Involvement of experienced professionals in the field into the implementation of various study courses of the Study Programme
- Involvement of the professional community and the students in discussions about the content of the Study Programme
- Good cooperation with the stakeholders offering internship opportunities and their committed attitude towards the trainees
- Students interested in obtaining good-quality education
- Good technological equipment for the study process
- Good infrastructure and library
- The Faculty of Electrical and Environmental Engineering ensures wireless access to the Internet

Weaknesses:

- Lack of financial opportunities for inviting guest lecturers
- More varied study method forms in the study courses are needed
- A heavy workload of academic staff in academic and organisational work, leaving little opportunity to conduct research
- The students' different knowledge level when starting studies at RTU
- Lack of study materials in Latvian
- Full amount of computer software licensing

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master's and doctoral study programmes, 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 Study Programme is aimed at meeting demand for the specialists operating in the field of electric power systems and networks, as well as power utilities in the local and international labour markets.

Since the Study Programme has been developed by considering the thoughts of experts in the field, the requirements of the labour market, and based on the national educational 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 specialisation areas form the academic basis for Doctoral studies and independent work in related industries, conducting scientific and applied research. In addition, the Study Programme is also intended for 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.

During the development of the Study Programme, the development scenario of the energy sector was considered, as well as the energy policies in the electric energy sector on the national scale, on the EU scale and globally. This was done by following changes in the field and changes in legislation as well as by means of knowledge of the current developments in the professional field and evaluating the newest textbooks and other scientific publications, including advice to the library as to purchasing the newest study literature since an important role in the study process is also allotted to applied studies: the students write study papers on the subject of issues topical in the field, researching and analysing scientific and professional literature in libraries and international databases. The students use the obtained knowledge and findings during their internship at Latvian or foreign enterprises, analysing issues related to the electric energy field, developing and implementing solutions for improving the operation of the enterprises. The students present the results of their research at the annual RTU student scientific conference and collect them into their master's papers.

Analysing the correspondence of the Programme to Regulation No. 512 of the Cabinet of Ministers of the Republic of Latvia dated 26 August 2014 "On the State Standard of Second-Level Professional Higher Education" (https://likumi.lv/doc.php?id=268761), it can be concluded that the Programme corresponds to all the requirements set. Annex 6 compares the Programme with the requirements of the educational standard.

The activities to be conducted during the development of the Programme (for example, involvement of the industry) and the learning outcomes to be achieved (the competitive graduates) are optimal and will contribute to the resolution of the existing issues related to the competences of the young professionals and their ability to adapt to new tendencies. 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.

According to the evaluation of the working group developing the professional standard (further — PS) "Leading Electric Engineer" (215101) (Level 6 of professional qualification framework, which corresponds to Level 7 of the Latvian Qualification Framework, it has been concluded that the newly developed professional Master study programme "Smart Power Systems" ensures full-fledged correspondence of the education content to the requirements set in the PS in the above professions and corresponds to the requirements suggested and set by the leading enterprises in the field (among others). Annex 7 compares the Programme with the requirements of the professional standard.

The process 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 drawing up the application regarding the development of a new study programme to the procedure of closing down the study programme. The Procedure has been harmonised with the normative acts valid in the country regarding the licensing of study programmes and making amendments to them.

The current priority of the development of the global power engineering industry is the designing of smart energy systems (SESs), which results in an intersectoral approach being introduced, integrating the achievements of electric power technologies and information technologies. Besides, the global aim of building SESs is all-encompassing and contains a number of sub-aims related to effective power supply to buildings and adaptive control of the power systems of different countries. All of these sub-aims 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 Programme to maintain its relevance in the long term, the structure of the Programme will make it possible to form new specialisations, reacting to changes in the demand of various industries. Much attention will also be paid to continuous improvement of the study process and ensuring quality of materials during 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 "Power and Electric Engineering and Electric Technologies" and submitted for confirmation to the Council of the Faculty.

The administration of the Study Programme is planning to continuously improve the study process, considering the suggestions of the students, graduates, and the industry. The Study Programme has been developed and will be 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 surveying them at the end of each term, i.e., students will be asked to evaluate the content of the study courses taught during the term and the quality of their implementation.

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

By its structure and content, the study programme is designed to achieve its main aims and tasks, i.e., to educate and train young professionals to be able not only to process a large amount of information but also to implement a creative approach to the development of the industry and independently solve the problems and challenges faced by the industry, which will make the graduates of the programme competitive in the field of the industry and in rapidly developing areas of science. All of these results are achievable during the study programme. Therefore, the aims set in the study course descriptions are intricately linked to the learning outcomes to be achieved by the programme and the study courses are interlinked and complement one another so that the learning outcomes could be achieved after the completion of the programme. The interlinkage of these courses with the learning outcomes of the programme is reflected in the mapping of the study courses (see Annex).

The implementation of the Study Programme will promote the following:

- 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.izm.gov.lv/sites/izm/files/ztaip_2014-20201_0.pdf (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).

The descriptions of the study courses are summarized in a unified RTU Register of Study Courses. The descriptions of the study courses included in the professional Master study programme “Smart Power Systems” are enclosed to the given report. All in all, there are six compulsory study courses (A), twenty compulsory elective study courses (B), internship (D) and a final examination (E).

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 (specialisation) courses are intended for the future specialists to deepen their knowledge in the speciality chosen. The part of humanities and social studies contains study courses that develop communication and social skills. If a foreign student has not acquired the study course “The Latvian Language” at an undergraduate study programme, their compulsory elective study amount (B1) is diminished by one credit point and the compulsory part (A) is increased by one credit point, adding the study course “Latvian for Foreign Students”. The study process is concluded by an internship and a state examination, which includes writing and defending a Master Thesis and (for graduates of the academic Bachelor study programme) an engineering project.

To successfully achieve the learning outcomes of the study programme, the study courses will be delivered following 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 modern, IT-based solutions. Individual work is an important study form during the Master studies. In addition:

- Within the study courses taught, the students will have the opportunity to write study reports on themes proposed by the academic staff. In this way, the students will learn to independently obtain information that is of interest to them as well as obtain skills for defending their Master Thesis;
- There will be opportunity for the students to independently choose the theme of their report according to the contents of the study course, subject to approval by the instructor;
- The students will choose the theme of their Master Thesis themselves, subject to approval by the scientific adviser of the Master Thesis.

The curricula of the study programme are provided in Annex 9.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

1. By way of lectures, practical classes, laboratory classes and internship, the Study Programme provides for mastering in-depth knowledge in power and electrical engineering and obtaining skills in the fundamentals of scientific research work, developing research skills and training highly qualified specialists in the fields of Power Supply to Smart Power Systems, Electric Power Networks and Systems, Electric Machinery and Apparatus (the field is freely chosen by the student) as well as for preparing the students for further doctoral studies. By studying within the Study Programme,

the student obtains stable fundamental knowledge and an understanding about the theoretical and practical issues of power and electrical engineering which are necessary for starting practical work at various power and electrical engineering enterprises and for continuing studies at study programmes of a higher level.

The methods used in the Study Programme enable the achievement of the goals and results of the study courses and the programme. The principles of student-centred teaching and learning are observed. One of the basic principles in the study programmes of RTU Faculty of Electrical and Environmental Engineering is democracy and dialogue with students, actively involving them in the improvement of the study process. The students can participate in this improvement either directly — by expressing their wishes to the instructor of the study course, Head of Department, programme director; or via the student self-government, whose representatives are members of the Council of the Faculty, RTU Senate and its commissions as well as RTU Academic Assembly. The relations between the Faculty and the students are characterized by mutual trust, respect and integrity. Correspondence to the principles of student-centred learning (SCL) is ensured continuously. In accordance with the guidelines defined in the SCL manual, students are involved in the study process and the improvement of the content, which endows them with additional obligations as well as additional rights. Students have the opportunity to influence their study process, exercise their autonomy, and provide feedback regarding the study process, aligning it with their expectations. An important role in ensuring the link between students, instructors and the programme administration belongs to the student self-government of the Faculty, which actively participates in all of the mentioned processes and conducts annual assessment of the teaching staff.

Already at the stage of composing the study courses and commencing the studies, a compulsory part thereof consists in clearly formulated course goals, tasks, and assessment criteria. In this way, as the students start a study course, they know the contents of the study course as well as the expected requirements for successful mastery of the course and the assessment criteria. All of the above facilitates the further cooperation of the teaching staff and the students as well as prevents problem situations. The tasks for the annual papers and the reports provide for the possibility of different solution alternatives, with a comparison of these desirable alternatives. In this way, there is practical development of problem-solving skills.

Since the Study Programme is open to graduates of a bachelor programme, both with a previous professional qualification (a professional bachelor degree in Electrical Science and the qualification of an Electrical Engineer, or second-level higher professional education and the qualification of an Electrical Engineer) and without one (with an academic bachelor degree in Electrical Science), two different Study Programme implementation alternatives are provided for: with a respective study duration of two years (80 Latvian credits) or two and a half years (100 Latvian credits). Both alternatives have the same number of compulsory study courses, both alternatives provide for compulsory writing and defence of a master’s thesis and the most important difference lies in the size of the internship (26 Latvian credits for graduates of the academic bachelor programme and 10 Latvian credits for students with a previous professional qualification) and in the engineering design project, which is only demanded of students without a previous professional qualification. The methods of implementation (including assessment) are the same. The provision of the study process for both alternatives is set out in detail in the study plan, Appendix 9.

The teaching (the lectures, the practical classes, and the laboratory work) will use new technologies — modelling software, computer projectors and other types of technology. Part of the technological equipment and computer software has been developed by the institution and the other part has been purchased.

The practical work and the practical classes will be organized in the form of traditional laboratory classes with special equipment as well as in the form of practical tasks in which the students will have to be able to combine the knowledge obtained from a number of study courses, thus strengthening interdisciplinarity as well as providing the necessary feedback about other study courses and the effectiveness of the teaching methods used in them.

The teaching methods, the structure of the study courses and the assessment methods are chosen by the teaching staff responsible for the study courses, in accordance with the specific character of the course and the course programme as well as the needs of the students. The specific assessment criteria of each study course must be communicated to the students by the instructor during the first study class and these are published in the e-study environment of the course.

The students will write their annual papers and reports individually, with consultations from the instructor. The defence of these papers is individual, which ensures both an individual approach to each student and feedback.

In addition to the classical study forms —lectures, seminars, laboratory work — there is a growing proportion of using computers and the Internet in the study process. Various calculations are made both by standard software and specialized study software. Video materials will be widely used in streaming lectures. Information about additional opportunities and various activities (e.g. free software, excursions, opportunities for internship, scholarships, summer work, etc.) will be published on the website of the Department (https://www.rtu.lv/lv/evif). A stimulating study environment will be created, by offering the students modern study materials, promoting the use of e-study means, and providing access to modern laboratory equipment.

The study results at RTU are assessed according to the Regulation on the Assessment of Study Results (https://www.rtu.lv/writable/public_files/RTU_1_studiju_rezultatu_vertesanas_nolikums.pdf) and the Regulation on Final Examinations at Riga Technical University https://www.rtu.lv/writable/public_files/RTU_par_nolikuma_par_studiju_nosleguma_parbaudijumiem_rtu_apstiprinasanu_jauna_redakcija.pdf

2. In order to achieve the set results within the Study Programme, innovative study methods have been planned, as well as access to information and e-solutions in the course of implementing it.

Education is a process that has both quantitative and qualitative features. In order to perform tasks aimed at the higher education system and overcome the transformation processes, a prerequisite is to determine the development criteria. To do this, the following is necessary:

- To select the indicators;
- To set the scale;
- To set up criteria as to what is “conforming” and what is “nonconforming”;
- To set up a monitoring system at all the levels.

Since there are two sides involved in the education process, i.e. instructors who pass information on and students who receive it, we will further look at a systematization of the existing problems for both sides as well as outline the possible solutions within the context of the existing study methods.

It is clear that modernization of the traditional management system is impossible without continuous summarization of information and software processing regarding the educational activity of each student (see Fig. 1). The results of this analytical digital processing have to be used by the students and by those involved into the management of their studies, maintaining a stimulus for improving the quality of the studies and forecasting the tendencies of future development, making a distinction between the study processes at the higher education institution (HEI) and their organizational component, i.e. the administrative structures of the university, the dean, the departments, etc.

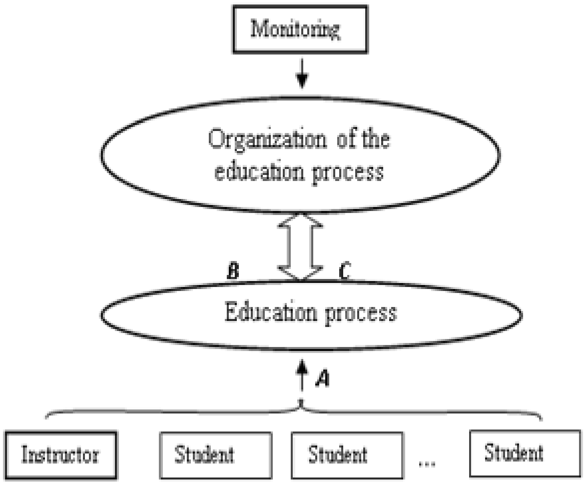

Figure. 1. A Flowchart of the Education Process: A — personal factors that influence education quality; B — the present development of the student; C — a function that transforms the student's status and progress into knowledge

As usual, the requirements set for the students are unified and are set without regard to their personal features, which are only considered in some individual cases of the study process. Still, the level of knowledge (and thus, the quality of the studies) is considerably influenced by various personal factors (P), which have to be taken into account when working with each student. These include the following: previous preparation level at school, current academic result, health condition, individual psychological and motivating traits, as well as the knowledge level of the instructor in the study course.

The amount of information can be shown from the point of view of sets (see Fig. 2), where it is necessary to determine the size of the initial quantitative information set and transform it into a qualitative body of information with methodological teaching work.

Besides, when determining the qualitative level (elaborated in detail), it is necessary to consider the initial knowledge of the students depending on the level of the academic achievements.

$$I \xrightarrow{f} E$$

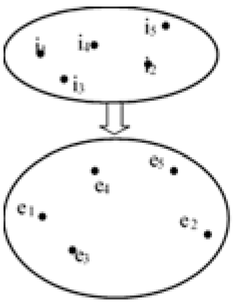

Figure 2. The information amount from the point of view of the set theory: i – information, e – the educational process

Based on the present academic achievements (*A*), the student's specific level of knowledge (*K*) is formed in the educational process, whose amount depends on the personal factors of the student (*S*) and transforms the academic progress of the student into knowledge. The study management process can be described as follows:

$$S = F(X, A) \rightarrow \max(K) \text{, (1)}$$

where F is a determined function.

The results of learning are closely linked not only to the status of the present academic achievements *(A)* but also to the time spent *($t = t_l + t_p + t_k$)* to attend lectures *( )*, laboratory classes and/or practical classes *($t_p = \sum_{i=1}^{N_p} T_{pi}$)*, tutorials, additional classes due to absence, etc. *(t_k)* as well as the degree of the student's activity within a certain time period *(η)*. By a time interval, we mean the timespan in which the studies take place, e.g. from the first term to the last in the lecture-room.

Thus, the study process management system within time interval t, based on the overall criterion k, is calculated according to the following equation:

$$k=(\alpha A+\beta T+\gamma\eta)\mu, \qquad (2)$$

where α, β, γ are the weight factors;

μ – the direction factor;

T – the time period (day, week, month, term, etc.)

Out of the whole study cycle, the weight factors can be related to the theoretically possible maximum value, for example: $\alpha = R_0 = 10$ (the maximum average grade); $\beta = T_0$(the study time per term in accordance with the study programme) and $\gamma = \eta_0 = 6$ (the average estimation of activity).

Another option is to link the numerical evaluation with the weight of each factor in the criterion, for example: $\alpha = 0.6$, $\beta = 0.4$, $\gamma = 0.2$.

Further, all the elements of criterion k will be evaluated individually.

The present academic achievements can be assessed by the following equation:

$$R = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{t_i}\sum_{j=1}^{t_i} R_{ij}, \qquad (3)$$

where n stands for the number of study courses;

t_i — the time allotted to each study course according to the study programme;

R_{ij} — the result that the student receives for the i-th study course at a class.

Then, the time that the student has to spend learning, is as follows:

$$t = \frac{1}{N}\left(\sum_{i=1}^{N}\ \sum_{j=1}^{t_i}\varepsilon_j \cdot t_{ij}\right) + t_k + t_d, \qquad (4)$$

where ε_j is a factor that is equal to *1* if the student is attending the class, and *0* if the student is absent;

t_{ij} — the time spent for mastering the i-th study course at the j-th class;

t_k — the time spent at the tutorial;

t_d — the time for additional learning.

The activity of the student can be assessed by a five-grade assessment system, which, among other things, includes the time that the student spends for various social and educational activities.

Along with the improvement of the present activities, it is proposed that completely new external activities be introduced:

- The students communicate directly with specialists (scientists, engineers) on the spot (organizing surveys and/or interviews, analysis of results, professional consulting of students on the part of specialists in the field, etc.);

Organization of special activities for students who combine work with full-time studies, etc.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

The Study Programme contains internship. The Study programme provides for internship for students in the amount of 10 Latvian credits (for graduates of the professional bachelor programme and the second-level higher professional education programme) and 26 Latvian credits (for graduates of the academic bachelor programme). The internship ensures mastery of practical skills at enterprises whose specialization is manufacturing of power equipment, operation of power equipment and facilities, or designing of power equipment and facilities. During the internship, the knowledge obtained at the special (professional) study courses is broadened, deepened and strengthened, and its application in solving professional issues is mastered. The task of the intern is to get acquainted with process equipment and systems of the power industry at the place of internship (electric power engineering and energy construction enterprises or institutions), with special focus on smart technologies, automation systems and management of processes as well as renewable energy resources.

Internship support in both alternatives of the Study Programme is identical and the differences in the provision of the internship are only related with planning (for graduates of the academic bachelor programme, the internship is planned for Term 1 (in the amount of 6 Latvian credits) and, like for students with previous professional qualification, for Term 3 (20 or 10 Latvian credits according to the alternative implemented). Such a division has been made with the purpose to help students with academic education and without prior professional experience to get involved in the profession already at the start of their studies, starting work at an enterprise of the electric power engineering field.

The place of internship has to be related to the building, operation and installation of electrotechnical equipment in various fields of the national economy, helping to prepare highly qualified staff for electrotechnical enterprises and organizations, improve the productivity and analytical skills of employees, which serve as the basis for the development of new products and technologies (innovations). If the student is already employed at a corresponding enterprise, they can also use it as the place of internship.

A special note has to be made of the fact that the majority of the enterprises where the internship is to be conducted, are also able to ensure internship for foreign students (including provision of the process in English). Foreign students will be supported in finding their places of internship at Latvian energy enterprises by the management of the Study Programme. Internship abroad can be implemented by using an ERASMUS scholarship.

During the internship, the student gets acquainted with the structure and work organization of the internship enterprise and its technical and economic indicators. The student is provided with the opportunity to master the most recent scientific and innovative technical solutions in the field of power and electrical engineering, to get acquainted with standards in the field of labour protection, safety engineering, environment protection and electromagnetic compatibility, and with the technical and organizational solutions of the above. During the internship, the student masters the following abilities and skills:

- To solve tasks related to the specific technical and production problems in power and electric engineering;
- Ability to form a standard-compliant description of the task received during the internship and the technology used, formulating the possible technical solutions;
- Ability to solve tasks at the place of internship by using the knowledge obtained during the studies;
- Ability to purposefully work in a professional engineering team, getting acquainted with the distribution of obligations, specialization, cooperation of specialists of various levels and qualifications;
- Ability to select the necessary information and source materials and to use them purposefully.

In order to start the internship, three-sided agreements will be signed. During the training, a training journal is kept. At the end of the training, a training report is submitted, together with the assessment of the trainee from the provider of the placement. The training report is to be defended in front of a commission.

The readiness of enterprises to allow students to apply their knowledge in practice is proved by the existing cooperation agreements (see Appendix 10) 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.

Appendix 11 contains the Decision of the Senate (revised in 2019) on the procedure for organizing internship at RTU. According to this procedure, the students are helped to secure a placement by the placement coordinator in the organizational unit of RTU. If additional assistance is needed, students can approach the Career Support and Services Department, where a career advisor and a project manager help them in finding and addressing placement providers as well as, by means of various measures, facilitate the development of their career management skills, which may ensure successful results in the training process. Once a year, the Career Support and Services Department holds the RTU Career Day, when students can meet representatives of various enterprises and talk about future opportunities. More information about events can be found at https://www.rtu.lv/lv/studentuserviss/karjeras-centrs-ssc/projekti-un-seminari.

An additional resource that has been in place since 2015 is a website where enterprises are invited to publish vacancies that are of interest to RTU students (https://ekarjera.rtu.lv/, in Latvian), to which the students can log in with a university username and follow the internship opportunities pertaining to their field and later, job vacancies.

Support in the promotion of practical skills is provided by the RTU Development Fund (https://www.rtu.lv/en/developmentfund). Over one year, several hundreds of competitions for developing practical skills are held, which are organized in cooperation with enterprises and where students can learn practical skills.

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

The study process concludes with a national examination that includes the writing and defence of a master’s thesis and an engineering project. The engineering project is only required from graduates of the academic bachelor programme who do not have a professional qualification certificate. The master’s paper and the engineering project (further referred to as the Graduation Paper) is publicly defended before the National Examination Commission. The Commission acts according to a regulation approved by the Senate of the higher education establishment, and its composition is confirmed by the rector’s order. During the defence, the degree-seeker replies to questions about the fundamental and topical issues in the relevant field. The Graduation Paper is reviewed by at least one member of the National Examination Commission and the issue regarding the award of qualification and assessment of the Graduation Paper according to a 10-grade scale is settled by voting.

The description of the Graduation Paper is provided in the Study Course Register of Riga Technical University. The description reflects the goal and the main tasks of the paper, and the results to be achieved. All of them are naturally linked to the overall programme goal and the results to be achieved during the study process. In addition to the description, there are methodological directions for writing a Graduation Paper for the students of the professional master study programme at the Institute of Power Engineering of the Faculty of Electrical and Environmental Engineering.

The subjects for the Graduation Papers will be developed by the teaching staff of the Control and Optimization Department as well as certain enterprises, who will communicate them to the director of the Study Programme. The subjects have to correspond to the specifics of the Study Programme as well as have to be dedicated to the exploration of a topical problem within smart power engineering, for example:

1. Acceptance of the smart grid technology by a wide scope of consumers, which is a society-level problem;
2. Implementation of the smart grid technology, which is a necessary component for developing the future network into a more sustainable and more effective power system;
3. Creation of essentially new energy management and utilization models so as to plan, support and check the operating modes of power systems at national and European levels, instead of the present models, since these do not fully correspond to all the new challenges of smart power engineering (i.e. decentralization of power supply and its changeability, the need for flexibility, integration of power systems, introduction of innovative technologies and interaction between an increasing number of independently operating agents at the conditions of liberalized markets, etc.).

After the subjects have been discussed at a department meeting, a draft of the Dean’s ordinance will be prepared, and these subjects will be placed onto the website. The subjects for Graduation Papers and their supervisors are approved by an ordinance from the Dean. The functions of a supervisor will be assigned to a member of the RTU academic staff or a specialist from an enterprise (who can be a self-sufficient supervisor or, in the case of lacking qualifications, participate in the supervision of the paper in the capacity of a consultant, together with a member of the teaching staff of the Department).

While working on their Graduation Papers, the students demonstrate the research skills acquired during their studies as well as their ability to work with international scientific databases, which are available at the RTU library with electronic access from the ORTUS environment. The Graduation Paper is a serious piece of research, which is developed in accordance with the subject chosen by the student themselves. It has to be topical and to correspond to the specifics of the Study Programme.

The subject of the Graduation Paper is of the student’s own choosing. In this way, they learn to obtain information that they are interested in and gain skills for defending the Graduation Paper.

There will also be the possibility for the students to choose the subjects of reports on their own, with approval from the potential supervisors, which is of particular importance to those students who combine their studies with work at relevant enterprises.

Approximately two months before the defence, the student has to present and defend the goals and tasks of the paper as well as substantiate the object and subject of the study at a meeting of the pre-defence commission, arranged by the programme director, consisting of staff members of the Department with research interests and competences in the relevant field.

Before the defence of the Graduation Paper, all the students of the master programme have the opportunity to participate in the annual RTU students’ scientific and technical conference, where, by presenting their research and the results achieved within it, the students enhance their scientific research skills, develop the skills of speaking in front of an audience, engaging in discussions and replying to questions. To participate in the conference, the students have to submit a collection of the main tenets (theses) of their Graduation Paper, which are published in the electronic environment. The best participants in each section are awarded prizes.

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

Traditionally, higher education graduates are mainly employed by commercial enterprises and other large organizations. At present, these employers are often not fully content with graduates of the existing academic master and professional engineering programmes “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.

The analysis was conducted by considering the results of surveys among the students and graduates of the three programmes that correspond to the review period, as well as by considering the opinions of the employers regarding the quality of training of the young professionals.

The positive aspects especially highlighted by the surveys:

- The attitude of the records management office and the administration towards the students is welcoming and positive;
- Good relations among the students as well as between the students and the programme administration;
- The teaching staff is professional and capable of in-depth answers to students’ questions;

- The classrooms and their equipment are of good quality;
- The information about the study process and the course materials are readily available.

Still, based on the replies of the students and the employers regarding the negative aspects of the academic master and engineering programme, it has to be pointed out that the study process should be subjected to a development and modernization approach that will make it possible to move towards excellence and further competitiveness and export of Latvia's professional education.

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.

It is also important to point out that such a 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.

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 will change 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;
- A 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 their study programme.

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 was created by implementing the following priorities:

- The 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 developing new, improved study programmes 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.

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

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) 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.

Analysing the statistical data regarding the years 2014–2020, it has been found that the students of the academic master programme and the professional programme “Power and Electrical Engineering” at the Faculty of Electrical and Environmental Engineering used the mobility opportunities insufficiently. So, over the whole period under discussion, only five students spent one or two terms at a foreign institution within the Erasmus+ programme. Information about the dynamics of outgoing mobility is provided in Appendix 12.

This is mainly due to the fact that the students are employed and have limited possibility to go on study mobility or practical mobility for several months.

All of the study programmes mentioned before were only conducted in Latvian. Thus, the opportunities of incoming mobility were scarce. These were only provided in specialized courses that were available in other study programmes. As an example, we can name three master students from the Slovak Republic, who had passed all the examinations at their HEI before going to RTU and whose mobility was only concerned with writing their Graduation Papers.

For the new professional master study programme, an international dimension will be developed: measures are being planned and cooperation agreements are being signed so as to maintain contacts and promote cooperation with education institutions in the EU and outside it, thus ensuring international accessibility of the Study Programme and its recognizability, supporting the implementation of the Study Programme and study courses in foreign languages, forming sustainable cooperation with foreign HEIs, implementing joint study programmes and exchange of students. It is hoped that this will help to increase the proportion of students who participate in mobility programmes, thus expanding the horizon of their knowledge and competences, improving their communication skills and their language knowledge. It is also planned to invite more foreign studies within the mobility programme.

At RTU, there is a stable and comprehensible recognition system for study courses mastered during mobility. Before leaving, the student obtains individual approval from the Study Programme director regarding the list of study courses at the foreign HEI which will be equated to the study courses planned in that term at the student's home institution. If any changes occur during the mobility programme, these are approved electronically. Upon returning from the exchange programme, the student's courses mastered at the foreign institution are recognized on condition that their assessment is positive, which is proved by the documents issued by the foreign HEI.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

The implementation of the Study Programme will mainly take place at 12/1 Azenes Street, at the premises of the Faculty of Electrical and Environmental Engineering, which is part of the Kipsala campus (further referred to as the Campus).

The Study Programme will be implemented by means of the infrastructure, the research basis, and the material and technical basis of the RTU Faculty of Electrical and Environmental Engineering, 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 direction 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 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), 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.).

To ensure efficient management of available space and planning of studies, study rooms and schedules have been digitized (https://telpas.rtu.lv; https://nodarbibas.rtu.lv/). 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 *OpenAccess* principle (https://science.rtu.lv). 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, deskp 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 ensures support to the IT users and processing of applications according to the one-stop principle, based on the *ITIL* guidelines. Since 2007, the IT user support centre has processed and solved above 150,000 applications from IT users.

The most important role in ensuring students methodologically and informationally is played by the university library. RTU Scientific Library (SL) (https://www.rtu.lv/lv/studijas/biblioteka) is an official state-level library which has obtained its status as a result of library accreditation. The SL provides the RTU study process and the research activities with the required information, providing library services, bibliographical and informational services to RTU students, academic and other staff. The SL has 1.4 million printed documents as well as electronic resources in the databases that correspond to the RTU branches. The library stock is located in the Central Library, the Study Literature Loan System, the Chemistry Branch, the Transport Branch and study and research centres in Daugavpils, Liepaja, Cesis 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 directions of RTU studies and scientific activity.

Upon receiving RTU financing for the library, a calculation of funds for informational resources for each study programme is made. The replenishment of the stock takes place according to the suggestions of the study programme directors and researchers, taking account of the financing granted. Upon contacting the SL Acquisition Department regarding new acquisitions, the desired items can be ordered at the website of the library by filling in an order form, an application form, calling 67089353, or visiting the library at 5-105 Paula Valdena Street. The SL offers a guide summarizing the web addresses of various Latvian and foreign publishers and bookshops for searching for items to be ordered as well as e-resources.

Database subscription agreements are signed both directly with suppliers and via the "Kulturas Informaciju Sistemu Centrs" (Culture Information System Centre) state agency, which is the Latvian national representative at the international non-profit organization "Electronic Information for Libraries", EIFL. The "EIFL Licencing" programme offers the libraries of different countries to subscribe to internationally recognized databases at a considerably diminished subscription fee which is not offered to individual subscribers, thus allowing libraries to save financial means.

The databases subscribed to by RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/abonetas-datubazes) are as follows:

- *ProQuest Ebook Central, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, EBSCOhost eBook Academic Collection, Wiley Online Library, SpringerLink, The International Monetary Fund*.
- RTU SL also has access to databases financed by the Ministry of Education and Science of Latvia: *ScienceDirect, SCOPUS (Elsevier), Web of Science*.
- Latvian databases: LETA, Letonika, the Latvian Standards Database (this database is only accessible from the library premises).
- In addition, also the **IEEEXplore** database is subscribed to. Actually, it is the best-recognized international association whose character is directly linked to the study programme in question. Students have free access to this database to use both scientific articles and study courses. For the most active students, also the membership fee can be paid, ensuring possibilities for additional activities within the IEEE Latvia Student Branch.

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 new premises of the library have allowed expanding the range of services provided to the users. Since the opening of the new premises in 2018, the number of library visits has increased from 103825 to 235600 per year. The Central Library is open to visitors from Monday till Saturday. There is a 24-hour reading complex. In the summer period, the Central Library is open every weekday with shorter working hours (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3).
In the library, the sources of information are placed to ensure open access. The last copy of the older items that have RTU-related subject matter is retained on site and is always accessible to users.

Users are shown around the stock by the librarian on duty. In case of more detailed inquiries and in other cases as necessary, consultations are provided by bibliographers. At the library, there is a service provided by branch-specific librarians (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija).

Searches for library resources are ensured by the *Primo Discovery* search tool (https://www.rtu.lv/lv/studijas/biblioteka/vienota-informacijas-meklesana). This provides a single interface for finding information in the library catalogue (https://kopkatalogs.lv/F/?func=find-b-0&local_base=rtu01), the subscription databases as well as the databases formed by the SL (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes). When searching for information in the electronic general catalogue (https://kopkatalogs.lv/F), information can be obtained about resources in twelve libraries in Latvia. Both in the electronic catalogue and at the RTU portal (ORTUS), library resources can be ordered remotely; also, remote access to databases is ensured. Since the implementation of *RFID* technologies, users have access to five lending/returning machines and can return books via the returning/sorting machine around the clock.

The library ensures students, academic staff and other interested persons individual consultations and group trainings on the subject of information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas). Items not available at the library are delivered by means of the inter-library loan system or the international loan system. In all the premises of the library, Internet access is ensured. There are copying, scanning, printing, and binding services as well as a self-service kitchenette.

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.

Publications that are not available at the SL are provided by means of the inter-library loan system or the international loan system. In the whole SL, Internet access is provided.

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 will ensure the study and methodological work, form and renew the programmes of study courses, ensure the implementation of appropriate study courses, supervision of master’s papers, and conduct other activities related to the study, methodological, and scientific work.

The Study Programme will be 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 Innovation and Business Administration of the Institute of Business Engineering and Management;
- The BALTECH Study Centre.

In addition, it has to be pointed out that the work will be done in close cooperation with colleagues from the research centre of the Institute of Power Engineering of RTU Faculty of Electrical and Environmental Engineering 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 Faculty of Electrical and Environmental Engineering).

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 costs of the Study Programme are provided in Appendix 13.

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.

Detailed information about resources and their provision is reflected in Criteria 3.1.–3.3. of Section II.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

In comparison to the composition of the teaching staff of the two programmes that correspond to the period under review (the academic master programme and the engineer programme), changes should be highlighted: the total number of study courses has diminished and so has the teaching staff; also, the average age of the teaching staff has diminished due to the attraction of new doctors. As can be seen from the table below, the Study Programme is characterized by a large proportion of young academic staff (82% are under fifty years of age) and high qualifications of the academic staff, which ensures theoretical and research potential (96% have the degree of Doctor of Engineering or a different doctoral degree (PhD)).

Characterization of the academic staff in the Study Programme

No.	Indicator	Number	Percentage
	Academic positions:		
1.	Professors	5	18%
1.1.	Associated Professors	9	32%
1.2.	Assistant Professors	5	18%
1.3.	Lecturers	2	7%
1.4.	Scientific Assistants	1	4%
1.5.	Leading Researchers, Researchers	6	21%
	Total:	**28**	

2.	Scientific degrees:		
2.1.	Doctors	27	96%
2.1	PhD students	1	4%
	Total:	**28**	
3.	Age distribution (years of age):		
3.1.	25–30	5	18%
3.2.	31–40	11	39%
3.3.	41–50	7	25%
3.4.	51–	5	18%
	Total:	**28**	

In addition, it has to be pointed out that the qualifications of the teaching staff are constantly improved, as are the methodological and scientific materials authored by them. For example, this goal was addressed when the study direction "Power and Electrical Engineering and Electric Technologies" became involved in the European Social Fund project "Strengthening the Academic Staff of Riga Technical University in the Fields of Strategic Specialization", No. 8.2.2.0/18/A/017.

The total list of the teaching staff of the study direction, indicating the programmes in which they are involved, is appended to Section II.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The implementation of the Study Programme will be 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, which is proved by their Curricula Vitae (see Appendix in Section II). The qualifications of the teaching staff are continuously improved, as are the methodological and scientific materials authored by them.

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.

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 will 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 following elected teaching staff is involved in the implementation of the Study Programme:

Kārlis Baltputnis, Dr.sc.ing., Leading Researcher. Professional experience: experience in scientific work, participating in the research and innovation projects implemented by RTU Institute of Power Engineering (for more than five years now), including two international Horizon 2020 projects, which involve cooperation with both foreign HEIs and international enterprises in the industry. On the national level, his scientific work pertains to three national research programme projects and projects of the Latvian Council of Science. It is worth noting his cooperation with the most important representatives of the power industry in Latvia, performing contract work commissioned by the Ministry of Economics, JSC Augststprieguma Tikls and JSC Latvenergo. All these studies include modelling of various elements of the power system and simulating their operation, also by developing and applying modern optimization methods. The scientific work of Mr. Baltputnis has resulted in 21 scientific publications, 6 popular science articles, as well as participation in a number of international conferences.

Jānis Bartušauskis, *Master degree* in Labour Protection; qualification of Senior Labour Protection Specialist obtained at RTU. Additional knowledge about the most recent tendencies in the field and in science is gained at various local and international courses (Nord+, Sweden), professional and scientific conferences. Professional experience: Lecturer with more than 12 years of experience at a university; participation in research projects (a project estimating the impact of Ventspils Grain Terminal, etc.). Writing of scientific articles develops the research skills. In various group assignments, research projects and case studies during the study process, the students develop and improve their skills in conducting research and analysing results, which ensures that the learning outcomes are achieved. During his employment at RTU, Janis Bartusauskis has received a number of awards for his high-quality academic work from the Faculty of Engineering Economics and Management and the Student Parliament.

Kristīna Bērziņa, Dr.sc.ing., Leading Researcher, Associate Professor of the Institute of Power Engineering of the Faculty of Electrical and Environmental Engineering. Professional experience: academic and scientific work for more than 14 years at a higher education institution. Since 2018, she has been the Head of the Certification Centre of the Latvian Association of Power Engineers and Energy Constructors (LEEA). Ms. Berzina specialises in education methodology, modern lighting systems, renewable energy sources, planning and optimization of distribution power systems. Kristina Berzina has more than 25 scientific publications. She has a large experience in designing power supply systems. She continuously improves her professional qualifications, participating in various seminars and study courses in the field of electric power engineering.

Oļegs Borščevskis, Dr.sc.ing., Assistant Professor, Researcher. Professional experience: long-term academic, scientific, and administrative experience at a university, 5 years of academic work experience at a higher education institution. More than 5 years of scientific activity and research, with specialisation in the analysis of load and voltage levels, evaluation of power supply optimization, development of models of determining the optimal voltage level, etc., proved by participation in scientific projects and national research programmes; participation in international scientific conferences; publications. More than 20 years of practical experience at the power companies JSC Latvenergo and JSC Sadales Tikls as a project manager, electric engineer and building supervisor in large projects of national importance. He is an expert at the Latvian Association of Power Engineers and Energy Constructors (LEEA). LEEA certificate in designing up to 35 kV (issued by LEEA), building supervision of electric device construction works up to 35 kV (issued by the International Project Management Association). Level C certificate from the Latvian National Project Management Association (LNPVA).

Zane Broka, Dr.sc.ing., Leading Researcher. Professional experience: scientific work at the Institute of Power Engineering of RTU (more than 6 years), participating in the drawing up of applications of international and national research projects, project implementation, and performance of contract work. Close cooperation with international partners and leading representatives of the power industry in Latvia (e.g., the Ministry of Economics, JSC Augstsprieguma Tikls, JSC Latvenergo). She takes part in the Power Engineering Sub-Commission of the Terminology Commission of the Latvian Academy of Sciences. She participated in the preparation of two textbooks published by RTU Press (scientific and terminological editing).

Aleksandrs Dolgicers, Dr.sc.ing. Long-term experience of academic, scientific and administrative work at a higher education institution. He is an Associate Professor of the Institute of Power Engineering of the Faculty of Electrical and Environmental Engineering, Acting Head of the Power Systems Control and Optimization Department. Organisational activities: member of RTU Senate and the Council of the Faculty of Electrical and Environmental Engineering. Participation in organising committees and programme committees of international scientific conferences. Chair of the State Examination Commission of the Power Systems Control and Automation Department (now — the Power Systems Control and Optimization Department) of the Institute of Power Engineering. Mr. Dolgicers' research is concerned with relay-based protection and automation. He has more than 30 scientific publications, 2 patents, and has been involved in 8 projects.

Mikus Dubickis, Mg.oec., PhD candidate, Researcher. Professional experience: academic and scientific work at higher education institutions since 2013 (Mr. Dubickis has developed and delivered study courses in marketing, business administration, innovation, and social dialogue at undergraduate and graduate programmes; he has a number of publications in journals indexed in international citation databases); administrative/ management experience at higher education institutions since 2015 (Deputy Director of the Business Engineering and Management Institute, Deputy Rector of Vidzeme University of Applied Sciences for Quality of Studies, Quality Manager at RISEBA University of Applied Sciences). Mr. Dubickis' Doctoral Thesis investigates innovation and technology transfer from the point of view of business. He also participates in various research projects and reports the results at international scientific conferences. Mikus Dubickis has been a member of the Board and President (2011–2014) of the Latvian Students' Association. Since 2015, he has been a member of the Latvian Association of Young Scientists; since 2016, a member of the Consultative Council of the Technology Transfer Programme of the Investment and Development Agency of Latvia. Mr. Dubickis improves his professional qualifications by pursuing a Doctoral degree as well as by regularly participating (once a month, on average) in various seminars both on the subject of business and business administration and on the subject of teaching and scientific work; also, he improves his knowledge at free online courses (MOOCs).

Jana Eriņa**,** Dr.oec., Associate Professor. Professional experience: 9 years of academic work at a higher education institution. Also, 9 years of scientific activity and research, specialising in the field of financial services as well as calculation of costs of professional and higher education, which is proved by participation in scientific projects, research programmes, international scientific conferences, and by publishing research papers and articles. She is an expert of the Latvian Council of Science. She is an Acting Head of the Department of Innovation and Business Administration.

Kārlis Gulbis**,** Lecturer. Mr. Gulbis has obtained a Master degree in Power and Electrical Engineering and is currently pursuing Doctoral studies at RTU. His professional experience is concerned with the development of energy audits, electrical measurements and expert examination of electrical wiring. The results of his professional work have improved the reliability of systems, human safety and environmental protection. The professional experience makes it possible to explain the most recent tendencies in the industry to the students, to share experience and to link academic knowledge to real-life examples. In the study process and in the supervision of the students' graduation papers, Mr. Gulbis encourages the students to search for solutions to problems themselves, sharing examples with them and recommending the possible approach, but without offering a ready-made solution.

Elīna Gaile-Sarkane, Dr.oec., B.sc.ing., Professor of the Faculty of Engineering Economics and Management. Professional experience: more than 20 years of academic and scientific work at a higher education institution. The additionally obtained Bachelor degree in Chemical Industry provides an excellent basis for academic and research work in the fields of innovation, management and business. Therefore, Ms. Gaile-Sarkane's scientific research is concerned with interdisciplinary fields, encompassing management science, innovation management, technology transfer and various aspects of business. More than 150 scientific publications in the fields of management, economics and related areas. More than 35 of them have been published in internationally recognised sources or conference proceedings indexed in international databases (e.g., Thomson and Reuter, Scopus, EBSCO, etc.). Author and/or co-author of 4 textbooks, 3 monographs, and 1 patent. She is an expert of the Latvian Council of Science. Expert, Researcher or Project Manager in a total of more than 20 projects, promoting interdisciplinary, international cooperation with a significant contribution to the improvement of the education system in Latvia.

Larisa Iļinska, Dr.philol., Professor. Professional experience: long-term academic, scientific, and administrative experience at a university. Scientific activity of more than 40 years, with specialisation in teaching foreign languages to students and assessment of foreign language skills. Development of study aids and materials for foreign language learning. Ms. Ilinska's research work is proved by her participation in local and international scientific conferences as well as her publications in scientific journals and conference proceedings. Since 2011, Larisa Ilinska has been the Head of the Institute of Applied Linguistics and Head of the Department of Languages for Specific Purposes. Since 2015, Ms. Ilinska is an expert of the Latvian Council of Science in terminology, contrastive linguistics, translatology, applied linguistics, and academic language.

Jevgēnijs Kučkovskis, M.sc., Research Assistant. Professional experience: 3 years of scientific work experience at a higher education institution (involved in laboratory classes within the study course "Designing of Smart Power Supply Systems"), 2 years of work experience at a low-current system designing company in the capacity of Engineer of Electrical Equipment. More than 2 years of scientific activity and research, with specialisation in the analysis of renewable energy sources, evaluation of the stability of autonomous systems, development of digital models of wind generators, etc., which is proved by participation in international scientific conferences and developing of publications.

Antons Kutjuns, Dr.sc.ing., Assistant Professor at the Faculty of Electrical and Environmental Engineering of Riga Technical University. He has been delivering lectures, laboratory classes and practical classes at RTU since 2007. Academic work experience at RTU since 2006, when he obtained a Doctoral degree in Power Engineering. Professional work experience in the field of power engineering since 2000, while being employed at JSC Augstsprieguma Tikls.

Scientific activity and research since 2003 (the beginning of Doctoral studies), with specialisation in the investigation of energy reliability, issues of evaluating reliability criteria, and issues of developing models for evaluating reliability criteria under conditions of an electricity market. He has participated in 17 scientific conferences and 3 scientific projects and research programmes. All in all, 41 scientific articles have been published. He is a member of the Latvian Association of Power Engineers and Energy Constructors (LEEA).

Sergejs Kovaļenko, Dr.sc.ing., Assistant Professor. Professional experience: more than 10 years of academic work at a higher education institution. More than 10 years of scientific activity and research, with specialization in the analysis of complex electric power systems, evaluation of stability, development of mathematical models, etc., which is proved by participation in scientific projects, research programmes, and international scientific conferences, as well as by developing the research papers and articles. He is a member of the scientific committees of such international conferences as the International Scientific Conference on Power and Electrical Engineering of Riga Technical University (RTUCON) and the International Conference on Environment and Electrical Engineering (EEEIC).

Jevgeņijs Kozadajevs, Dr.sc.ing., Assistant Professor. Professional experience: long-term scientific and academic work experience at a university since 2008. The research is mainly concerned with emergency protection and automation of a power system as well as the analysis of the causes of emergencies and their solutions. Since 2016, he has been actively involved in the power supply and power supply management of residential houses. His research activities are proved by participation in scientific projects, research programmes, international scientific conferences and by developing research papers and articles. The students are taught the theory of management, automated control systems, and develop basic skills necessary to solve various technical problems related to design and application of automated control systems. The study process integrates the most recent and topical scientific research and its results as well as the topical issues in other countries. He actively participates in contract work.

Oļegs Linkevičs, Dr.sc.ing., Associate Professor, Researcher. Professional experience: 12 years of academic and scientific work at Riga Technical University, Faculty of Electrical and Environmental Engineering (formerly: Faculty of Power and Electrical Engineering), 26 years of administrative work experience at the Department of Research and Development of JSC Latvenergo, the Latvian national energy enterprise. More than 17 years of scientific activity and research (including the Doctoral Thesis), with specialisation in the simulation of the operation of power plants and microgrids by developing optimization models and algorithms, proved by the h-index of 6 and more than 30 Scopus-indexed publications, participation in international scientific conferences, national research programmes, Horizon 2020 projects as well as contract work at enterprises in the field. Since 2016, he has been an expert of the Latvian Council of Science. He has been a member of the Technical Council of the VGB Power Tech e.V. (www.vgb.org) Association since 14 September 2015 and member of the Thermal & Nuclear Workgroup of the EURELECTRIC association (www.eurelectric.org) since 2010. He obtained Annual Award 2008 named after Professor Alfreds Vitols for young scientists for achievements in power engineering. He has teaching experience with local (in Latvian) and foreign (in English) students as well as students of the extramural department. Since 2009, more than 1000 students have mastered the study course "Fundamentals of Power Engineering", which includes practical classes (tests). The study materials are continuously improved, considering topical materials and the latest tendencies in the field. He improves his professional qualification by regularly attending training and further education courses.

Tatjana Lomane, Dr.sc.ing., Researcher. Her scientific and academic work experience is 45 years at a higher education institution. The main research areas are emergency protection and relay-based protection of a power system, also based on the long-term employment at JSC Latvenergo, JSC Augstsprieguma Tikls and the Daugava cascade of HPPs (since 1971).

Anatolijs Mahņitko, Dr.sc.ing., Professor of the Faculty of Electrical and Environmental Engineering. Professional experience: academic and scientific experience of more than 47 years at a higher education institution. More than 300 scientific publications in the field of power engineering, including 9 monographs, 4 textbooks, 12 study aids and 10 teaching aids. Over the last 3 years, 29 research papers were been published in internationally recognised periodicals or conference proceedings indexed in international databases. Organisational activity: An expert of the Latvian Council of Science, member of the Council of RTU Faculty of Power and Electrical Engineering (now — Faculty of Electrical and Environmental Engineering). Active participation in editorial boards of scientific journals and organisational committees and programme committees of international scientific conferences.

Jeļena Malahova, Dr.oec., Associate Professor. Professional experience: more than 12 years of academic work experience and more than 10 years of administrative work experience at a university. More than 10 years of scientific activity and research, with specialisation in the analysis of problem issues of civil protection and fire safety, evaluation of various safety risks, which is proved by her participation in the scientific project "Formation of Unified Study Courses in the Field of Social Security", active participation in contract work, as well as participation in professional and scientific conferences, including international scientific conferences, various local and international courses and seminars, extending knowledge about the latest tendencies in the industry and in science. She is an expert of the Latvian Council of Science in social science: 1. Social and Economic Geography; 2. Economics and Business. Deputy Director of the Institute of Labour and Civil Protection for study issues. During the implementation of the study course "Civil Defence", the study process integrates the most recent and the most topical scientific studies and their results as well as topical issues in other countries.

Anna Mutule, Dr.sc.ing., Associate Professor. Ms. Mutule has a long-term academic experience at RTU (since 2005) and scientific and administrative experience at the Institute of Physical Power

Engineering (since 2001), where she has been the Head of the Smart Grids Research Centre since 2015. Anna Mutule's experience encompasses leadership and participation in international and state-financed projects, for example, EU-DEEP (FP6); ICOEUR, ELECTRA and SmartGrids ERA-Net SmartGen (FP7), Strongrid (Nordic Energy research), CloudGrid (ERA-Net Smart Grid Plus), ITCity (ERA-Net LAC) as Project Coordinator, PANTERA (H2020). Ms. Mutule has large experience in the development of study materials and laboratory classes, using the MATLAB environment. Her research is aimed at planning of power systems, use of renewable energy sources, energy efficiency solutions and smart grid technologies; research results are incorporated into the study course "Control of Electric Networks and Systems and Planning of Their Development". Anna Mutule is a member of the Latvian Association of Power Engineers and Energy Constructors (LEEA); since 2007, she has been an expert of the Latvian Council of Science in the field of power engineering and since 2019, she has been a member of the Engineering and Technologies Expert Commission of the Latvian Council of Science; member of IEEE PES, founder and chairperson of WIE AG of the IEEE Latvia section; since 2018, member of the managing committee of the European Energy Research Alliance Joint Programme on Smart Grid (EERA JP SG), working in the development of position/opinion documents of the SP5 Flexible Transmission Network sub-programme.

Ļubova Petričenko, Dr.sc.ing., Senior Researcher and Assistant Professor at RTU Institute of Power Engineering. She is an expert of the Latvian Council of Science. Professional experience: more than 10 years of teaching, supervision of study and graduation papers, delivering lectures within the course "Designing of Power Supply Systems", reviewing scientific publications and graduation papers. More than 6 years of research experience, with specialisation in the modelling of power systems, designing and optimization, which is proved by participation in scientific projects (the H2020 RealValue project, EnergoPlanT (Optimum Planning of an Energy-Intensive Manufacturing Process and Optimization of its Energy Consumption Depending on Changes in the Market Price)) and research contracts (for the EC Joint Research Centre and the Latvian Ministry of Economics), participation in a post-doctoral research support project ("Electrical Grid Design Methods and Tools, Considering Smart Technologies and Market Conditions"), international scientific conferences (more than 15) and publishing research papers and articles (about 50).

Andrejs Podgornovs, Dr.sc.ing., Professor. He has a Doctoral degree in the field of Electrical Engineering, the sub-field of Electrical Machinery and Apparatus. More than 15 years of experience in higher education: provision and management of the study process, research, performance, and management of international and local contract work. Active work with students of all study levels; supervision of more than 25 qualification papers. Several nominations to RTU Student Parliament awards for academic staff. He develops professional experience by participating in international projects and contract work for governmental bodies and commercial enterprises in Latvia. Chairman and active participant of the Standardization Technical Committee "Electrical Power Engineering" of the Latvian State Standard Institution since the foundation of the Committee in 2012.

Tatjana Smirnova, Dr.philol., Associate Professor. Professional experience: long-term academic, scientific, and administrative work at a university. Head of the Methodological Commission of the Institute of Applied Linguistics, responsible (at the Institute level) for the development of methodological materials for teaching English for Specific Purposes (ESP). Wide experience in the development of video lectures.

More than 20 years of scientific work and research, specialising in the analysis of the semantic, pragmatic, and terminological aspects of the translation of specialised texts, teaching ESP, investigation of the manifestations of linguistic iconicity in expressive and operative texts, which is proved by the large number of publications in internationally cited journals, participation in scientific projects, participation in international scientific conferences. She is an expert of the

Latvian Council of Science.

Valentīna Urbāne, Dr.chem., Professor, Researcher. Professional experience: long-term academic, scientific, and administrative work at a university (40 years at RTU). More than 44 years of scientific and research activity, with specialization in the synthesis and analysis of new substances, assessment of labour risks, development of methods for risk prevention, which is proved by participation in research programmes in the capacity of a consultant, participation in international scientific conferences as well as publications (more than 65 publications). Latvian Council of Science expert, member of the Latvian Labour Protection Association.

Andrejs Utāns, Dr.Sc.Ing., Associate Professor, Leading Researcher. Professional experience: 10 years of academic work at a higher education institution. More than 20 years of scientific and research activity, specializing in the development of power system relay-based protection and automation operation algorithms and the implementation of their apparatus part. Solid experience in the modelling of power system operating modes and analysis of emergency situations. Long-term experience working with real-life relay-based protection and automation devices. Participation in a number of scientific projects, research programmes, as well as participation in local and international scientific conferences.

Ivars Zālītis, Dr.Sc.Ing., Researcher. Professional experience: 1.5 years of academic experience in leading laboratory classes for bachelor and master level students in relation to the modelling of faults in electrical systems and their stability. In parallel, Mr. Zalitis has made improvements to the laboratory work about directional earth fault protection within the course "Theoretical Fundamentals of the Relay-Based Protection of Electric Power Systems" and the laboratory work about fault location within the course "Automation of the Energy Generation and Transmission Processes in Electric Power Plants". More than 4 years of scientific work experience at a university, specializing in the computer modelling of electrical systems and analysis and synthesis of relay-based protection and automation algorithms, which is proved by participation in a number of international conferences (for example: 12th IEEE PES Powertech Conference, IEEE EEEIC 2017, RTUCON, etc.) and publications both in the proceedings of scientific conferences and in a scientific journal as well as three patents of the Republic of Latvia.

Inga Zicmane, Dr.Sc.Ing., Leading Researcher, Professor at the Institute of Power Engineering of RTU Faculty of Electrical and Environmental Engineering. Professional experience: 20 years of academic work experience at a higher education institution. Almost 20 years of scientific work and research. Her research is concerned with the quality of education, evaluation of the sensibility of electric power systems, transient processes, stability of power systems, local power networks, renewable energy sources. Ms. Zicmane has more than 100 scientific articles, one monograph, 2 study aids; also, she is the author or a co-author of 6 sets of methodological guidelines and has participated in the implementation of the tasks of 8 scientific projects of different scale.

Organisational activities: exert of the Latvian Council of Science, member of RTU Council of Professors in the field of Electric Engineering and Electronics, member of the Promotion Council "RTU P-05", RTU Senate, the Study Quality and Programme Commission of RTU Senate, and RTU Arbitration Committee. Participation in organising committees and programme committees of international scientific conferences. Vice-Chairperson of the State Examination Commission of the Power Systems Control and Automation Department (now — Power Systems Control and Optimization Department) of the Institute of Power Engineering (since 2018), member of the Editorial Board of the journal "Электротехнические и информационные комплексы и системы" (ISSN 23075864), thematic editor of Sustainability Journal (IF 2.576, ISSN 2071-1050), long-term reviewer of several journals.

Diāna Žalostība, Dr.sc.ing., Associate Professor, Leading Researcher. Professional experience:

long-term experience of academic, scientific, and administrative work.

From 2010 to 2014, Ms. Zalostiba worked as an Assistant Professor. Since 2015, she has been an Associate Professor at RTU Institute of Power Engineering. Since 2017, she has been a Coordinator and Manager of the implementation of the international Erasmus+ project “ESSENCE: Establishing Smart Energy System Curriculum at Russian and Vietnamese Universities”. She develops her professional competence by regularly participating in courses and seminars as well as by way of self-study. The knowledge (including new learning methods) and experience gained are used to improve the study process. More than 15 years of scientific research, specialising in the modelling of power systems, imitation of various operation modes of power systems and their elements, management and planning of the modes of a power system (including optimization and risk assessment), which is proved by participation in scientific research projects, e.g., the NER projects “FasTen: Fast, Flexible and Secure Decarbonization of the Baltic States — Possible Progress in the Next Ten Years”, and “Amber: Impacts of Ambitious Energy Policy Pathways”; EEA project “Optimised Residential Battery Energy Storage Systems”; Latvian State Research Programme project “INGRIDO: *Innovative* Smart Grid Technologies and Their Optimization”; participation in international scientific conferences and publishing research papers and articles. Within the study course, the students master theoretical knowledge about the main optimization methods and develop skills in applying these methods to solve various problems in power engineering. To support the students’ integration in the labour market, the study process involves the most topical scientific research results, for example, the application of the GAMS special modelling system for solving mathematical programming and optimization problems. In the study process, the students have the opportunity to develop and improve their research competences and skills, participating in research work within projects in cooperation with higher education institutions, scientific institutions, companies and/or institutions in the industry. For example, it is planned to involve at least two students in the Amber project, for the evaluation of the development scenarios of the Baltic power system and their impact on decarbonization, by imitating the operation of the power system of the Baltic States under market conditions, using GAMS for the optimization problems. Since 2016, she has been a Coordinator of RTU platform “Energy and Environment”; since 2017, member of the Scientific Council of RTU Faculty of Electrical and Environmental Engineering; since 2012, member of RTU Academic/Constitutional Assembly; member of the state examination commission of RTU Faculty of Power and Electrical Engineering (now — Faculty of Electrical and Environmental Engineering), member of the scientific committees and reviewer at various conferences.

The *Curricula Vitae* of the academic staff in *Europass* format are provided in Annex to section II.

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime

contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

Every year, the Faculty of Power and Environmental Engineering hosts international scientific conferences of the RTUCON series. Within these conferences, scientists and students from various countries exchange the results of their scientific activity in the field of electrical engineering, promising ideas, and establish contacts for potential research. Typically, the conference involves 100...200 participants from 20...50 countries. At present (since 2014), the conference is supported by the IEEE and IEEE IAS societies. Since 2014, about 650 articles have been published in the IEEE Xplore database as well as in the SCOPUS and TR-WoS databases.

One more conference in the field of electrical engineering that took place at the Faculty of Power and Environmental Engineering was POWERENG2015. The conference was supported by the IEEE and IEEE IES societies. The 113 articles of the conference are available at the IEEE Xplore, SCOPUS and TR-WoS databases.

The conferences of the RTUCON series impact the study work of the Faculty both directly and indirectly. The direct impact is exerted by a special work session, "Education in Engineering Sciences", within which teaching staff from a number of universities and countries can exchange methodological experience in the field of training engineers. Also, the tendency to use the newest scientific achievements in the study process is visible. Besides, the RTUCON conferences support (by means of special sessions and awards) students who present their scientific results. Lastly, a number of instructors of study subjects involve their students into the conference, for example, by means of reports, in which students are offered, subject to a separate grade, to analyse and evaluate the achievements of other scientists.

Both on a national level and on an international one, the academic staff of the Study Programme is actively involved in scientific research in the field of smart electric power engineering. The research is integrated into the study process. This interaction is supplemented and topicalized by labour market studies and consultations with employers and practising specialists. The changes are mainly aimed towards modern and applicable research. For example, in the period under review, the teaching staff was involved in various scientific research activities, including:

1. Participation in international scientific conferences in Latvia and abroad, for example:

- International Conference on the European Energy Market (EEM);
- IEEE PowerTech (PowerTech);
- IEEE International Conference on Environment and Electrical Engineering and EEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe)
- RTUCON Conference and others.

Reports were presented by Sergejs Kovalenko, Lubova Petricenko, Zane Broka, Karlis Baltputnis and other members of the teaching staff.

2. Publications in internationally reviewed journals indexed in several databases (including Scopus, Web of Science), for example:
    - Sauhats, H. Coban, K. Baltputnis, Z. Broka, R. Petrichenko, R. Varfolomejeva. Optimal investment and operational planning of a storage power plant. International Journal of Hydrogen Energy, 2016. Field-Weighted Citation Impact: 4.229;
    - Sauhats, A., Utāns, A., Antonovs, D., Svalovs, A. Angle Control-Based Multi-Terminal Out-of-Step Protection System. MDPI Energies, 2017. Field-Weighted Citation Impact: 3.045;
    - Zalitis, A. Dolgicers, J. Kozadajevs. An adaptive single-pole automatic reclosing method for uncompensatedhigh-voltage transmission lines. Electric Power Systems Research, 2019. Field-Weighted Citation Impact: 2.856;
    - Sauhats, A., Zemīte, L., Petričenko, Ļ., Moškins, I., Jasevičs, A. Estimating the Economic Impacts of Net Metering Schemes for Residential PV Systems with Profiling of Power Demand, Generation, and Market Prices. MDPI Energies, 2018. Field-Weighted Citation Impact: 2.743;
    - Ivanova, A. Sauhats, O. Linkevics. District Heating Technologies: Is It Chance for CHP Plants in Variable and Competitive Operation Conditions? IEEE Industry Applications Magazine, 2019. Field-Weighted Citation Impact: 2.743 and others.

3. Participation in EU and international programme projects, State Research programme projects, for example:

- Horizon 2020 programme: Realising Value from Electricity Markets with local Smart Electrical Thermal Storage Technology (RealValue); Duration: 01.06.2015–31.05.2018, EU budget € 632 318,http://www.realvalueproject.com/1 Among others, the following specialists participated: Zane Broka, Aleksandrs Dolgicers, Olegs Linkevics, Lubova Petricenko, Ivars Zalitis, Diana Zalostiba.

- Future-Proof Development of the Latvian Power System in an Integrated Europe (FutureProof). Duration: 21.01.2019–21.01.2049, EU budget EUR 472 440. Among others, the following specialists participated: Olegs Borscevskis; Zane Broka; Jevgenijs Kuckovskis; Antons Kutjuns; Ivars Zalitis.

- Building and District Thermal Retrofit and Management Solutions (THERMOSS). Duration: 01.10.2018–30.06.2020, budget EUR 183 750. Among others, the following specialists participated: Zane Broka.

- Innovative Smart Grid Technologies and Their Optimization (INGRIDO). Duration: 23.01.2019–23.01.2049, EU budget EUR 472 440. Among others, the following specialists participated: Karlis Baltputnis, Aleksandrs Dolgicers, Tatjana Lomane, Andrejs Utans, Diana Zalostiba.

- Trends, Challenges and Solutions of Latvian Gas Infrastructure Development (LAGAS). Duration: 23.01.2019–23.01.2049, EU budget EUR 472 440. Among others, the following specialists participated: Jevgenijs Kozadajevs, Andrejs Utans, Ivars Zalitis.

4. Participation in contract work, for example:

-15.I2637. Technical Support for the Risk Assessment of the Power Transmission Network: LOT 2: Expertise from the perspective of electricity system of gas-electricity network for reference system: Republic of Latvia. 12.01.2017–11.09.2017. EUR 29 250.00. European Commission Joint Research centre (Commissioner). Financing: European Commission Joint Research Centre. Among others, the following specialists participated: Antons Kutjuns.

- 17.L8292. on the implementation of the investigation "Demonstration of Smart Electrical Thermal Storage Heaters at Facilities of JSC “Latvenergo” and JSC “Sadales Tikls””. 06.07.2016–01.06.2018. EUR 1890.00; Among others, the following specialists participated: Diana Zalostiba.

The research and the study process is organized in such way that the subjects of the study and research work of the students might encompass the topical issues of smart power systems. In the implementation of their study courses, the teaching staff of the Study Programme use the results of their own research as well as that of other researchers (the information is summarized in the Table), thus ensuring the transfer of topical knowledge to the students.

A full list of the publications, patents, artistic work of the teaching staff over the period under review is appended to Section II.

Table. Examples for using information obtained as a result of scientific research in the study process

The main directions of the scientific research of the teaching staff within the Study Programme	Teaching staff involved in the research	The study courses in which the results of the corresponding research directions are used
1. Management of the effectiveness, reliability, stability, and risks of power systems	I. Zicmane, A. Dolgicers, A. Mahnitko, T. Lomane, A. Utāns, S. Kovaļenko, I. Zālītis, J. Kozadajevs	***EES702*** Power System Dynamics ***EES700*** Principles of Protective Relaying of Electric Power Systems ***EES703*** Electronic Devices of Power System ***EES701*** Computer Application in Power Engineering ***EES713*** Control Systems in Electric Power Engineering
2. Development of power facility operation methods and means	Ļ. Petričenko, Z. Broka, K. Baltputnis, O. Borščevskis	***EES708*** Power Plants, Electric Stations and Substations
3. Development of innovative electric machinery, electric apparatus and electric devices	A. Podgornovs, K. Gulbis	***EEM553*** Electrical Equipment Diagnostics ***EEM559*** Modern Electromechanical Converters ***EEM560*** Optimization of Modern Electromechanical Converters ***EEM558*** Electrical Equipment Diagnostics Mathematical Methods
4. Electric power supply systems, distribution networks and their reliability	A. Kutjuns, O. Linkevičs, K. Bērziņa, J. Kučkovskis	***EES708*** Power Plants, Electric Stations and Substations ***EES754*** Design of Smart Power Supply Systems ***EES711*** Reliability of Power Systems

5. Planning and optimization of electric power supply systems	A. Mahnitko, D. Žalostība, L. Petričenko	***EES716*** Optimisation of Smart Power Systems ***EES714*** Power System Optimization Methods
6. Investigation and optimization of smart lighting systems	K. Bērziņa, K. Kasperuks	***EEA701*** Electrical Installation of Buildings
7. The peculiarities of electricity producers in the overall energy system at the conditions of an electricity market	A. Mutule, A. Kutjuns, Z. Broka, K. Baltputnis, Ļ. Petričenko	***EES712*** Management and Development Planning of Electrical Networks and Systems

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

To achieve the desired results of the Study Programme, the interlinkage of the study courses and their logical, sequential layout in time is of great importance. In order to stimulate mutual learning by members of the teaching staff as well as transfer of education innovations and good practice and strengthen their sense of belonging to the profession and their motivation, the Study Programme provides for cooperation of teaching staff both within the department, the faculty, and the university and internationally. For example, during the approbation, the Study Programme was assessed by invited experts from other universities (foreign experts from the Technical University of Iasi (TUI), Romania, and the Technical University of Kosice (TUKE), Slovakia, with experience in the implementation of teaching procedures, development of innovative problems for students as well as with experience in smart energy systems and investigation of their stability issues. All of these institutions have a high-level competence and experience in special teaching and practice in the field of electric power engineering and smart power engineering, including power system analysis, power system operation and supervision, power system stability and monitoring for an economic model of a local power system).

It is planned to maintain close contacts with these and other higher education institutions in Latvia and abroad.

The kernel staff of the Study Programme is composed of teachers of study courses related to the relevant industry, almost half of which (about 48%) have experience in the industry or have at least undergone practical training at an enterprise within the project “The procedure for organizing practical training of academic staff within the European Social Fund project No. 8.2.2.0/18/A/017 “Strengthening of Academic Staff of Riga Technical University in *Strategic* Specialization Areas”. This factor helps to form a close dialogue with the industry, which is extremely important for successful implementation of the professional programme, i.e.:

- The cooperation with an energy enterprise ensures that the problems the students have to solve correspond to the needs of the industry and are practically applicable, and that the implementers of the study process have updated the information at their disposal and their knowledge about the main operation problems faced by the power industry;
- Quick and precise reaction from the power industry in the form of references and replies to the initial results and the work done within this close cooperation will ensure initial access to the results of the study process;
- Representatives of the industry are invited to propose long-term research subjects;
- Support from the power industry, obtaining data, models or other information related to the implementation of the Study Programme will have a greatly beneficial effect.

Aleksandrs Dolgicers, the director of the programme, meets the above members of the teaching staff at least once a month, with the aim to improve the contents of the programme and the interlinkage, including:

- Supplementation of the contents of lectures within the study courses;
- Supplementation of the contents of practical or laboratory classes within the study courses;
- Proposition of new subjects for graduation papers in cooperation with an enterprise;
- Offering new internship opportunities for the students;
- Development of cooperation with an enterprise in the field of science or commercialization.

The expected proportion between the numbers of students and teaching staff in the Study Programme is as follows: an average of 1 to 2 students per member of the teaching staff, or 3 students for one member of the teaching staff who is mainly employed at the Faculty (at the initial stage of programme implementation); an average of 3 to 4 students per member of the teaching staff or 7 to 8 students for one member of teaching staff who is mainly employed at the Faculty (in two or three years' time).

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	Pielikums_5_REGR0_statistika_EN.docx	Pielikums_5_REGR0_statistika_LV.docx
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	Pielikums_6_REGR0 _Studiju programmas atbilstiba valsts izglitibas standartam_EN.docx	Pielikums_6_REGR0 Studiju programmas atbilstība valsts izglītības standartam_LV.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)	Pielikums_7_ REGR0_Studiju programmas atbilstība profesijas standartam_EN.docx	Pielikums_7_REGR0_Studiju programmas atbilstība profesijas standartam_LV.docx
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Pielikums_8_REGR0 kartejums_LV_EN.xlsx	Pielikums_8_REGR0 kartejums_LV_EN.xlsx
Curriculum of the study programme (for each type and form of the implementation of the study programme)	Pielikums_9_REGR0 plānojums.docx	Pielikums_9_REGR0 plānojums.docx
Descriptions of the study courses/ modules	Pielikums_14_Apraksti_pdf.zip	Pielikums_14_Apraksti_pdf.zip
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	Pielikums_14_Diploms.zip	Pielikums_14_Diploms.zip
Description of the Study Programme - Other mandatory attachments		
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	Confirmation of the possibility to continue education MSP.pdf	apliecinājums par studiju turpināšanas iespējām.edoc
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	Apliecinajums - Par zaudējumu kompensaciju.edoc	Apliecinajums - Par zaudējumu kompensaciju.edoc
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.	Apliecinājums - Svešvalodu prasme.edoc	Apliecinājums - Svešvalodu prasme.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education		
Sample (or samples) of the study agreement	Sample_of_study_agreements.zip	Studiju līgumi.zip
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.		

Adaptronics (47522)

Study field	*Power Industry, Electrical Engineering, and Electrical Technologies*
ProcedureStudyProgram.Name	*Adaptronics*
Education classification code	*47522*
Type of the study programme	*Professional master study programme*
Name of the study programme director	*Leonīds*
Surname of the study programme director	*Ribickis*
E-mail of the study programme director	*Leonids.Ribickis@rtu.lv*
Title of the study programme director	*habilitētais doktors*
Phone of the study programme director	
Goal of the study programme	*The aim of the study program is to provide students with the opportunity to improve theoretical and professional knowledge, develop professional, creative and research skills, work with modern adaptive systems in the field of electrical engineering, electronics, power engineering, mechatronic system automation. It will ensure the acquisition of effective skills in the design, development, implementation and management of new technologies and systems and allow for successful integration in the local and international labour market in various industries, as well as enable students to continue further education in order to improve professional competence or pursue a PhD degree.*
Tasks of the study programme	*Tasks of the study program:* *• to develop effective skills in computing techniques both for solving tasks and creating adaptive systems;* *• to teach how to solve practical electrotechnical tasks at the project level;* *• to promote the creative application of knowledge of the adaptive properties of animals and plants in the design of modern electrical technologies;* *• to teach how to solve automation tasks of electrical and electronic equipment in various production spheres;* *• to provide an overview of work organization, social issues and principles of economic activity;* *• to facilitate the interaction of the academic staff and students in the performance of scientific research work and in the practical use of the obtained results in accordance with international standards and trends in the field of quality management;* *• to facilitate international exchange and participation of academic staff and students in projects.*

Results of the study programme	*Learning outcomes of the study program:* *• able to design, practically implement and operate new systems adaptable to external conditions, using modern electronic equipment, semiconductor energy converters, drive systems and various types of sensors;* *• able to evaluate the possibilities of applying the properties of environmental objects (representatives of animal and plant kingdom) for the design and development of modern electrically adaptive technologies;* *• able to use computer equipment, compiling programs for automation of technological processes;* *• able to design, create and operate new computer control systems for electrotechnical equipment of all sectors of the economy with the properties of energy saving and rational use;* *• able to conduct research with scientific value in the fields of electrical engineering and electronics and their management, substantiate it and analyse the results;* *• able to analyse practical challenges and evaluate the appropriate theoretical approach in the field of development and operation of electrical and electronic equipment;* *• able to assess the level of knowledge of applicants/students and to implement scientific and pedagogical activities accordingly.*
Final examination upon the completion of the study programme	*The Qualification paper - Master's thesis.*

Study programme forms

Full time studies - 1 years, 6 months - latvian

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*60*
Admission requirements (in English)	*professional bachelor degree in adaptronics and qualification of electrical engineer*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*

Amount (CP)	*80*
Admission requirements (in English)	*professional bachelor degree or equivalent education in electrical engineering, energy, mechatronics, electronics and qualification of electrical engineer*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 2 years - latvian

Study type and form	*Part time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*60*
Admission requirements (in English)	*professional bachelor degree in adaptronics and qualification of electrical engineer*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 3 years - latvian

Study type and form	*Part time studies*
Duration in full years	*3*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*professional bachelor degree or equivalent education in electrical engineering, energy, mechatronics, electronics and qualification of electrical engineer*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 2 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*60*
Admission requirements (in English)	*professional bachelor degree in adaptronics and qualification of electrical engineer*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 3 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*3*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*professional bachelor degree or equivalent education in electrical engineering, energy, mechatronics, electronics and qualification of electrical engineer*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 1 years, 6 months - english

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*6*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*professional bachelor degree in adaptronics and qualification of electrical engineer. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*professional bachelor degree or equivalent education in electrical engineering, energy, mechatronics, electronics and qualification of electrical engineer. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 2 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*professional bachelor degree in adaptronics and qualification of electrical engineer. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 3 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*3*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*

Admission requirements (in English)	*professional bachelor degree or equivalent education in electrical engineering, energy, mechatronics, electronics and qualification of electrical engineer. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 2 years - english

Study type and form	*Part time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*professional bachelor degree in adaptronics and qualification of electrical engineer. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 3 years - english

Study type and form	*Part time studies*
Duration in full years	*3*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*professional bachelor degree or equivalent education in electrical engineering, energy, mechatronics, electronics and qualification of electrical engineer. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address

Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years, 6 months - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*100*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science energy, electronics and automatics or comparable education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years, 6 months - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*6*
Language	*english*
Amount (CP)	*100*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science energy, electronics and automatics or comparable education. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 3 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*3*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*100*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics or comparable education*

Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time extramural studies - 3 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*3*
Duration in month	*0*
Language	*english*
Amount (CP)	*100*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics or comparable education. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 3 years - latvian

Study type and form	*Part time studies*
Duration in full years	*3*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*100*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics or comparable education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Part time studies - 3 years - english

Study type and form	*Part time studies*
Duration in full years	*3*
Duration in month	*0*

Language	*english*
Amount (CP)	*100*
Admission requirements (in English)	*bachelor degree of engineering science in electrical science, energy, electronics and automatics or comparable education. The knowledge of English is tested for applicants to studies in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional Master Degree in Adaptronics*
Qualification to be obtained (in english)	*Leading Electrical Engineer*

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

Modern technologies are complex systems that include elements of different areas: electrical engineering, electronics, mechatronics, adaptive materials, adaptive elements and systems, their regulation, and computer control. This, in turn, requires professionals employed who have knowledge not only of their main field of specialisation and adjacent industries, but also of sectors that seem far and unrelated to the main field, such as medicine or biology. At the same time, skills and competencies are needed to interact with each other. In this context, students – future specialists – need knowledge and skills in the interdisciplinary sectors, which are not particularly widely offered by today's highly specialised study programmes.

In addition to the above-mentioned factor, in 2014 the requirements for the certification of specialists in construction and power engineering were changed: the specialists under discussion were required to obtain an engineering diploma that could only be acquired by completing the professional study programme. In this context, in recent years, the number of students of the academic study programme “Computerised Control of Electrical Technologies” has declined sharply, while at the same time the number of students in the corresponding professional study programme has remained at the previous level and started to increase even in extramural studies. This development has led to the idea of transforming the former academic study programme “Computerised Control of Electrical Technology” into a professional one, making substantial changes to it. Therefore, in 2015 the professional Bachelor study programme “Adaptronics” in the study field of power engineering and environmental engineering sciences was developed and launched. It incorporates an in-depth study of natural sciences and bio-adaptive properties, as well as the students acquire the knowledge of information technologies that can be applied to the development of modern high-precision unique technologies. As the first students completed this program five years ago, there was a need to create an opportunity for graduates to supplement their knowledge and continue their studies in order to obtain the corresponding Master degree, as well as offer study opportunities to graduates of other programmes who would like to acquire knowledge and skills in a broader specialization. Thus the professional Master degree program “Adaptronics” was established, supplemented with the qualification of a leading electrical engineer, in compliance with the standard of the profession of the Leading Electrical Engineer approved on 11 August 2021.

The newly created programme was licensed on September 2, 2020 by the decision of the Study Quality Commission No. 2020/57-L (License certificate No. 04051-189).

In 31 May 2021, the study programme was improved by RTU Senate Resolution No 650, and it was decided to supplement the program with the 3rd implementation option, in which

- The volume of the study program (CP, ECTS) is 100 CP (150 ECTS);
- Duration of studies – for full-time studies with academic education in engineering – 2.5 years, for part-time studies – 3 years;

- Degree and qualification to be obtained - Professional Master Degree in Electrical Engineering and Qualification of Leading Electrical Engineer;
- Required previous education - Academic Bachelor Degree in Engineering.

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

Since the study programme has been licensed relatively recently, enrolment of students is planned to start only in September 2021. Therefore, there are currently no statistics on students enrolled in this programme. However, it is expected that the graduates of the professional Bachelor study programme "Adaptronics" will continue their studies at the corresponding Master study programme, as well as students from foreign universities will be attracted, as the 3rd implementation option of the programme has specially been designed for foreign students. It is planned to admit 20-25 students totally in Latvian and foreign groups for full time studies of the program implementation. The envisaged minimum number of students in each version is 5.

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

The aim of the study program is to provide students with the opportunity to improve theoretical and professional knowledge, develop professional, creative and research skills, work with modern adaptive systems in the field of electrical engineering, electronics, power engineering, mechatronic system automation, ensuring in such way the acquisition of effective skills in the design, development, implementation and management of new technologies and systems and allow for successful integration in the local and international labour market in various industries, as well as enable students to continue further education in order to improve professional competence or pursue a PhD degree.

The professional Master study programme is the second level of education after obtaining a professional Bachelor degree in the fields related to electrical engineering, power engineering, mechatronics and electronics. The general aim of the professional Master study programme "Adaptronics" is to provide theoretical knowledge and practical skills corresponding to the professional Master degree and qualification. (https://www.latvijaskvalifikacijas.lv/en/educational-system/; https://europa.eu/europass/en/description-eight-eqf-levels)

The specific aim of the study programme is to provide students with the opportunity to improve theoretical and professional knowledge, develop professional, creative and research skills, work with modern adaptive systems in the field of electrical engineering, electronics, power engineering, mechatronic systems automation. It will ensure the acquisition of effective skills in the design, development, implementation and management of new technologies and systems and allow for successful integration in the local and international labour market in various industries, as well as enable students to continue further education in order to improve professional competence or pursue a Doctoral degree.

During the professional Master studies, students acquire technical study courses of the highest importance for the specialty, as well as undergo internship. The main task is the development of a Master Thesis, in which, based on theoretical knowledge and practical skills, the student formulates the principles of adaptive automation of specific industrial technologies, and provides a possible engineering solution for an automation system, which introduces functions or characteristics of an automatic system that adapts to external conditions or other influencing parameters.

The learning outcomes of the study programme:

- able to design, practice and operate new systems that can be adapted to external conditions, using modern electronic equipment, semiconductor energy converters, drive systems and various types of sensors;

- able to evaluate the possibilities of application of properties of environmental objects (representatives of animal and plant kingdom) for design and development of modern electrically adaptive technologies

- able to use computer equipment when compiling programmes for automation of technological processes;

- able to design, create and operate new computer control systems for electrotechnical equipment of all sectors of the economy with the properties of energy saving and rational use;

- able to carry out research of scientific value in the fields of electrical engineering and electronics and their management and to substantiate it and analyse the results;

- able to analyse practical challenges and evaluate the appropriate theoretical approach in the development and operation of electrical and electronic equipment;

- able to assess the level of knowledge of applicants/students and to implement scientific and pedagogical activities accordingly.

During professional Master studies, the student acquires the necessary knowledge, skills and competences for comprehensive and effective operation in the field of electrical engineering and adaptronics, i.e., design, implementation, improvement, operation and management of various adaptive systems, as well as forms the basis for further studies and professional development.

The implementation of the professional Master study programme has three possible options, of which only the first two are licensed, as the third has to wait for the approval of the new professional standard:

Variant 1 - 60 CP (90 ECTS), 1.5 years for full-time studies, 2 years for part-time studies, for applicants with a professional Bachelor degree in adaptronics and qualification of electrical engineer, possibility to obtain a Professional Master Degree in Adaptronics and Qualification of Leading Electrical Engineer.

Variant 2 - 80 CP (120 ECTS), 2 years for full-time studies with recognized previous education, 2.5 years for part-time studies, for applicants with a professional Bachelor degree or equivalent education in electrical engineering, power engineering, mechatronics and electronics and qualification of electrical engineer, possibility to obtain a Professional Master Degree in Adaptronics and Qualification of Leading Electrical Engineer.

Variant 3 - 100 CP (150 ECTS), 2.5 years for full-time studies, 3 years for part-time studies, for applicants with an academic Bachelor degree in engineering, possibility to obtain a Professional Master Degree in Adaptronics and Qualification of Leading Electrical Engineer.

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master's and doctoral study programmes, 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 study programme is a continuation of Bachelor studies and gives students knowledge and skills on theoretical and practical issues of automation principles and application of electrical technologies in various sectors of the national economy. The knowledge gained is sufficient for students to start practical activities as technicians in the industry upon graduation or to pursue Doctoral studies.

Descriptions of study courses will be available at RTU website, in the Study Programme Register (https://stud.rtu.lv/rtu/vaaApp/sprpub). Their description is based on the principles of Bloom's taxonomy, namely, including not only an abstract and a short description of the study course, but also providing information on the aims and tasks of the study course expressed in competencies and skills, defining the learning outcomes to be achieved and their assessment, as well as prerequisites for acquiring the study course.

It is planned that most applicants will have completed the study courses that ensure the achievement of professional competence in business, technology transfer, product development, environmental, civil and labour protection. If the student has not acquired such skills at the undergraduate study programme, the student will acquire the relevant study courses in addition to the ones included in the study programme.

To ensure the internal quality of the study programme, methodological seminars of the Department will be organized, in which the academic staff that implement the study courses of the study programme will participate. The methodological seminars of the Department will be regular and will be organized for two hours twice a month. Student, graduate and employer surveys will be conducted for the analysis of study quality. The surveys will be electronically conducted in ORTUS environment; the results will be available to the head of the respective department and the head of the Institute, which will allow evaluating the activities of the academic staff accordingly.

To ensure the high quality of the competence of the academic staff, within the limits of financial possibilities, the academic staff will be provided with the professional development activities and internship opportunities at other universities in Latvia and abroad will be carried out. In addition, projects will be submitted for the funds of RTU, the EU, and the Ministry of Education and Science in order to improve the study programme and conduct scientific research, where students will also be involved.

The staff of the Department of Industrial Electronics and Electrical Engineering is also active in scientific research, attracting EU projects to both education and science, as well as performing contract work for companies. Students will also be involved as performers. One of the ways students can, if they wish, gain additional knowledge is to work at a laboratory, use its infrastructure, materials and advice from scientific staff when building a converter/equipment.

The assessment of student knowledge is based on the Cabinet Regulation (Regulations No. 512 of 26 August 2014, Sections 45-54) and the corresponding decisions of RTU Senate.

Learning outcomes are evaluated according to two criteria: qualitative criterion (evaluation on a 10-point grading scale) and quantitative criterion (credit points, which are obtained if the evaluation of the study course is positive).

Student participation in study process improvement is implemented in a variety of ways. First, students are regularly polled at ORTUS portal. Based on the survey results, the head of the study programme may evaluate the results and initiate the necessary changes. Second, improvement/modernization of a new or existing laboratory stand may be a theme of a graduate paper, specifically if it is connected with the neds of an enterprise and new technologies, or development of a methodological aid, corresponding to the Master level, or, for example, supplementing a manual with new computer models, electrical circuit, their description, etc. Third, students with the help of student self-government of FEEE organise various activities, e.g., field trips to manufacturing enterprises, engineering contests, take part in exhibitions and discussions.

The students of all levels of the Faculty of Electrical and Environmental Engineering run Latvenergo Creative Laboratory, where every student of the Faculty has the opportunity to consult and practically develop various electrical devices and systems, using both their ideas and do-it-yourself computer chips, thus improving their practical skills in drawing, creating chips, soldering, performing electrical measurements, testing, optimization, which significantly improves students' knowledge and readiness for internship at Latvian or foreign companies. Every year, students' interest in this opportunity grows.

The volume of the programme and the duration of studies are different for students with different previous education:

- 60 CP - 1.5 years for full-time studies with previous education in adaptation, 2 years for part-time studies
- 80 CP - 2 years for full-time studies with recognized previous education, 2.5 years for part-time studies
- 100 CP - 2.5 years for full-time studies with academic education in engineering, 3 years for part-time studies (implementation is possible after licensing)

	Parts of the study programme	1) Variant 60 CP *(90 ECTS)*	2) Variant 80 CP *(120 ECTS)*	3 Variant 100 KP *(150 ECTS)* (After licencing)
A.	Compulsory study sources	6 CP	26	26
B.	Compulsory elective study courses	24 CP	24	18

C.	Free elective study courses	-		
D.	Internship	10 CP	10 CP	26 CP
E.	State examination	20 CP	20 CP	30 CP

The structure of the programme and all formal conditions comply with the state regulatory enactments and the requirements specified in the decisions of RTU Senate. As a result of professional studies, students acquire knowledge and professional competence that meet the requirements of a professional Master degree and allow them to start professional activities corresponding to the specialty. The structure of the study programme is shown in Annex 11.

If the student has not acquired knowledge in compliance with the requirements stipulated by the Law on Environment protection and the Law on Civil Defence at a lower level study program, within the scope of the Ph.D program students can choose the study courses “Civil defence” of 1 CP (ICA301) and Environment and Climate Roadmap of 1 CP (VAS038), if such disciplines were not included in the preceding study program, and students of the program in English can choose to study the Latvian language in the study course “Latvian language for foreign students” amounting to 1 CP.

Study courses of the program are selected and develop to ensure that they can conform to the modern trends of the industry and science in the field of electrical technologies and automation. For instance, the study courses like “Adaptive adjustment of cyberphysical systems” and “Development of the virtual reality project of a large scale robotic movement simulator” provide knowledge and skills of technology adaptive control, within the study courses “Autonomous robotics system” (a study project) and “Embedded electronics systems” (a study project) students develop the skills of designing automation adaptive systems. Conferring of the degree is also based on the achievements and conclusions of the field of electrical technologies and automation, where students develop, study and analyse new technologies, control approaches, propose their original versions, propose energy efficient technologies.

To ensure that the content of the programme is as close as possible to the needs of the labour market, the State Examination Commission includes representatives from the industry. They give their suggestions on preferred research themes for students that are relevant to the labour market. In cooperation with employers' representatives, students develop their study projects and graduation papers. Employers positively evaluate students' performance in developing and publicly presenting their graduation papers, as well as highly assess the tasks completed during the internship, by inviting students to participate in projects or undertake employment at a company.

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

The study programme “Adaptronics” defines seven learning outcomes to be achieved corresponding to the results of the professional standard “Leading Electrical Engineer”:

- able to design, realise in practice and apply new systems adaptive to outside conditions using modern electronic devices, s/c power converters, driving systems and sensors of different types;
- able to estimate opportunities to apply the properties of the environmental objects (representatives of animals or plants kingdoms) for the design and realisation of modern electrically adaptive technologies;
- able to apply computers, to compile computer programs for automation of technologic processes;
- able to design, realise and use new computer control systems for all range of electric equipment applied in economy with saving of electric energy and rational application properties;
- able to conduct research with scientific value in the fields of electrical engineering and electronics and their management and substantiate and analyse the results;
- able to analyse application challenges and estimate the appropriate theoretical approach in the field of development and operation of electrical and electronic equipment;
- able to evaluate the level of knowledge of applicants / students and to implement scientific-pedagogical activities.

In their turn, the aims set out in the study courses are closely linked to the learning outcomes to be achieved by the joint programme. The content of the courses is fully in line with the learning outcomes. There is regular monitoring and development of the content of study courses, which helps control the content of study courses, training methods and update the learning outcomes to be achieved.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

A variety of study methods and forms will be used during the education process, the choice of which is related to the specific nature of each study course. General subjects and theoretical aspects will be offered in the form of lectures, where the materials used will be made available to students electronically, including the e-learning environment. Practical work will also be organised in the form of traditional laboratory classes in special facilities, as well as in the form of practical tasks where students will be able to combine acquired knowledge from several courses, thereby promoting both interdisciplinarity and obtaining the necessary feedback on other courses and the effectiveness of their teaching methodologies. The resources available to students are replenished and improved regularly; several books and methodological aids are developed for publication, the existing training laboratories are also upgraded and improved. Some of the study courses implemented are gradually being digitised.

The training process (lectures, practical and laboratory classes) will be based on new technologies such as modelling computer programs, computer projectors, micro-control kits, unified digital and analogue control plates, and other types of technology. The resources available to students were added and improved, several books and methodological aids were developed for publication, and existing training laboratories were upgraded and improved. Some technological equipment and computer programs were self-created, and some of them were purchased. The study programme will be implemented through project tasks, their public presentation and assessment. Students will be involved in various research projects.

Descriptions of study courses will be available at RTU website, in the Study Programme Register (https://stud.rtu.lv/rtu/vaaApp/sprpub). Their description is based on the principles of Bloom's taxonomy, namely, including not only an annotation and a short description of the study course, but also providing information on the aims and tasks of the study course expressed in competencies and skills, defining the learning outcomes to be achieved and their assessment, as well as prerequisites for acquiring the study course.

The study program is implemented as full time studies and remote studies in Latvian and English, by following the requirements defined by laws and regulations, the core principles of organisation of studies set by RTU and by complying with all the study course requirements. Course description of the study program defines the set of compliant knowledge, skills and competences and their evaluation system, defines the study outcomes for attaining which credits are granted, which do not depend on the form of the program implementation: full time studies in person, half-time studies in person or remote studies. The procedure of evaluation of students' knowledge, skills and competences is defined by Senate of RTU decision of 27 May 2017 "Regulation on the Assessment of Learning Outcomes", which conforms to the core principles and procedure of assessment of education on the relevant study level defined by the Cabinet Regulations. The cumulative assessment system is applied in assessing students' achievement where the final grade consists of several components.

Full time studies consist of 40 CP per academic year and 40 academic hours of the student's work per week accounting for 1 CP. In order to satisfy the requirements defined in the program and every course, in comparison to full time studies, a longer time for completing the program and a lower number of credit points is set for half-time studies, in particular, less than 40 CP per academic year and less than 40 academic hours per week. Thus, as the study program is implemented in different types and forms of studies, only the number of in person (or contact) and independent work hours and the study methodology or instruction approach of courses differs. The teaching methods for implementation of study courses, as well as the assessment methods are selected by the academic staff responsible for the study course in compliance with the specifics of the content of the study course and the study program, as well as students' needs. As full time students have less practical experience in the field of study, the applied methods include study trips to the industry companies, visiting lectures by the industry professionals, etc. As regards half-time students, who have practical experience in most cases, the employed teaching methods consist more of lectures, practical assignments, group works, home assignments and research involving cases studies and their explanation from both the theoretical and practical perspective. Within the half-time in person and half-time remote study process the focus is on the independent work of students by using both the problem-based learning and case studies, as well as the professor's advisory role.

As stated above, in addition to theory classes in classrooms, students also participate in study trips to the biggest companies and organisations of the industry, for example, within the scope of the study course "Introduction to the speciality" the first year students visit Latvenergo AS, Sadales tīkli, Rīgas mašīnbūves rūpnīca, Getliņi and other companies. Organisation of study trips and study visits ensures the link between the content of the study program and the industry specifics, in addition to the knowledge of the theory students can relate it to daily situations in companies on the matters of both automation processes, energy saving and efficiency improvement, to analyse issues and to substantiate their view.

The student-focused education principles are considered during the whole implementation of the study process:

1. Involvement of students in the study process and content improvement. RTU has developed procedures providing for the student feedback on the quality of the study process (surveys, regular meetings of students with the program director and leading teaching staff, etc.). Thus, students have an opportunity to affect the study process. Students in the program are regularly involved in the program quality assessment, participate in the work of decision making bodies and advisory bodies.
2. Study outcomes. The assessment of the study courses of the program and the number of credits is related to study outcomes. The study outcomes of each study course are notified to students. Professors relate the course outcomes to the study program outcomes, as well as substantiate the necessity of acquisition of the information of the relevant course for mastering the profession of an electrical engineer.
3. Mobility. Within the study program “Adaptronics” mobility resources are used to improve the teaching process of the university, as the student-focused education is based on a powerful teaching process. Teaching staff of foreign universities is involved in the program implementation, thus benefiting not only students, but also the teaching staff involved in the program implementation by taking over the best practice.
4. Social dimension. When students study within this program, their study process is sufficiently flexible, providing an opportunity for students to combine studies with work starting from the second or third study year. Students of the day department also have an opportunity to change the form of studies to remote studies in order to combine studies and work. The fact that the premises of the RTU library are available to students round the clock and also on weekends should be mentioned as another advantage.
5. Teaching methods. Various teaching methods are applied in the program implementation process. For example, study projects are developed, there are group works, the peer-to-peer method is applied in some study courses. Students can receive individual consultations from the academic staff in personal meetings or by communicating in the e-environment.
6. Study environment. During the program implementation there is cooperation between librarians and the academic staff aimed to improve the teaching and learning process. Both students and the teaching staff involved in the program have access to premises with relevant equipment appropriate for research and the learning process.
7. Development of the academic staff competences. The academic staff involved in the program have regular opportunities for improvement of their methodological and teaching skills. The process of development of the academic staff competences includes also discussions on application of the teaching and learning methods, including innovative teaching methods. For instance, within the scope of ERASMUS+ and NordPlus projects workshops on innovative teaching methods were organised with participation of colleagues from Latvia, Lithuania, Estonia and Finland.
8. Extracurricular activities of students. The program management supports the work of the students’ self-government, thus allowing students improving their independence, providing opportunities for implementation of ideas, as well as to study additionally outside the scope of lectures. For example, students have an opportunity to implement their ideas in the laboratory of Latvenergo AS at the time most convenient for students. Everybody studying in the program is offered an opportunity to participate in extracurricular activities (sports teams, dance groups, choirs, debate associations, etc.). All the above attests that there is active study life and extracurricular possibilities for students.

Students studying in the study program are also involved in research work and studies on topics important for the field by participating in domestic and international conferences.

Assessment of the students’ knowledge is based on the Cabinet Regulations (Clauses 45-54 of Cabinet Regulations of the Republic of Latvia No. 512 (26 August 2014) and relevant decision of the RTU Senate.

Study outcomes are assessed based on two criteria, in particular, the quality criterion (**the assessment according to a scale of 10 points**) and quantity criterion (**credit points**, obtaining positive assessment of acquiring the study course content).

The following core principles of assessment of eduction are followed in the assessment:

- The principle of adding of positive achievements - positive achievements within every course and totally within the program are added;
- The principle of mandatory checks - the assessment is mandatory at the conclusion of every study course;
- The principle of transparency and clarity of assessment criteria - test requirements are accessible to all stakeholders from the program administration or teaching staff and are described accordingly upon starting every subject, they are electronically available in ORTUS environment;
- The principle of a variety of assessment forms - classroom tests, study works, independent works, presenting at seminars, tests, exams (verbal, written, containing a practical assignment), defence of the internship work, defence of the Master’s Thesis, etc.
- The principle of accessibility of the examination - the scope and content of examinations conforms to the content defined by subject syllabus and the requirements regarding the professional qualification skills and knowledge. All the conditions for obtaining credit points are described in the syllabus of every subject.

  An **exam and test** are the basic forms of assessment of acquisition of the program and they need to taken at the completion of every study subject.

  Also the **internship** is assessed based on the 10 point scale. The assessment of the internship is provided by the head of the internship and the internship defence commission by accepting the defence of the internship reports and assessing the reference of the internship company. The commissions of defence of the internship are assigned based on the order of the head of the relevant structural unit.

In addition, the teaching staff pays attention to and assesses also the students’ ability to work with the study and scientific literature sources, to prepare notes, to draft reports, to arrange materials, to analyse, to draw conclusions. A lot of attention is on the students’ ability to read literature in foreign languages, to present the main ideas of not adapted texts, to discuss with other students, to use technical study aids, to perform scientific research work on the basic level. Development of these skills is encouraged by using the interactive study environment in the study process.

The qualification paper – **Master Thesis** – is presented publicly. It is assessed by the State Examination Committee. The State Examination Committee appointed by the Rector in 2017 shall consist of 5 members: representatives of the Faculty of Electrical and Environmental Engineering, representatives of the industry, and the Chairman, Alnis Kaļāns (EK Sistēmas Ltd). The volume of the Master Thesis is about 50 pages with diagrams and figures, which showcase research of modern electrical equipment. The Master Thesis should also provide proposals and recommendation for the technical implementation of such equipment. The following criteria are applied for defence of the Master Thesis:

- systematisation, updating and expansion of theoretical and practical knowledge, the experience gained within the individual and study practice,;

- independent acquisition of the study and scientific literature, laws and regulations compliant with the selected speciality and information in other information sources, including in foreign languages;
- the ability to solve the issue of research, comprising particular novelty elements and tasks, by relating this to theoretical guidelines;
- analysis of problems, systematisation;
- the skill of presenting of performed research and obtained practical results.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

The main tasks of the internship are fully in line with the objectives and learning outcomes of the study programme, as they are directly determined to apply and enhance knowledge, skills, and competencies acquired during studies:

- to use knowledge and skills acquired within the framework of the professional Master study programme,
- to introduce students to the activities of modern businesses; to introduce instructors - to the needs of businesses,
- to involve partners in the study process by organising internship outside the higher education establishment,
- to ensure cooperation with the leading companies in the industry.

As a result of Master studies, the following knowledge is acquired, which must be applied during internship at companies operating in the field of electrical engineering and can be regarded as the main tasks of internship:

- the ability to apply theoretical knowledge to address scientific challenges;
- the ability to organise and conduct pedagogical activities;
- the ability to design and create new computer management systems for electrical equipment in all sectors of the economy;
- the ability to design and develop electronic equipment, semiconductor energy converters, and propulsion systems;
- the ability to use computers, to develop programs for automation of technological processes;
- the ability to rationally use and save electric energy;
- the ability to use information technologies – personal computers, the Internet, computing devices;
- the ability to search, analyse and process data.

Special internship tasks shall be set on a case-by-case basis for each student, according to the specialisation of internship company.

Internship is organised and its tasks are set in such a way that learning outcomes of internship fully match as many learning outcomes of the study programme as possible.

Within the first and second version of the study program, the scope of the internship amounts to 10 CP, and in the third version for those who have graduated from the academic program, it is 26

CP. The internship is organised in various Latvian and foreign companies, providing an opportunity to provide internship for foreign students, and there are also Latvian companies prepared to accept foreign students for internship and to employ them, for instance, Rīgas mašīnbūves rūpnīca, etc. In addition to the internship, students can use the laboratories of IEEI where practical or research work is performed.

In 2019, according to the Senate decision, the internship organisation procedure at RTU was reviewed. As indicated in the internship organisation procedure, an internship coordinator at the department assists students in finding the company. If additional assistance is needed, it is possible to resort to the Career Support and Services Department, where a career adviser and a project manager help students find internship site, as well as through a variety of measures, to develop career management skills that can provide successful results during the internship process. Once a year, the Career Support and Services Department organises RTU Career Day, which also allows students to meet with business representatives and communicate on future opportunities. Detailed information on RTU Career Day is available at http://karjera.rtu.lv/projekti/karjeras-day-Archiv/.

An additional resource developed in 2015 is a home page where companies are invited to place job openings that are up to date for RTU students (https://ekarjera.rtu.lv/). Students have the opportunity to log in with the University username and keep abreast of current internships and job opportunities in their field.

RTU Development Fund provides additional support for practical skill promotion (https://www.rtu.lv/en/developmentfund). Hundreds of practical skill competitions are offered during the year, which are organised in cooperation with companies.

In addition, students can obtain information on internship places on the institute's website (www.ieei.rtu.lv), which includes a dedicated section with all the information on internship (http://ieei.rtu.lv/prakse.html).

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

The programme was licensed in September 2020, so the first enrolment of students is planned in September 2021. Therefore, currently, information is available only on the themes of the graduation papers at the professional Master study programme “Computerised Control of Electrical Technologies”.

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

RTU Office of Vice-Rector for Academic Affairs regularly conducts student surveys on the ORTUS portal (during autumn and spring semester). The results of these surveys are available to the head of the study programme, as well as to the instructor of each study course. The head of the study programme and the instructor of the study course evaluate the results and make the necessary improvements. It can be concluded from the surveys carried out that students positively evaluate the study process and teaching methods used.

The survey results are available at the ORTUS platform.

Student participation in the improvement of the study process is already being implemented and will take place in several ways. First of all, students will be regularly surveyed in ORTUS e-learning environment where, according to the results of the survey, the head of the study programme can assess the results and make the necessary improvements. Secondly, one of the themes for the Bachelor Paper may be the upgrading of a new or existing laboratory workspace, particularly when it relates to the needs of businesses and new technologies, as well as the development of methodological material for teaching (more representative for the Master level), or, for example, the addition of material with new computer models, electrical circuits, their descriptions, etc. Thirdly, students, also through the Student Self-government of the Faculty, organise various activities, field trips to production companies, competitions in the field of civil engineering, exhibitions, discussion clubs.

After the internship, a survey of internship supervisors at companies is organized about students' knowledge, skills, and achievements during the internship and their assessment.

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

Students regularly have traineeship at foreign technical universities. Cooperation has been launched with several foreign universities, where, through the ERASMUS+ exchange programme, students successfully start training and successfully develop Master Theses. It can be concluded that interest in mobility opportunities is high, and the level of students' knowledge is sufficient with the level of knowledge, skills and competencies of study courses implemented by other internationally recognized higher education institutions. During mobility, the students study and pass tests and exams at the best European universities, such as RWTH Aachen or the University of Duisburg-Essen in Germany.

Recognition of study courses covered during mobility takes place according to the “Amendments to the Organisation Procedure of Erasmus+ Student Mobility” (Resolution of RTU Vice-Rector for Academic Affairs No. 01000-1.1/240 as of 29 October 2014) and “Regulation on the Recognition of the Courses Completed at Other Universities and RTU Study Programmes” (Resolution of RTU Vice-Rector for Academic Affairs No 02000-1.1/29 as of 4 April 2016). The recognition of ERASMUS+ mobility is carried out by the head of the study programme on the basis of the Transcript of Records submitted by the student after the ERASMUS+ mobility and a pre-signed application for the recognition of study courses.

In order to make the recognition of courses more successful, the student carefully chooses the most appropriate partner school for the curriculum and the area before applying for ERASMUS+. The study courses, which are coordinated with the Erasmus+ coordinator in the form of an application, are approved by the head of the study programme.

During the recognition process, the evaluation of courses acquired during ERASMUS+ programme is not converted to a 10-point grading scale, but the successfully covered ones are marked as “recognised” instead of an assessment of courses of partner higher education institution, thereby recognising the credit points obtained. If the application for recognition of courses calls for amendments to the study programme and the student has been successful during ERASMUS+ programme, an order of RTU Vice-Rector for Academic Affairs is issued regarding individual amendments to the study programme which are then prepared. Once the order has been issued, the courses of the partner higher education institution are included in RTU Study Register and the student's individual plan is amended to include the courses acquired abroad. Amendments to the study programme are made only at the expense of Part B, replacing RTU study courses with courses of partner higher education institution.

Since the programme was licensed on 2 September 2020 and will start admitting students in September 2021, statistics on inbound and outbound mobility are not yet available.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

State budget subsidy for students of the professional Master study programme "Adaptronics" amounts to EUR 194,007.59, the tuition fee amounts to EUR 24,904.00. The total sum amounts to EUR 218,911.59 or EUR 6,060.99 per student;

In order to improve the resource base, additional financing from contractual work conducted by the faculty units is attracted.

It is planned to involve 9 members of academic staff of the Department of Industrial Electronics and Electrical Technologies of FEEE IEEI in the implementation of the study programme "Adaptronics".

In addition to the academic staff of the Faculty of Electrical and Environmental Engineering, general staff are involved in the management of the study programme that undertake study support processes, such as the organisation of study process, the management of public and international relations, student records, technical support of study programmes, work related to the implementation of the study programme. Their duties also include the organisation of business correspondence, the circulation of information, including cooperation organisations in Latvia and abroad, the coordination of telephone calls, e-mails, and correspondence, planning the work schedule of the manager, administration of appointments. They may also carry out simple financial records, analysis, assessment, and control of documentation, as well as drawing up various types of activity related reports on behalf of the manager and solving problems or non-standard situations.

Successful cooperation has been developed with the staff of the relevant faculty of Tallinn University of Technology, which ensures the improvement of the professional skills of employees and the exchange of students and employees.

In Latvia, study programmes in Power, Electrical Engineering and Electronics are implemented at Latvia University of Life Sciences and Technologies and the Latvian Maritime Academy, and the academic staff of the Faculty of Electrical and Environmental Engineering and Power Institute are actively involved in these programmes, creating joint scientific projects. The joint projects are also implemented with the Institute of Solid-State Physics of the University of Latvia, the Institute of Physical Energetics of the Latvian Academy of Sciences, RTU Faculty of Mechanical Engineering, Transport and Aeronautics, as well as Faculty of Computer Science and Information Technology.

With ERDF funding to the field of Power, Electrical Engineering and Electronics, since 2014 the study process has been implemented in a new and modern building with an up-to-date building management system with embedded sensors, climate control systems, energy-efficient lighting, etc., which also serve as a means of research. In parallel, existing and new laboratories have been upgraded:

- Power Electronics Training Laboratory;
- Electrical Propulsion Training and Research Laboratory;
- Manufacturing Automation Training and Research Laboratory;
- Computer Management Training and Research Laboratory;
- Microelectronics and Sensor Training and Research Laboratory;
- Energy Efficiency Training and Research Laboratory;
- Electronic Equipment Training Laboratory;
- Electrical Engineering Fundamentals Laboratory;
- Electrical Engineering and Electronics Training Laboratory;
- Research Laboratory of Semiconductor Converters;
- Industrial DC System Laboratory (AREUS Demo Lab);
- Student Creative Laboratory.

These laboratories have a brand-new infrastructure – furniture, network voltage links, blackboards, projectors, etc. In addition, the following training facilities have also been purchased: oscilloscope (RigolDS1052D, total number: 10 pcs), oscilloscope (Rigol DS4012, total number: 2 pcs), power measurement keys (Rigol RP1001C, 7 pcs), differential keys (RigolRP1025D, total number: 2 pcs), multimeters (u1233a, total number: 16 pcs), solar meter (solar-100), power parameter analysers (CIR-E3, number: 14 pcs), power units (EX752M - PSU, total number: 8 pcs), power units (QL355TP - PSU, PROG, TIPLE, 35V, 5A, 5V, 5V, 1A), total number: 2 pcs, power units (TTI - CPX400s - PSU, total number: 2 pcs), two power units (EA-PS 2042-20b - PSU), transformer (VELLEMAN sr-1000), accumulator-screwdriver/drill-machine (Festool), portable optical meter (Konica MINOLTA LS110)). New test benches have also been created for students' practical work: microelectronics, electron devices, propulsion system “lift drive” bench.

Within the FP7 project framework AREUS, a unique laboratory has been set up: a 600 V DC power supply network consisting of an industrial 21 kW robot KUKA Quantec Prime, a 55 kW active rectifier, two power benches capable of emulating electricity consumption of any robot, super condenser, and lithium-ion energy storage systems and other equipment. The Faculty of Electrical and Environmental Engineering has a compact solar storage system at its disposal; the storage system is with lithium-ion batteries and a charge-level control system; local, interlinked autonomous power supply systems with 3.6 kW wind generators and 6.6 kW solar panels; inverter electricity for grid transfer or lithium-ion storage systems for energy storage. In parallel, special programmable DC power units have also been purchased, which are capable of simulating solar panels or hydrogen systems with a power of 2 · 15 kW, 2 · 5 kW, 2 · 3 kW, fuel cell research set Ballard Nexa with a power of 2 1.2 kW and 8 kW.

For industrial process studies, the FESTO mini plant MPS and FMS complex, the compact water-level control work station FESTO Compact-Workstation, EMCO Concept Turn 105/EMCO Concept Mill 105 equipment kit are available.

Digital oscilloscope YOKOGAWA DLM6054-F-HE-L16/P4, oscilloscope (Rigol DS1052D – 10 pcs; Rigol DS4012 – 2 pcs), digital oscilloscope TEXTRONIX, Fluke, Rigol, etc. are available for signal measurement. In 2017, a fine BNC-type oscilloscope power key Ultra mini CWT015 was purchased to measure the current running through the legs of a transistor.

For the measurement of lighting parameters, the Avantes spectrometer, the solar meter (SOLAR-100), the portable optical meter (Konica Minolta LS-110), the infrared temperature meter Raynger ST60 ProPlus are available.

To determine energy performance parameters, electricity parameter analysers (CIR-E3 – 14 pcs), power analyser set N4L PPA5530-3 Phase (5 pcs), network analysers AR5 and AR5L, Fluke network analysers, etc. are used.

Variable AC and DC power sources, as well as other sources are used for the development of various converters, such as diesel generator SDMO DX 6000TE, solar panels, wind generator, hydrogen fuel cells, power units (EX752M – PSU, 8 pcs), direct voltage laboratory power unit (EA-PSI 9360-120 3U), direct voltage electronic load (EA-ELR 9150-30 3U) and electronic load for DC Electro Automatic ea-el3400-2, direct voltage laboratory supply unit (EA-PS 8032-10 T).

Electronic Technology Management System Development Platform dSPACE, Matlab/Simulink R14 modeling programme, simulation programme PSIM Profesional 8.0, Synopsys Analog Simulation and Modeling Synopsys Advanced TCAD individual license, license OrCAD PCB Design University Edition, software PSIM-JMAG, etc. are also available.

Prototyping equipment for PCB plates is used such as LPKF ProtoMat S64 PCB prototyping equipment, LPKF ContacRS PCB metalizing plant, HAWK 3D axis microscope, automatic multi-layer PCB press (4-8 slice plate development) LPKF multi-press; and electrical coil (throttle) rolling stand are available with Jovil Manufacturing SMC-2 equipment.

In 2017, owing to the financial support of Latvenergo JSC shareholder, equipment was supplemented in Latvenergo Student Creative lLboratory by purchasing a programmable 6 kW three-phase AC power unit, electro-automatic EA-ACP3P 520-16.8-6000-20U f 45-450.

In 2017, scientific research equipment was purchased, such as smart network, industrial robots, human and environment interaction research equipment consisting of a physical motion simulator system (based on an industrial robot boom with lifting capacity from 500 kg), a robot boom assembly (with integrated video projection equipment and controls), which is compatible with a system simulation and can use computer data exchange protocols (EtherCat, etc.), and a physical grid emulator with an integrated HIL system and electrical unit measuring equipment (system power 200 kW, at least 6 (with the possibility to expand to 12) free programmable channels for power flow management as a source in its load mode, with integrated software support for the simulation of power grids, drives, solar panels).

In 2020, the Ergonomic Electrical Technology Research Laboratory joined the Institute. The Laboratory promotes interdisciplinary research, integrating the developments of materials science, electrical engineering, electronics and anthropometrics in ergonomic applications. Creating innovative and completive environment, it is possible to attract young researchers offering them opportunity to develop their PhD Theses for promotion of new research, creation of new products and services to promote sustainable development of Latvia in cooperation with the industry. In the process of studies, students have opportunity to conduct research in the fields of anthropometry and ergonometry using the equipment available at the laboratory (Vitus Smart XXL

3D scanner, traditional measuring equipment used in anthropometrics, twin-axis goniometer for measuring movement amplitude, relevant software).

All the equipment and laboratories mentioned above have been successfully used in the study process, students' research, and in the development of graduation papers.

The infrastructure and technical support available for the implementation of the study programme, thanks to a high level of digitization, provide an opportunity to increase the competitiveness, quality, and efficiency of the University, as well as the availability of information, by integrating information technology (IT) solutions into the University's administrative, study and research work processes, providing students, administrative and academic staff with modern, reliable, secure and integrated IT infrastructure and high quality IT services.

To ensure easy and efficient identification of IT users, an IT user identity management system has been introduced; as a result, each IT user has a unique electronic identity that is valid in all information systems. In addition to the aforementioned, a user session management system is ensured in IT systems, which means that there is no need for IT users to re-authenticate when logging in to RTU information systems. It gives the experience of using a unified integrated information system without having to memorize different identification data and re-enter them, implementing different IT application scenarios.

All IT users are provided access to the centralised portal ORTUS (https://ortus.rtu.lv), which functions as a single digital gateway, combining information from all RTU information system components and providing users with an easy-to-use way of accessing the directory of all IT services in one place.

The Centralised Study Management System is used for efficient administration of the study process, which ensures digital provision of the study life cycle, incl. Electronic Register of Study Programmes (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub), drawing up learning agreements and enrolment of students in study programmes, Register of Study Courses (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub), designing student's individual study plans, drawing up orders, implementing study courses and study process, registering grades, recognising study courses, awarding qualifications, administering payments, hostel information, gathering information to issue diploma supplements, etc. This system is one of the main cornerstones in the administration of RTU study process.

To ensure effective implementation of the study process, Moodle e-learning system is used, where all relevant information is compiled in an automated way (study courses, users, groups, access rights, etc.). This system ensures student-instructor communication. The academic staff members place various electronic materials, assessment tests, homework assignments, information on a particular study course, etc. in the system. Students can also view their financial information on the ORTUS portal, as well as make request for documents (references, transcripts of records, copies of a learning agreement, etc.).

Since 2007, more than 130,000 unique study course sites have been generated in the e-learning environment of RTU. Students can access electronic learning resources anytime and anywhere.

Digitisation of classrooms and schedules has been carried out to ensure efficient premise management and study planning (https://telpas.rtu.lv; https://nodarbibas.rtu.lv/). Each RTU student and academic staff member can access their schedule, which provides information on the venue, time, instructor, room, title and type of lecture. In addition, for user's convenience purposes, the system greatly facilitates lecture planning and scheduling, as well as optimises the use and efficiency of premises.

Electronic Staff Management and Record-keeping Systems, which cover the circulation of record-keeping and personnel documents at RTU (https://docs.rtu.lv/), are also used to ensure the efficient administrative work. Electronic document coordination and document e-signing functionality have been introduced, thus reducing print-based document circulation and significantly increasing document circulation speed. Since autumn semester of 2019, students have been provided with electronically signed learning agreements. Since 2016, RTU graduates have been receiving electronically signed transcripts of records.

In terms of quality assurance, a digital student survey system is used, with the help of which the quality control of study courses and study programmes is implemented each semester. Based on the results of quality control, regular measures are taken to improve study programmes and the study process, in general.

For additional convenience of RTU students, academic and general staff members, RTU leases Microsoft Windows and Microsoft Office software, which provides all IT users with access to the latest Microsoft software. RTU students can use the licensed Windows operating system and the Microsoft Office productivity suite provided by RTU for study needs. All IT users have access to Microsoft Office 365 cloud computing platform with one terabyte of storage space available to each user and access to a variety of additional collaboration and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic and general staff have access to the University's email system.

To support research activities, RTU has developed the Centralised Research Support System, which records all information on publications, patents, commercialisation applications, Doctoral Theses, RTU scientific journals, research staff, etc. The system provides access to information according to Open Access principle (https://science.rtu.lv). RTU students and academic staff also have centralised access to research software.

RTU has the high-speed fibre optic Internet and extensive wireless network infrastructure with over 400 access points, including the international *Eduroam* service. In addition, desk phones and mobile communications are provided for fast and easy communication.

To ensure a stable and secure operation of the information technology infrastructure, continuous monitoring of the IT infrastructure and systems is performed, resulting in proactive incident control. Data backup is also ensured.

The Information Systems Security Policy has been developed and implemented with the primary goal of ensuring the secure use of RTU information systems by establishing and maintaining a sufficient set of measures to reduce or prevent potential or resulting harm. Implementation of the Information Systems Security Policy envisages security checks, data transmission network monitoring, as well as preventive measures. Regular IT security and personal data protection training is organised for IT users. Automated security incident management and risk management have been implemented. Statistics demonstrate that the number of IT security incidents dropped significantly 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.

The University library plays a major role in providing methodological and information support to the students. The Scientific Library of RTU (https://www.rtu.lv/en/studies/scientific-library) is an academic library of state significance, which has obtained its status as a result of library accreditation. The Scientific Library of RTU provides the necessary information for RTU study process and research activities, performs library, bibliographic and information services for RTU students, teaching staff, and employees. The Library's collection includes 1.4 million printed documents and e-resources in the databases relevant to RTU fields.

In 2016, significant investment was made in the development of the library infrastructure, with the construction of an additional 2240 m2 of space for the Central Library. The total area of the library premises is 6393 m2, of which 3417 m2 are for reader services. There are 713 workstations for library users. The library has four group rooms and six individual cubicles, a Western reading room and a conference room. The library is accessible to users with reduced mobility.

To improve the work of the Scientific Library of RTU and to ensure the availability of information needed for study and research work, the Library Council has been established, which decides on the replenishment of the library's collection with printed publications and subscriptions to the necessary databases. The Library Council has approved the "*RTU SL Collection Completion Policy*", which defines the basic principles of collection formation and development in accordance with the fields of RTU study and scientific activities.

When RTU provides funding for the library, the funding for information resources for each study programme is calculated. The collection is replenished according to the recommendations of the heads of study programme, researchers, and the allocated funding. The desired titles can be ordered by contacting the Library's Collection Development Department, ordering on the Library's website, filling in the order form, filling in the application form, by phone 67089353 or by visiting the Library at Paula Valdena 5-105. The Scientific Library offers a guide to ordering titles and e-resources, which brings together the websites of various publishers and bookshops in Latvia and abroad.

Database subscription contracts are concluded both directly with the supplier and through the "Cultural Information Systems Centre" state agency, which is the Latvian national representative of the international non-profit organisation EIFL (Electronic Information for Libraries, http://www.eifl.net/). The EIFL Licensing Programme offers national libraries subscriptions to internationally recognised databases at significantly reduced subscription fees not offered to individual subscribers, thus saving financial resources of the libraries.

The database subscriptions maintained by RTU Scientific Library

(https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/abonetas-datubazes):

- ProQuest Ebook Central, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, EBSCOhost eBook Academic Collection, Wiley Online Library, SpringerLink, The International Monetary Fund.
- Databases financed by the Ministry of Education and Science available to RTU Scientific Library: ScienceDirect, SCOPUS (Elsevier), Web of Science.
- Latvian databases: LETA, Letonika, the Database of Latvian Standards (available on the premises of the Library).

Database usage at the Scientific Library of RTU has been growing since 2016. E-resource loans have increased from 75,391 to 525,194 items.

The new library premises have allowed to extend the range of services. Since the opening of the new premises in 2018, the number of visits to the library has increased from 103,825 to 235,600. The Scientific Library of RTU is open to everyone. The Central Library is open to users from Monday to Saturday. There is a 24/7 reading room. During the summer period, the Central Library is open every weekday with reduced opening hours. (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3).

The library sources are housed in an open-access collection. The last copies of the oldest publications corresponding to the RTU profile are kept in the library repository. They are always available to the users.

The librarian on duty helps visitors find their way around the collection. Bibliographers (information specialists) provide more detailed information and advice. The library has a branch librarian service. (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija).

The library resource search is supported by the Primo Discovery search tool (https://www.rtu.lv/lv/studijas/biblioteka/vienota-informacijas-meklesana). It allows searching the library catalogue (https://kopkatalogs.lv/F/?func=find-b-0&local_base=rtu01), the subscribed databases, as well as databases created by the RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes) in one interface. Searching for information in the electronic joint catalogue (https://kopkatalogs.lv/F), it is possible to simultaneously obtain information on the resources available in 12 Latvian libraries. Both the electronic catalogue and the RTU portal ORTUS allow remote reservation of library resources, as well as remote access to the databases. Since the introduction of RFID technology, users can use five self-service book-dispensing machines and check out books from the pick-up machines around the clock.

The library provides students, academic personnel and other stakeholders with various levels of individual consultations and group training in information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas).

Publications not available in the library are delivered via an interlibrary loan or an international loan. Internet access is available throughout the library. The library has copying, scanning, printing, binding services and a self-service dining room.

During the reporting period 118 textbooks and 15 electronic books totally amounting to 133 study materials were purchased for the program acquisition.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

The implementation of the study programme is ensured by the academic staff of RTU FEEE IEEE – professors and associate professors, each of whom is an expert in their field.

Academic staff from partner universities abroad are invited to participate in the implementation of the study programme, as well as industry professionals provide classes that are orientated more towards practical tasks. Partners from Tallinn University of Technology, RWTH Aachen University, the University of Duisburg-Essen provide onsite and online lectures and practical/laboratory classes.

According to the aims of the study programme, the primary criteria for the selection of academic staff are (a) knowledge of the latest technologies and participation in scientific and research projects in their fields, (b) pedagogical skills relevant to current trends in the field, and (c) experience in academic courses to foreign students in English.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The qualification of the academic staff implementing the study programme complies with the requirements specified in Section 39 of the Law on Higher Education Institutions, as well as the indicators and regulations specified in Chapter IV of the Law on Higher Education Institutions. The compulsory part and the limited electives part of the study programme are implemented by 11 professors and associate professors with many years of experience in electrical engineering, electronics, process automation and other fields related to the study programme, who have been elected to academic positions at RTU structural units and are experts in their field approved by the Latvian Council of Science, as well as their scientific and pedagogical qualification complies with the criteria specified for the scientific and pedagogical qualification. The qualification of the academic staff corresponds to the necessary requirements for the implementation of the study courses of the study programme, which is evident in their curricula vitae. All instructors involved in the study programme are very active in their scientific research and methodological work, all have publications in SCOPUS and WEB of Science resources and have high citation rates. They regularly participate in international conferences, research projects and supervise students' research. There is a constant qualification improvement of the academic staff, as well as improvement of their methodological and scientific developments. All 11 professors and associate professors are constantly working with foreign students and improving their English language skills.

The implementation of the study programme is ensured by the academic staff of RTU FEEE IEEE – professors and associate professors, each of whom is an expert in their field.

Academic staff from partner universities abroad are invited to participate in the implementation of the study programme, as well as industry professionals provide classes that are orientated more towards practical tasks. Partners from Tallinn University of Technology, RWTH Aachen University, the University of Duisburg-Essen provide onsite and online lectures and practical/laboratory classes.

According to the aims of the study programme, the primary criteria for the selection of academic staff are (a) knowledge of the latest technologies and participation in scientific and research projects in their fields, (b) pedagogical skills relevant to current trends in the field, and (c) experience in academic courses to foreign students in English.

In order to ensure the quality of the study content, the academic staff involved in the implementation of the programme regularly improve their professional and academic knowledge at methodological seminars, conferences (national and international), as well as in scientific and research work (see List of publications of academic staff for the reporting period), participate in various scientific and methodological projects.

The involved academic staff actively benefit from international cooperation mobility programmes. For example, from 2014 to 2019, Prof. Ribickis visited the following universities: in 2014 - Moscow State Technical University, Chennai University, Delhi University, Autonomous University of Barcelona, University of Catalonia, Technical University of Valencia, Bordeaux University, Paris Tech University, Compiègne University, University of Florence, Lausanne Polytechnic University; in 2015 - Lausanne Polytechnic University, University of Moratuwa (Sri Lanka), University of Colombo (Sri Lanka), University of Antwerp, Holon Institute of Technology, Technical University of Wroclaw; in 2016 - Czech University of Life Sciences, Prague, Lodz University of Technology, Royal Institute of Technology, Sweden, Blackburn University; in 2017 - University of Malaga, University of Granada, University of La Laguna, University of Bergen, University of Porto, University of Ottawa, Polytechnique Montréal, Leiden University, Aalborg University, Muhammed V University in Rabat, Budapest University of Technology and Economics; in 2018 - Kumamoto University, University of Tokyo, Tokyo Denki University, Waseda University, Tallinn University of Technology, Palackas University, University of Madeira, University of Las Palmas de Gran Canaria, Kyungook National University, National Taiwan University of Science and Technology, WuFeng University, University of Duisburg Essen, University of Bucharest, LaSapienza University, University of Turku, Swiss Federal Institute of Technology, University of Bucharest; in 2019 - University of Trieste, University of Padova, University of Bergamo, Polytechnic University of Turin, University of Oulu, Albert Einstein University (Mexico), Monterrey Institute of Technology and Higher Education (Mexico), University of Peru, University of San Ignacio de Loyola (Lima), Catholic Pontifical University of Peru, Catholic University of Santiago del Estero, Tsukuba University (Japan), Shizoko University (Japan), University of the Azores, Alto University, Université Libre de Bruxelles, Vilnius Gediminas University, Mykolas Romeris University (Lithuania).

In 2013 and 2014, Professor Anastasija Žiravecka and Assistant Professor Svetlana Andrianova participated in the ERSAMUS+ staff mobility programme and visited the University of Ljubljana and Varna Technical University for an exchange of experience. In 2020, the head of the study programme Professor L. Ribickis, Professor A. Žiravecka, Researcher A. Avotiņš, with the Doctoral students involved in the academic process visited Aalborg University. Professor N. Kunicina visited Berlin University of Technology, Germany in 2014, Kaunas University of Technology, Lithuania in 2018. In 2019, Professor O. Krievs undertook internship at Ltd. EK Sistēmas within the ESF project SAM 8.2.2 – “Improvement of professional skills on the latest industrial automation technologies in academic year 2019/2020”. In 2018, he visited the Robotics Laboratory of the University of Duisburg-Essen and attended lectures (16 hours) on the use of industrial manipulator motion control software.

Mobility of academic staff, international scientific cooperation within projects, as well as publications ensure that the programme content changes and teaching methods are in line with the latest trends in the world, thus helping achieve the aims and learning goals of the study programme.

Pedagogical methods used in the implementation of study courses, as well as assessment forms and methods are selected by the instructors responsible for the study courses in compliance with course curriculum and specifics of the programme, as well as student needs. Seminars and course on the modern teaching and pedagogical methods are organised for academic personnel, career advancement courses are also organised both at the faculty and on RTU level, as well as internationally.

The Centre for Academic Excellence (teaching and learning centre) was established at RTU in order to support RTU academic staff (in the areas of pedagogical, intercultural communication and self-development).

The main tasks of the Centre for Academic Excellence are as follows:

- to organize various educational events, such as seminars, thematic series of events, guest lectures, conferences, discussions with the participation of the Latvian and foreign specialists;
- to coordinate experience exchange activities within faculties and other organizational units;
- to inform (including posting to ORTUS) the academic staff about the latest teaching and learning trends that are appropriate for RTU;
- to provide guidance to academic staff on the use of teaching and learning methods, as well as on the assessment of students' knowledge, skills and competence;
- to inform students about learning opportunities, such as platforms, systems, applications, effective methods and forms of learning that can be used both in the study process and individually.

Each semester, a core set of activities is offered taking into account the professional competence and needs of the academic staff, which are identified through a survey, in which the lecturers indicate the most important topics and areas in which they want to improve themselves. Student surveys data and information from student self-governments are also evaluated, to gain some topics which should be improved for lecturers from students' point of view. At the same time, proactive actions are being taken to assess the potential needs of academic staff.

The Centre for Academic Excellence organizes two methodological conferences a year. The conference organized in the autumn semester is dedicated to the modern content of the study courses, while the conference held in spring focuses on modern teaching and learning methods. Materials of all events are available on ORTUS within the study course "Materials of the Centre for Academic Excellence".

After each professional development event, participants complete assessment questionnaires, which enable organizers to improve the range of offered events. In order to promote the development of competences of the academic staff, the student surveys are analysed each semester, as well as discussions with the representatives of faculties, student self-governments and the instructors themselves take place.

Educational events are also organized by the Career Support and Services Unit, providing regular seminars to RTU academic and general staff on the following issues:

- cultural diversity;
- work productivity (time planning, conflict resolution, communication culture, stress management etc.);
- critical thinking.

For participation in seminars, employees receive professional development certificates issued by RTU Department of Further Education.

The themes of seminars and classes are offered taking into account the results of RTU staff surveys, as well as current trends at foreign universities. Information on seminars organized over the years is available at http://karjera.rtu.lv/projekti/seminaru-un-vieslekciju-arhivs/ in Latvian.

Academic personnel participating in study programme implementation regularly take part in the career advancement events organised by RTU Trade Union, Student Parliament, Department of Study and Curriculum Design, IEEI also regularly organises career advancement activities for its academic staff.

Academic personnel at the department maintain regular contact with the staff of related study programmes implemented at Lithuanian and Estonian technical universities.

Professor I. Raņķis underwent internship at KTH Royal Institute of Technology in Stockholm, and prof. I. Galkins – at Professor's group of power electronics of Tallinn University of Technology. Professor L. Ribickis is a member of the board of *Power Electronic* and *Power Electronic and Motion Control* councils and constantly maintains coordinating links with the representatives of these fields in various European universities.

For many years, IEEI in cooperation with FEEE organise *International Doctoral School of Electrical Engineering and Power Electronics*. Guest lecturers and PhD students from partner universities participate in this event.

Professor Leonīds Ribickis holds a Doctoral degree in engineering. Alongside his academic, scientific and organisational activities, he is actively involved in Latvian and global scientific organisations, contributing to the development and improvement of the power and electrical engineering sector. He has more than 40 years of experience in higher education: study process management, scientific research, project management. Leonīds Ribickis is an academician of the Latvian Academy of Sciences and an expert in the field of engineering and technology - electrical engineering, electronics, information and communication technologies, as well as a member of RTU Senate and the Council of RTU Faculty of Electrical and Environmental Engineering, Chairman of RTU Promotion Council in Electrical Engineering, Chairman of RTU Council of Professors in Electrical Engineering. He has co-authored more than 600 publications, including 21 monographs and 77 patents on the following topics: electrical engineering, electronics, electrical drives, technological process and motion control, industrial robot equipment; semiconductor power converters, power electronics equipment and their control systems; energy efficiency of electrical equipment, smart DC networks; electric transport and e-mobility; electromechanical converters, AC and special electrical machines; alternative energy systems. He supervises Bachelor, Master and Doctoral Theses in subjects related to electric drive systems, industrial electronics and control systems for power electronic converters. He managed and executed more than 50 international and national projects related to scientific research.

Professor I. Raņķis carries out scientific work in the field of design and optimisation of DC electrical drives for electric trains, industrial and public electric transport. Raņķis has worked with both full-time and part-time students, as well as delivered study courses to foreign students in English. He has also been a guest lecturer at Tallinn University of Technology and a trainee at the Royal University of Technology in Stockholm. He has supervised the internship of young lecturers of electrical engineering subjects at Vilnius Gediminas University and Riga Technical University. Raņķis has been active as a scientific adviser of students' qualification papers, i.e., engineering projects (50), Bachelor Papers (30), Master Theses (40). Prof. I. Raņķis has supervised 9 Doctoral Theses in engineering.

Professor I. Raņķis is active in the field of science. His research interests include the development and study of energy storage systems in active cooperation with various enterprises, the study of pulse regulation systems for AC electrical systems, and the study of the efficiency of the application of non-linear inductances.

In general, Prof. I. Raņķis purposefully improves his qualification, actively cooperates with young engineering specialists, is able to confidently help students overcome study difficulties and problems and promotes students' professional growth. He is a very effective member of the student learning system.

Professor Oskars Krievs holds a Doctoral degree in the field of power electronics and has 20 years of academic experience in electrical engineering and power electronics. During this period, O. Krievs has led or participated in 16 scientific projects, including two international ones. Since 2020, O. Krievs has been the Dean of the Faculty of Electrical and Environmental Engineering at RTU, and from 2011 to 2020 - Dean of the Faculty of Power and Electrical Engineering at RTU. Currently O. Krievs delivers 3 study courses in the field of electrical engineering, but in total he has developed or participated in the development of more than 10 study courses. To improve his qualifications, O. Krievs has participated in 36 international scientific conferences, as well as undertaken internships at the Polytechnic University of Turin (2007), University of Duisburg-Essen (2018) and Ltd. EK Sistēmas (2020). In 2019, O. Krievs received the award of the Latvian Academy of Sciences for the most significant achievements in science, and in 2017 - the annual award of the Latvian Academy of Sciences and JSC Latvenergo for significant contribution to the field of power engineering. Since 2019, O. Krievs has been a member of the Latvian Association of Power Engineers and Energy Constructors.

Professor I. Galkins holds a Doctoral degree in Electrical Engineering, which he obtained in 2001 for his Doctoral Thesis "Design and Research of Matrix Converters". He has more than 20 years of experience in the participation and management of national and international projects. He is currently leading or has led from 2001 to 2021 more than 10 projects with a total budget of around 2 million EUR. Several years of research experience - author of 3 books and 88 articles related to power electronic converters, electrical drives and electrical devices for orthopaedic applications, as well as 6 patents. I. Galkins' h-index in SCOPUS database is 11, his 88 articles have been cited 364 times. He conducts research in the field of power electronics, including lighting and medical electrical equipment. He has been the scientific adviser of 6 successfully developed Doctoral Theses in the field of electrical engineering and the reviewer of 4 Doctoral Theses. He has several years of experience in the field of education as well as in the management of the study process. He has developed and delivered 15 study courses. He has supervised 36 graduation papers. He is the chairman of IEEE - Professional Electrical Engineers Society, a joint chapter of IEEE Latvia IAS/IES/PELS. He is an expert of the Latvian Council of Science in Electrical and Power Engineering. He is the Editor-in-Chief of RTU Scientific Journal on Electrical, Control and Communication Engineering.

Anastasija Žiravecka, Dr.sc.ing., Professor. She publicly presented her Doctoral Thesis in 1999 at Riga Technical University. She has worked as an Assistant Professor, Associate Professor since 2005, and as Professor since 2014 at the Institute of Industrial Electronics and Electrical Engineering. Author of more than 90 scientific publications and textbooks related to electrical drives and their control, power electronics, energy saving. Participated in and managed local and international research and training projects - TEMPUS, ERASMUS+, ERDF. In 2014/2015 she participated and coordinated the development of the new professional Bachelor study programme "Adaptronics", in 2019/2020 she coordinated the development and licensing of the new professional Master study programme "Adaptronics". In addition, she publicly presented her Master Thesis in English Philology in 1998. She participates in, as well as coordinates the work with foreign students.

Professor Nadežda Kuņicina holds a Doctoral degree in electrical engineering and has been elected Professor of Electrical Engineering, Electronics, Information and Communication Technologies (Electrical Engineering and Automation). She holds the Expert status of the Latvian Council of Science in Social Sciences - Educational Sciences until 6 January 2024 and in Engineering and Technology - Electrical Engineering, Electronics, Information and Communication Technology until 3 September 2023. Professor Nadežda Kuņicina conducts research in the field of electrical engineering, mainly related to improving the efficiency of electricity use in industrial electronics and electric vehicles. Nadežda Kuņicina has participated in the development of study programmes, such as Erasmus plus KA 2 Applied Curricula in Space Exploration and Intelligent Robotics Systems - APPLE (2017-20); Electrical Energy Markets and Engineering Education - ELEMEND (2017-21); Innovative Approach towards a Master Program on Smart Cities Technologies - SMARTCITY (2018-21); Development of Practically-Oriented Student-Centred Education in the Field of Modelling of Cyber-Physical Systems - CybPhys (2019-22), Knowledge Triangle for a Low Carbon Economy - KALCEA (2020-23). Within the projects, academic objects and methodological tools have been developed on the following topics: innovation in information and communication technologies; introduction to the specialisation in design of energy-efficient technologies; metrology and mathematical modelling; Internet of Things and smart electrical technologies; energy saving in electrical equipment; electrical processes and equipment in biotechnology; thermal energy, fundamentals of control theory; energy efficient technologies; fundamentals of industrial computer networks; automation theory; automation elements; non-traditional non-contact electromechanical converters; non-traditional energy converter systems and storage; methods of analysis and calculation of electronic circuits. Nadežda Kuņicina develops study materials within the following study courses: “Fundamentals of Industrial Computer Networks”, “Computerization of Mathematical Tasks in Electrical Engineering”, “Elements of Automation”, “Industrial Safety”, “Control Fundamentals of Critical Infrastructures”, “Design of Adaptive Systems”, “Linear and Non-linear Systems”.

Associate Professor Aivars Pumpurs holds a Master degree in engineering (M.sc.ing.). After completing his studies, he has more than 15 years of practical work experience in manufacturing related to the development and operation of electronic and automation equipment. He has participated in several research projects and scientific conferences. He has more than 20 years of academic experience: delivering lectures, supervising laboratory work and graduation papers, and developing a number of study courses. He has completed his Doctoral studies and is currently working on his Doctoral Thesis. He continues to keep abreast of trends in automation processes, reading the latest literature and putting into practice the knowledge acquired in the process of training students, both in theory and in laboratory work.

PhD student, Researcher and Lecturer Armands Šenfelds holds a Master degree in electrical engineering from Riga Technical University and a Master degree in electrical engineering from RWTH Aachen University in Germany. He continues his Doctoral studies at RTU and carries out research work in the fields of robotic production systems, their energy efficiency and DC power supply system applications. Professional experience is related to the development of energy-efficient technological solutions for robotic applications in manufacturing, in cooperation with industrial partners Daimler AG, KUKA GmbH, Siemens AG. He is a member of the Institute of Electrical and Electronics Engineers (IEEE) and Deputy Head of the Latvian Section. Member of the Latvian Alumni Board of the Latvian-German Academic Exchange Service (DAAD). He is active in international research cooperation and exchange of study experience with universities in Germany (RWTH Aachen, Universität Duisburg-Essen, Stuttgart University), Denmark (Aalborg University) and the Baltic States.

Pēteris Apse-Apsītis hold a Doctoral degree in engineering. He has more than 50 years of industrial and scientific research experience in electrical engineering, electronics, ICT, automation, printing, papermaking, audio-visual arts and automotive technology in Latvia and abroad. In total, he has managed and implemented more than 300 projects, including international ones, for various equipment and systems. Author and co-author of several patents and dozens of scientific publications. He received the Annual Award 2018 named after Professor Alfreds Vitols from Latvenergo JSC and the Latvian Academy of Sciences. Expert of the Latvian Council of Science.

Professor and Senior Researcher at the Institute of Industrial Electronics and Electrical Engineering, Riga Technical University.

Visiting Lecturer Dāvis Meike holds a Doctoral degree in engineering and is a Planning Engineer in the manufacturing industry. His Doctoral Thesis is on energy efficiency in industrial robotics. His research areas include highly automated manufacturing systems, power transmission in direct current (DC) grids and related technologies, consumption and flow optimisation, as well as general industrial automation. In these areas, D. Meike has coordinated both publicly co-funded international research projects and product development in the private sector. He is the author of more than 20 peer-reviewed scientific publications and patent articles.

Professor Mihails Gorobecs holds a Doctoral degree in electrical engineering and a Master degree in Information Technology. He has more than 15 years of academic and research experience. Since 2012, M. Gorobecs has been an expert of the Latvian Council of Science in the field of Electrical Engineering, Electronics, Information and Communication Technologies (i.e., in computer control of industrial processes, motion control and optimisation using artificial intelligence equipment and methods). His main research interests are embedded software engineering, computer control of transportation systems, embedded intelligent electrical devices, decision support methods in transportation systems, adaptive systems and methods, genetic and evolutionary algorithms, neural networks, fuzzy logic control methods, railway transport control, safety and optimisation methods, computer control of unmanned electric vehicles, mathematical and simulation modelling of systems. M. Gorobets has more than 10 years of experience in managing various international and national projects in the field of electric and railway transport. He is the author of several textbooks, methodological tools, and patents.

Overall, the qualification of all the teaching staff comply with the conditions of implementation of the study program and the requirements of laws and regulations, as well as ensures attainment of the program goals and study outcomes, which is attested by their qualifications and CV's.

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

4.5. Provide examples of the involvement of the academic staff in the scientific research

and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

The academic staff involved in the implementation of the study programme participate in academic and scientific conferences. They are engaged in various projects and develop scientific publications. Data on the involvement of the academic staff in scientific research are presented in the list of publications of the academic staff during the reporting period.

All academic staff participate in or lead various types of international and local research projects, such as ERDF, FLPP and others. Academic staff also participate in international ERASMUS+ projects, developing new courses and textbooks. The results of the projects are regularly reported in conference and journal publications and used in their pedagogical work - lectures, seminars, other activities with students, as well as in academic tools and monographs. Many of the graduation papers are written in the framework of the projects and on the scientific activities and results of the projects. The list of projects carried out is available in Annex 13.

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

In order to ensure integration among the study courses, each year all study courses are checked for compliance. Seminars are organised, where the academic staff implementing the study programme inform colleagues on the themes of the study courses, teaching mythology and discuss improvements that would ensure hight quality of the curriculum of the study programme and make it in line with the topicalities of the respective field.

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	Information.txt	Informācija.txt
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	6.pielik_Atbilstība valsts izglītības standartam REGA0_EN.docx	6.pielik_Atbilstība valsts izglītības standartam REGA0_LV.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)	7. pielikums Atbilstība profesijas standartam REGA0.doc	7.pielikums_Vad.Elektroinženieris_REGA_2.doc
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	6.pielik_Atbilstība valsts izglītības standartam REGA0_EN.docx	8.pielik_REGA kartējums_LV.xlsx
Curriculum of the study programme (for each type and form of the implementation of the study programme)	REGA0_plānojums_pilna laika_ENG.xlsx	9.pielik_Studiju programmas pilna laika studiju plānojums_REGA0.docx
Descriptions of the study courses/ modules	REGA_course_ENG.zip	REGA0_kursu apraksti LV.zip
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	REGA0_diploms_ENG.zip	REGA0_diploms LV.zip
Description of the Study Programme - Other mandatory attachments		
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	Confirmation of the possibility to continue education MSP (1).pdf	apliecinājums par studiju turpināšanas iespējām.edoc
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	Apliecinajums - Par zaudējumu kompensaciju.edoc	Apliecinajums - Par zaudējumu kompensaciju.edoc
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.	Apliecinājums - Svešvalodu prasme.edoc	Apliecinājums - Svešvalodu prasme.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education		
Sample (or samples) of the study agreement	Sample_of_study_agreements.zip	Studiju līgumi.zip
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.		