UL FACULTY OF BIOLOGY

AND

RTU FACULTY OF CIVIL ENGINEERING

Study fields

WILDLIFE SCIENCE

AND

CHEMISTRY, CHEMISTRY TECHNOLOGIES, AND BIOTECHNOLOGY

Joint study programme

BIOTECHNOLOGY AND BIOENGINEERING

SELF – ASSESSMENT REPORT

Director of Study programme Didzis Elferts (UL) and Tālis Juhna (RTU)

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I. INFORMATION ABOUT THE STUDY FIELD

1. Aims and tasks of the study field

The joint (University of Latvia and Riga Technical University (hereinafter referred to as RTU)) academic bachelor's study programme "Biotechnology and Biotechnology" at the University of Latvia (hereinafter referred to as UL) is included in the accredited study direction "Wildliife Sciences".

The aim and tasks of the "Wildlife Sciences" study field have been developed in line with the scope of the UL, strategic development directions, societal and economic development needs and development trends, as determined by the "University of Latvia Strategy 2021-2027" approved by the UL Senate on June 28, 2021. The UL Strategy states that UL contributes to science, higher education, innovation processes. The development lines of UL are scientific excellence, the development of studies and the contribution to society. The UL Strategy and the objectives and aims of the study field are based on external documents such as "Latvia's National Development Plan for 2021-2027" (approved by the Saeima on July 2, 2020), which includes actions such as Excellence in Science for Public Development, Economic Growth and Security, and Productivity and Innovation, promoting developments in smart specialisation areas. in areas. "Science, Technological Development and Innovation Guidelines 2021-2027" (Cabinet of Ministers Order No 246) provides for the development of a knowledge base and the creation of new knowledge for the provision of high-quality and post-industrial education, the promotion of research excellence, and the development of new technologies for the design of innovative products and services.

The aim of the "Wildlife Sciences" study field is to prepare bachelor's, master's and doctorate level specialists in biology and biotechnology to provide the country with the necessary specialists in priority research directions and economic areas. Tasks of the "Wildlife Sciences" study field:

1) developing and improving the supply of innovative and research-based studies by promoting the participation of students in research at all levels of education;

2) to promote the development of interdisciplinary and international study programmes by promoting the mobility of students and teaching staff;

3) to promote scientific cooperation in the pursuit of cross-disciplinary and international research projects, to encourage the involvement of staff and students in the creation of innovation;

4) to promote the promotion and transfer of natural science achievements and knowledge to the public;

5) to promote the development, growth and renewal of academic staff;

6) promote professional and academic prestige in the natural science sector.

RTU study field "Chemistry, Chemical Technologies and Biotechnology" includes five study programmes: academic bachelor study programmes "Chemistry and Chemical Technology", "Biotechnology and Bioengineering", academic master study programme "Chemistry and Chemical Technology", second level professional higher education study programme "Industrial Pharmacy" and doctoral study programme "Chemistry, Materials Science and Engineering". The aim of the study field is to provide the Latvian economy with comprehensively trained specialists in chemistry, chemical technology, biotechnology, pharmacy, and materials science to be able to work at various public and private sector institutions, as well as to promote graduates entering the labor market and stimulate business or research, engaging in job creation and maintenance. The goals of the study field are clearly defined and achievable. The study field and the corresponding study programmes correspond to the strategic development areas of the university, the needs and development tendencies of the society, and the national economy. The management structure of the study field and the corresponding study programmes is oriented toward the development of the study field. Decision-making process is efficient, and the support provided by the administrative and technical staff ensures all the needs of the study programmes corresponding to the study field. Being aware of the role of RTU in shaping the future of Latvia and the growth of the Baltic Sea region, the priorities of the European Union and the guidelines of the sector regulatory directives, as well as national and regional level education and innovation policy planning documents have been observed in the development of the study programmes.

The strategy of the study field is to promote the mutual coordination of the study programmes to be implemented within the field, emphasizing the orientation towards the jointly achieved result — quality education in the fields of chemistry, materials science, and technologies. The long-term plans of the study field include working on the development of joint international study programmes and modules and attracting foreign students and lecturers.

The study field combines academic and professional study programmes, which provide an opportunity to acquire theoretical and practical knowledge, skills and competencies in the fields of natural sciences and engineering, chemistry and chemical technologies and other related fields. This provides an understanding of the interplay between technical, social, and economic factors in building a sustainable industry. These principles are in line with the long-term interests of the Republic of Latvia and the strategic guidelines of RTU.

The activities of the study field promote the implementation of the keynote of the Strategy of Riga Technical University for 2021 – 2025: High quality and efficiency – proactive integration of RTU activities with the needs of the national economy. RTU is one of the leading universities of science and technology in the Baltics and Nordic Region that adopts the education system based on research, innovation and cooperation with the industry as the foundation of its activities. RTU educates and trains engineers competitive on the European and global scale – leaders, developers of new technologies.

2. Study programmes included in the study field

Study programmes included in the UL study field "Wildlife sciences"

No.	Name of the Study programme	NKI/EQF	The degree to be awarded, professional qualifications/degree and professional qualifications	Volume (CP; ECTS)
1.	Academic bachelor SP* "Biology"	6	Bachelor of Natural Sciences in Biology	120 CP; 180 ECTS
2.	Joint academic bachelor SP "Biotechnology and Bioengineering"	6	Bachelor of Natural Sciences	120 CP; 180 ECTS
3.	Academic master SP "Biology"	7	Master of Natural Sciences in Biology	80 CP; 120 ECTS
4.	Doctoral SP "Biology"	8	Doctor of Science (Ph.D.) in Biology	144 CP; 216 ECTS
5.	Doctoral SP "Natural sciences"	8	Doctor of Science (Ph.D.) in Biology, or Doctor of Science (Ph.D.) in Physics and astronomy, or Doctor of Science (Ph.D.) in Material Science, or Doctor of Science (Ph.D.) in Chemistry, or Doctor of Science (Ph.D.) in Earth Sciences, Physical Geography and Environmental Sciences, or Doctor of Science (Ph.D.) in Social and Economic Geography	144 CP; 216 ECTS

*SP – Study programme

Study programmes included in the RTU study field “Chemistry, Chemistry Technologies, and Biotechnology”

No.	Name of the Study programme	NKI/EQF	The degree to be awarded, professional qualifications/degree and professional qualifications	Volume (CP; ECTS)
1.	Joint academic bachelor SP „Biotechnology and Bioengineering”	6	Bachelor degree in natural sciences	120 KP; 180 ECTS
2.	Academic bachelor SP „Chemistry and Chemical Technology”	6	Bachelor degree of engineering science in chemical technology	160 KP; 240 ECTS
3.	Academic master SP “Chemistry and Chemical Technology”	7	Master degree of engineering science in chemical technology	80 KP; 120 ECTS
4.	Doctoral SP „Chemistry, Materials Science and Engineering”	8	Doctor of Science (Ph.D.) in Chemical Engineering	192 KP; 288 ECTS
5.	Second level professional higher education programme “Industrial Pharmacy”	6	-/Industrial pharmacist	60 KP / 90 KP

3. Relevance of the study programme to be included in the study field accreditation form

The joint academic study programme "Biotechnology and Bioengineering" (hereinafter referred to as the study programme) is in line with the study field "Wildlife Sciences", as biology courses represent around 40% of the overall volume of the study programme, as well as 12% of other science courses. In comparison, the proportion of engineering courses is around 20%. In addition, biotechnology is taken into account in general terms (not limited to specific industrial biotechnology, medical biotechnology or agricultural biotechnology) related to biology, more specifically with its subfields "microbiology" and "molecular biology", and other natural sciences are integrated into it.

The study programme corresponds to the direction of RTU studies “Chemistry, Chemistry Technologies, and Biotechnology” and has been developed in accordance with the Law on Higher Education of the Republic of Latvia, in conformity with the classification of Education of the Republic of Latvia. The study programme code according to the classification of Latvian education is 43421 (Regulation of Cabinet of Ministers, Nb. 322 Regulations regarding the classification of Latvian education (13.06.2017)) and has been developed in the light of the

strategic objectives of the RTU, market supply and potential demand. In the course of the study, about 40% consist of biology courses, as well as 12% of other science courses, while the proportion of engineering courses is around 20%. Students in the study programme shall acquire the knowledge, skills and competences relevant to level 6 of the European Qualifications Framework (EQF).

According to the classification of Latvian education, the study programme code is 43421[1] , and graduates of the study programme are granted a Bachelor of Natural Sciences degree.

Students in the study programme will acquire the knowledge, skills and competencies relevant to level 6 of the European Qualifications Framework (EQF).

According to the National Standards for Academic Education[2] provisions, the duration of the study programme is 120 CP and three years (six semesters, students obtain 20 CP in the semester).

The compulsory part of the study programme includes 26 study courses (including a bachelor's thesis) with 92 CP, including study courses in conformity with the Civil Protection and Disaster Management Law requirements and the Environmental Protection Law. The restricted elective part is 22 CP, including seven study courses with 30 CP. In addition to the study program, there is an elective part of six credit points. At the end of the study programme, students shall develop a bachelor's thesis of 10 CP.

[1] MK 322 Noteikumi par Latvijas izglītības klasifikāciju (13.06.2017)
[2] MK 240 Noteikumi par valsts akadēmiskās izglītības standartu (13.05.2014)

II. CHARACTERISTICS OF THE STUDY PROGRAMME

1. Parameters describing the study programme

Title of the study programme	**Biotechnology and Bioengineering**	
Code of the study programme according to the Latvian Education Classification	**43421**	
Type and level of the study programme	*The academic bachelor's study programme*	
Level of qualification to be obtained (NKI/EQF)	*NKI 6/EQF 6*	
The volume of the study programme (CP, ECTS)	*120 KP; 180 ECTS*	
Implementation mode/form, type, duration (if less than a year, in months) and language of implementation		
full-time regular studies	*6 semesters (3 years)*	*Latvian and English*
Place of implementation	*UL Faculty of Biology, Jelgavas iela 1, Rīga* *RTU, Ķīpsalas 6B, Rīga*	
Admission requirements	**For the study programme in Latvian:** 1. Secondary education 2. The secondary education document must have a successful (not lower than 4) annual mark 1) in biology or nature science, 2) in math (or average algebra and geometry) or chemistry or physics. 3. Evaluations in central examinations in Latvian, foreign language, math, biology or physics, or chemistry. **Study programme in English:** 1. Secondary education 2. The secondary education document must have a successful (not lower than 4) annual mark 1) in biology or science, 2) in math (or average algebra and geometry) or chemistry or physics. 3. Evaluations in central examinations in Latvian, foreign language, math, biology or physics, or chemistry. 4. Having acquired secondary education in foreign countries: 1) the secondary education document must have a successful assessment (1) in biology or science; 2) in math or chemistry or physics (markings must be no lower than 6 (10 on a scale) or "almost good"); 2) English proficiency according to paragraph 1.15 of the General Conditions for UL.	

Degree, professional qualification or degree and professional qualification awarded	*Bachelor of Natural Sciences*
Professional standard, year of approval (if applicable)	*Not applicable*
The final examination at the end of the study programme	*Bachelor's thesis*
Director of the study programme	*Dr.biol., prof. Didzis Elferts, didzis.elferts@lu.lv* *Dr.sc.ing., prof. Tālis Juhna, talis.juhna@rtu.lv*

Aim of the study programme

The aim of the study program is to prepare highly qualified specialists and scientists able to compete on both the local and international scientific labour markets in the various sectors of biotechnology and bioengineering.

Tasks of the study programme

- Ensuring the possibility of learning the theoretical and practical courses of biology, as well as basic courses of mathematics, physics and chemistry;
- Ensuring the possibility of conducting in-depth courses in a relatively specialised direction of molecular or organism biology;
- Developing capabilities related to critical thinking, analysis and reasoning;
- Developing skills in the design of biotechnological equipment and processes and product development;
- Developing the skills to carry out independent studies in a selected biology subsector and bringing results into a bachelor's thesis, and obtaining a Bachelor of Natural Sciences degree.

Learning outcomes to be achieved

Knowledge:

1. demonstrate basic and specialised knowledge in the working directions related to biotechnology and bioengineering, understand the key concepts of the field and legal relationship in the context of the basic concepts of biology, other natural sciences and engineering;

2. have knowledge of intellectual property issues, professional ethical problems and requirements in the field;

Skills:

3. use modern laboratory equipment to carry out studies, analyse the results of studies, interpret them, use them in the planning of further studies and present the results of studies;

4. independently acquire, select and analyse information and use it when taking decisions and when dealing with problems in the scientific sector or in the profession related to biotechnology and bioengineering;

5. explain the knowledge gained and discuss them in a reasoned way with both specialists and non-specialists;

Competence:

6. assess the environmental and societal impact of their professional activities and participate in the development of the relevant professional field, apply scientific ethical principles in practice;

7. carry out scientific studies, from hypothesis to results, with careful data collection, analysis and presentation;

8. demonstrate a scientific approach to solving complex problems, take responsibility and take responsibility for working individually or on a team, including with specialists from other sectors, and find creative solutions in changing or uncertain circumstances;

9. displays the skills needed to commercialise the results of biotechnological studies.

Table with Compliance of the joint study programme with the requirements added as Annex 1

2. Topicality of the study programme

2.1. Justification for the establishment of a study programme and compliance with industry trends in Latvia, the European Union and the world

In UL's Wildlife Science direction, there was only one bachelor's study programme, "Biology", whose main aim was to provide students with comprehensive knowledge, skills and competencies in the biology sector and only to start specialising in one of its subsectors. In addition, this programme is available only in Latvian. Students' surveys indicated that non-readiness to labour market requirements is one of the critical points of the existing study programme ("Wildlife Science" self-assessment report 2017./2018.ac.year[3]), and students have a desire to gain narrower specialisation already during the bachelor's study programme. This is one of the aspects why it was decided to develop a new bachelor's study programme which offers the possibility of obtaining a broader knowledge and skills base that meets the requirements of the labour market.

[3]https://www.lu.lv/fileadmin/user_upload/LU.LV/www.lu.lv/Dokumenti/Julijs_2019/Augusts_2019/Dzivas_dabas_zinatnes_2018_PUB.pdf

The study programme is designed to contribute to the achievement of the objectives set out in the UL Development Strategy[4] and the RTU Strategy[5]: 1) Preparation of human resources in line with the requirements of the Latvian and EU labour market, (2) internationalisation of education, (3) the establishment/development of international study programmes, including the establishment or development of study programmes in the official languages of the EU, joint and double-degree programmes with foreign universities. The study programme also continues to contribute to the strategic objectives of UL Strategy 2021-2027[6]: 1) a unique offer of studies and a high degree of graduates' competitiveness; 2) Activities of UL as the basis for Latvia's growth. As well as the study programme, directly linked to the strategic objectives of the RTU Strategy 2021-2025: 1) excellent science; 2) quality studies; (3) sustainable valorisation and (4) institutional excellence.

In reference to the European Biotechnology Federation, the following biotechnology definitions are defined: "Biotechnology is a science-based on knowledge in microbiology, biochemistry, genetics, gene engineering, immunology, chemical technology, immunology, chemical technology, equipment and mechanical engineering, using biological objects (microorganisms, animal and plant tissue cells) and molecules (nucleic acids, protein, enzymes, hydrocarbons and others) for the industrial production of substances and products necessary for humans and animals[7]. It includes several activities, such as: red or medical biotechnology, green or agricultural and environmental biotechnology, white or industrial biotechnology, blue or marine biotechnology and grey or virology biotechnology. Thus, biotechnology can be found in essential areas such as medicine, pharmaceuticals, agriculture, environmental protection, food and chemical industry, energy, etc. According to the study conducted by *acatech*[8], the German National Academy of Science and Engineering, biotechnology is one of the leading technologies of the 21st century, including both health and production and agriculture.

Red or medical biotechnology represents more than 1700 companies and market size of more than EUR 17 billion in Europe alone. In 2015, 50% of all medicines were projected to be obtained by biotechnological means. Among the four well-established biotech centres (the US,

[4] https://www.lu.lv/fileadmin/user_upload/LU.LV/www.lu.lv/Dokumenti/LUstrat_K_04.09.19.pdf
5 https://files.rtu.lv/public/ortus/Strategija_RTU.pdf
[6]https://www.lu.lv/fileadmin/user_upload/LU.LV/www.lu.lv/Dokumenti/Dokumenti_LV/1._VISPAREJIE_DOKUMENTI/LU_strategija_buklets_2021.pdf
[7] https://www.princeton.edu/~ota/disk3/1984/8407/840724.PDF
[8] acatech (ed.) Innovation potential of biotechnology https://www.acatech.de/wp-content/uploads/2018/03/IMPULS_Biotechnologie_EN_KF_final.pdf

Europe, Canada and Australia), in 2012, the US and Europe were leaders in terms of the number of medical biotechnology companies. They comprised 1799 private and 165 public companies in Europe[9].

According to the United Nations data, the world's population is projected to grow to an average of 8.18 billion in 2024 and 10.88 billion in 2100 from 7,71 billion in 2019[10]. Thus, sufficient food security represents a new challenge in society; based on data (2017), around 811.7 million people already feel chronic hunger and are inadequately fed[11]. In addition to other agricultural technologies, green or agricultural biotechnology will also face these challenges by providing increased yields on smaller available parcels and less water available while minimising the potential adverse effects of these activities on the environment. According to data from the Zion Market Research report, in 2018, the agricultural biotechnology market volume was $32.89 billion and is projected to grow to $67.01 billion in 2025[12]. Therefore, it is already necessary to provide new specialists with innovative ideas to address these challenges.

Europe is the leading leader in white or manufacturing biotechnology, producing more than 60% of all enzymes globally. Enzymes and other microorganisms are used to make bio-products in chemistry, food, paper and printed matter, detergents, textiles and bioenergy (biogas, biofuels), etc., increasingly moving towards renewable resources. The manufacturing biotechnology sector continues to grow in the European Union. In 2010 sales of products resulting from biotechnological processes amounted to EUR 91.9 billion, representing 6.2% of total chemical sales, and a significant increase in sales by 2020 is expected to reach EUR 515 billion[13]. This raises the issue of the preparation and availability of new biotechnology specialists in the European Union, including Latvia.

Based on a communication from the European Commission, additional efforts are needed to promote growth, competitiveness and job creation in Europe, thereby reinforcing these efforts

[9] Ernst&Young. Biotechnology Industry report 2013. Beyond borders. Matters of evidece. https://www.ey.com/Publication/vwLUAssets/Beyond_borders/$FILE/Beyond_borders.pdf
[10] United Nations. Worlds population prospects 2019. https://population.un.org/wpp/Publications/Files/WPP2019_Volume-I_Comprehensive-Tables.pdf
[11] Food and Agriculture Organization of the United Nations http://www.fao.org/hunger/en/
[12] https://www.globenewswire.com/news-release/2019/07/09/1879856/0/en/Global-Agricultural-Biotechnology-Market-Will-Reach-USD-67-01-Billion-By-2025-Zion-Market-Research.html
[13] Ernst&Young. Biotechnology Industry report 2013. Beyond borders. Matters of evidece. https://www.ey.com/Publication/vwLUAssets/Beyond_borders/$FILE/Beyond_borders.pdf

at the European Council in March 2012 to support the development of key enabling technologies (KETs). Industrial biotechnology, or white, has been recognised as Key Enabling Technologies (KETs). The definition of KETs developed by the European Commission is that "KETs are a knowledge-intensive area and involve intensive R & D, rapid innovation cycles, high capital expenditure, and a highly-skilled workforce. They promote the process, innovative goods and services in all areas of the economy and are systemically important. These are multidisciplinary technologies that cover many technology areas with a tendency towards convergence and integration. KETs can help technology leaders to use research activities for commercial benefit in other areas. Based on current studies, an economic analysis of market trends and their contribution to public challenges, the following technologies were identified for EU KETs: microelectronics and nanoelectronics, nanotechnology, photonics, advanced materials, industrial biotechnology and advanced manufacturing technologies. This highlights the critical role of the biotechnology sector in delivering innovative products, new jobs and growth in the European Union[14]. In identifying the need for the development of the biotechnology segment, there is an increasing need for young, highly qualified professionals to be able to work in these sectors. The study programme will contribute by preparing young scientists able to operate both in the direction of biotechnology and bioengineering. Biotechnology knowledge requires the pooling of understanding of life sciences and technical sciences.

Comparison of study programmes:

The study programme is compared with the study programmes of two universities of the European Union, the "Science & Technology" programme of the University of Tartu and the "Biotechnology" study programme of the Vytautas Magnus University. The two study programmes in question have been selected for comparison since the study programmes are of similar specialisation and are considered direct competitors for attracting international students to biotechnology studies in the region.

The analysed study programmes analysed have SIMILARITIES:

- All study programmes offer studies in English;

[14] "Eiropas stratēģija par svarīgām pamattehnoloģijām". https://eur-lex.europa.eu/legal-content/lv/TXT/?uri=CELEX%3A52012DC0341

- All study programmes are academic programmes;
- In all study programmes, the final test is the development of a bachelor's thesis on the subject of the selected study.

DIFFERENCES:

- The duration of studies at the Vytautas Magnus University is four years, for the rest (UL and University of Tartu) is three years;
- There is a different breakdown of credits between compulsory, restricted elective and elective part courses: the UL/RTU study programme has the highest volume of compulsory part courses, the restricted elective part at the University of Tartu, and the volume of elective part courses in the Vytautas Magnus University programme;
- At the University of Tartu, both compulsory and restricted elective part study courses are arranged in study course modules;
- Specialisation in the UL/RTU study programme occurs simultaneously in biotechnology and bioengineering; in the University of Tartu study programme, students should choose one of the specialisation directions, and bioengineering and biotechnology are in each direction of their specialisation. Specialising in the Vytautas Magnus University study programme takes place mainly in biotechnology.

University/College name	University of Latvia/Riga Technical University	University of Tartu	Vytautas Magnus University
Study programme name	Biotechnology and bioengineering	Science and technology[15]	Biotechnology[16]
Study length	3 years	3 years	4 years
Volume (CP and ECTS)	120 KP (180 ECTS)	120 KP (180 ECTS)	160 KP (240 ECTS)
Study courses and comparison of their volume	Compulsory courses - 82 CP (123 ECTS) Restricted elective courses - 22 CP (33 ECTS) Elective courses - 6 CP (9 ECTS).	Compulsory courses – 48 CP (72 ECTS) Restricted elective courses – 56 CP (84 ECTS) Elective courses – 8 CP (12 ECTS)	Compulsory courses – 114 CP (171 ECTS) Restricted elective courses – 15 CP (22 ECTS) Elective courses – 21 CP (32 ECTS)

[15] Tartu Universitātes studiju programmas “Zinātne un tehnoloģijas” apraksts - https://st.ut.ee/about/
[16] Vitauta Dižā Universitātes studiju programmas “Biotehnoloģija” apraksts - https://www.vdu.lt/en/study/program/overview/260/

	Bachelor thesis – 10 CP (15 ECTS) The compulsory part of the study programme includes study courses on topics: biology (biological systems, genetics, biomolecules, cells, microbiology, metabolism), physics (biophysics), chemistry (general and physical), mathematics and statistics, information technologies, economics (economic foundations, business, teamwork), gene and cell engineering, technological processes, mechanisms, legal framework, bioethics. The restricted elective part includes study courses on medical, environmental, industrial, plant tissue biotechnology, eukaryote gene engineering, big data analysis.	Bachelor thesis – 8 CP (12 ECTS) In the study programme, study courses are organised at three levels: Level 1: compulsory study courses for all students who give a picture of physics, chemistry, mathematics, programming, molecular biology, evolution, laboratory work, systems biology, statistics, electronics, genetics. Level 2 — restricted elective courses where students are required to choose one of the three courses of the specialisation: (a) genetics and biotechnology, (b) bioengineering and robotics, (c) chemistry and material science. The corresponding courses of 48 CP should be undertaken in each of these specialisations. Level 3 — restricted elective courses of 8 CP, which offer the possibility of acquiring additional knowledge in areas related to other subfields and learning foreign languages and economic awareness. In addition, there is a part of the elective courses where study courses can be taken from other programmes or other universities.	Bachelor thesis – 10 CP (15 ECTS) The compulsory part of the study programme includes study courses on topics: mathematics, statistics, chemistry (general, analytical, organic), biology (general biology, plant and animal biology, genetics), bioengineering, biotechnology, gene engineering, biochemistry, physics (mechanics, molecular physics, electromagnetism, biophysics), engineering, electronics. Individual study courses are also intended to acquire languages and knowledge regarding the regulatory enactments of patents. The restricted elective part includes study courses on the environment and development, human ecology, physiology, pharmaceutical biotechnology, plant biochemistry, data processing and research planning, food biotechnology.
Learning outcomes	Learning outcomes to be achieved *Knowledge:* 1. demonstrate basic and specialised knowledge in the working directions related to biotechnology and bioengineering, understand the key concepts of the field and legal relationship in the context of the basic concepts of biology, other natural sciences and engineering; 2. have knowledge of intellectual property issues, professional ethical problems and requirements in the field; *Skills:* 3. use modern laboratory equipment to carry out studies, analyse the results of studies, interpret them, use them in the planning of further studies and present the results of studies;	The general objective of the curriculum is to provide the graduates with a broad-based academic education in the natural sciences, which enables continuing studies at the master's level or commencing work in professions that require basic knowledge in the field and simpler working skills, such as at monitoring centres, different technological enterprises and laboratories as a member of technologically competent lab personnel. So after graduation, students may either continue their studies in any field of natural science or work for a technology company.	Graduates of the programme will be able to: 1. Apply fundamental knowledge of biology, biological processes, and the scientific method to solve problems in biotechnology; 2. Integrate biological knowledge and concepts with the legal, ethical, and business perspectives of the biotechnology/life sciences industry; 3. Work in groups or individually to develop written and oral presentations that effectively communicate scientific concepts and opinions using language appropriate to the discipline; 4. Apply major quantitative and computational skills and tools to solve problems in the biotechnology/life sciences industry; 5. Work in biotechnological industry laboratories; 6. Plan and conduct reliable, evidence-based laboratories, field

	4. independently acquire, select and analyse information and use it when taking decisions and when dealing with problems in the scientific sector or in the profession related to biotechnology and bioengineering; 5. explain the knowledge gained and discuss them in a reasoned way with both specialists and non-specialists; *Competence:* 6. assess the environmental and societal impact of their professional activities and participate in the development of the relevant professional field, apply scientific ethical principles in practice; 7. carry out scientific studies, from hypothesis to results, with careful data collection, analysis and presentation; 8. demonstrate a scientific approach to solving complex problems, take responsibility and take responsibility for working individually or on a team, including with specialists from other sectors, and find creative solutions in changing or uncertain circumstances; 9. displays the skills needed to commercialise the results of biotechnological studies.		studies or industry-focused projects by selecting and applying methods, techniques and tools; 7. Naturally manipulate processes in the development of new medicine, food and organic substances; 8. Apply scientific methods and good experimental designs in scientific experiments; 9. Empower themselves for lifelong learning and a career in biotechnology.
Final examination	Defending bachelor's thesis	Defending bachelor's thesis	Defending bachelor's thesis

2.2. Description of the content of the study programme

The content of the study programme is formed in accordance with the objectives defined by the "Growth and employment" programme for project 8.2.1. "Creating programmes of studies promoting international competitiveness and economic development in Latvia at the University of Latvia" and based on Law On Institutions of Higher Education[17] and the UL regulation of Study programmes and further education programmes (UL Senate 24.04.2017. decision No 102) requirements for academic bachelor's programmes.

[17] https://likumi.lv/doc.php?id=37967

The study programme code according to the classification of Latvian education is 43421[18].

Students in the study programme will acquire the knowledge, skills and competencies relevant to level 6 of the European Qualifications Framework (EQF).

According to the National Standards for Academic Education provisions, the volume of the study programme is 120 CP and three years (six semesters, 20 CP for students in each semester).

The compulsory part of the study programme includes 26 study courses (including a bachelor's thesis) with a total volume of 92 CP, including study courses in conformity with the Civil Protection and Disaster Law requirements and the Environmental Protection Act. The restricted elective part is 22 CP, which includes seven study courses with 30 CP. In addition to the study program, there is an elective part of six credit points. At the end of the study programme, students shall develop a bachelor's thesis of 10 CP.

The compulsory part of the study programme (Part A) consists of the following study courses:

1. Introduction to design of biological systems 3 CP
2. Information technology 2 CP
3. Biophysics 4 CP
4. Mathematical basics of biotechnology 5 CP
5. Basic Latvian (study programme in English) or English I (study programme in Latvian) 2 CP
6. Basics of economics and management 4 CP
7. General and physical chemistry 4 CP
8. Genetics and genomics 4 CP
9. Basics in materials science and engineering 2 CP
10. Biomolecules and cells 6 CP
11. Data analysis and mathematical statistics 2 CP
12. Principles of entrepreneurship 2 CP
13. Basics in microbiology 6 CP
14. Cultivation and physiology of microorganisms 2 CP
15. Metabolism 4 CP
16. Introduction to gene and cell engineering 4 CP
17. Electrical processes and equipment in biotechnology 2 CP

[18] MK 322 Noteikumi par Latvijas izglītības klasifikāciju (13.06.2017)

18. Gene and cell technologies	4 CP
19. Mathematical modelling of metabolism	2 CP
20. Biological reactors	4 CP
21. Fermentation – product identification and purification	4 CP
22. Organisation of biotechnological processes	6 CP
23. Environmental protection for biotechnologists	1 CP
24. Civil protection	1 CP
25. Legal regulation of biotechnological processes and bioethics	2 CP
26. Biotechnology and bioengineering bachelor thesis	10 CP

Students may choose the following study courses in the restricted elective part (Part B) of the study programme:

1. Challenges in medical biotechnology	4 KP
2. Introduction to industrial and environmental biotechnology	6 KP
3. Topics in plant tissue, cell culture and agrobiotechnology	6 KP
4. Eukaryotic genetic engineering	6 KP
5. Big data analysis of nucleic acid sequencing	2 KP
6. Vertically integrated project	2 KP
7. Teamwork for business design	4 KP

Students chose elective courses centrally by enrolling in the UL or RTU information system.

The study courses in the study programme plan are arranged in such a way as to initially give students basics in biology, biotechnology, bioengineering and natural sciences (chemistry, physics, mathematics) as well as in the economy and management. In further studies, students already acquire in-depth knowledge on various issues related to biotechnology and bioengineering, equipment to be inherited, practical experience with the organisation of work in companies, and the legal framework for these processes. In restricted elective courses, it is possible for students to choose already specific examples of biotechnology applications (medical biotechnology, industry-like biotechnology, gene engineering, agro-biotechnology) or to acquire additional expertise in data processing and teamwork. The results to be achieved by study courses are defined in such a way as to ensure overall achievement of the results of the study programme, in accordance with the knowledge, skills, and competencies to be acquired. The

contribution of the results to be achieved in each course to the programme's overall results is given to the mapping of study courses (Annex 4).

2.3. List and justification of changes made to the study programme since the licensing of the study programme

Changes made to the study programme	Justification
Reduction in the number of study results to be achieved in the programme to nine	The results of studies to be achieved in the study programme have been revised to highlight only the main results expected to be achieved during the programme and avoid fragmentation of the results. As the study results changed, the mapping of study courses and results has been repeatedly carried out (Annex 4).
Changes to study course Valo1051 English I	The content of the study course has been modified so that it is consistent with the Wildlife sciences study field, with emphasis on topics specific to the field of biology and biotechnology sciences, on learning and applying appropriate terminology.

2.4. Statistical data on the students in the study programme

The implementation of the study programme started in 2020./2021.ac.year when it was possible to apply for two state-funded study places and 28 private funding study places in the single national admission. There were 173 applications for two state-funded places, 50 of which with priority 1; 86 applications for private funding study places, five of which with priority 1[19]. A total of 27 students signed a contract for studies. In 2021./2022.ac.year, the single national admission for two state-funded and 38 private funding study places was received, respectively 194 applications (of which 38 with priority 1) and 105 (of which seven with priority 1), 26 students signed study contracts. The number of students in the admissions is close to the planned one when the study programme has around 30 students in the first year of study. The number

[19] Statistika par pieteikumiem pamatstudiju programmās https://latvija.lv/Epakalpojumi/EP190

of applications in the study programme, including the number of applications with priority 1, showed that potential students are interested in the study program in question. Interest could also grow if the study programme increases the number of state-funded study places (not all students are prepared or can pay for studies). Interest could rise when the study programme is incorporated into the accredited study field (each year before the admission, several students have questions regarding the accreditation status of the study programme). Starting in 2022./23.ac.year, the study programme will have a total of 10 state-funded study places.

By November 15, 2021, five students had ceased their studies out of all students admitted. In three cases in the context of personal reasons and two in connection with the timely non-fulfilment of the requirements of the study programme.

In the context of the COVID-19 pandemic and various restrictions, to organise studies on-site, conditions and claims for international students (vaccination and recognition of certificates), in the first two years of the realisation of the study programme, studies were carried out only for the Latvian language flow. The study programme in English is intended to start in 2023./24.ac.year.

The statistical data on students in the study programme is added in Annex 2.

2.5. Employment prospects for graduates

Biotechnology and bioengineering are one of the fields of smart specialisation in Latvia – "Biomedical, medical technologies, bioengineering and biotechnology" [20], which also sees development potential in Latvia and an expected increase in labour demand. The Latvian National Development Plan 2021-2027[21] also states that this is an area that needs to be focused on. Similarly, industrial biotechnology has been recognised by the European Union as the Key Enabling Technologies (KETs) [22]. The report by the rapporteur for the European biotechnology industry concluded that the number of people employed in biotechnology increased on average by 2.6% a year between 2008 and 2018, which is more than 0.2% a year in terms of

[20] Viedās specializācijas jomas – "Biomedicīna, medicības tehnoloģijas, bioformācija un biotehnoloģija" ekosistēmas analītisks apraksts

[21] Pārresoru koordinācijas centrs. Latvijas Nacionālās attīstības plāns 2021.-2027.gadam. https://www.pkc.gov.lv/sites/default/files/inline-files/20200204_NAP_2021_2027_gala_redakcija_projekts_.pdf

[22] https://ec.europa.eu/growth/industry/key-enabling-technologies/description_en

an increase in the total number of people employed in the economy[23], pointing to the high level of activity in this area.

In 2020, in its communication report on the medium and long-term labour market forecasts[24], the Ministry of Economics pointed out that a drop in labour demand in the industrial sector is expected for 2030 as a whole. Still, at the same time, demand growth in advanced industries, including biotechnologies, is expected. The demand for graduates in the study programme will remain stable in relation to the growing role of biotechnology in the economy and population welfare, not only in industry but also in science, through projects to develop new biotechnological, bioengineering and bio-pharmaceutical solutions and products (e.g. UL Microbiology and Biotechnology Institute, Latvian Biomedical Research and Studies Centre, Institute of Organic Synthesis). During their studies, part of the students starts to participate in scientific projects in scientific institutes.

3. Provision of resources and support

3.1. Description and assessment of studies, science (if applicable), information (including libraries), infrastructure and logistical support, and financial base

The most significant changes since licensing in 2020 are:

1. The Microsoft Teams system in UL and RTU has been introduced to provide remote study (including online lectures) opportunities during the COVID-19 pandemic;
2. information resources for the provision of the programme have been supplemented.

Description of studies base

The Faculty of Biology implements the study programme at the UL in cooperation with the UL Institute of Microbiology and Biotechnology. Academic and scientific staff from the Department of Microbiology and Biotechnology and the Department of Molecular Biology in the Faculty of Biology are mainly involved, while the teaching staff of the Department of Botany and

[23] Haaf, A., et al., 2020. Measuring the economic footprint of the biotechnology industry in Europe. WifOR Institute. https://www.europabio.org/wp-content/uploads/2021/02/201208_WifOR_EuropaBIO_Economic_Impact_Biotech_FINAL.pdf

[24] Ekonomikas ministrija, 2020. Informatīvais ziņojums – Par darba tirgus vidēja un ilgtermiņa prognozēm. https://www.em.gov.lv/lv/media/598/download

Ecology also is involved in teaching specific courses. Teaching staff from the Faculty of Medicine, the Faculty of Chemistry, the Faculty of Physics, Mathematics and Optometry, and the Faculty of Business, Management and Economics are involved in teaching other fields.

The secretary and methodologist of the Faculty of Biology (UL) are involved in implementing the study programme to provide students with the necessary services (registration of students for studies and study courses, assistance to students in completing formalities with other structural units). The number of current and planned newly enrolled students allows providing student service without the involvement of additional secretaries/methodologists. Departmental technicians and senior laboratory assistants help to ensure the course of laboratory and practical work provided for in the study programme.

The implementation of the study programme at RTU is coordinated and ensured by the Institute of the Water Systems and Biotechnology (ISWB) of the Faculty of Civil Engineering, which has its own methodologist to ensure the coordination of study work, the selection of programmes and the general counselling of students. ISWE doctoral and master level students assist teaching staff and other departments in conducting courses. Teaching staff from the University of Porto (Portugal) participate in the course Biological Reactor (BŪK711), and teaching staff from the University of Kartagen (Spain) provide individual courses. The teaching of relevant faculty will be involved in the teaching of sector-specific courses. Accordingly, the study courses in Basics in materials science and engineering (KVT728), Fermentation – product identification and purification (KOS721) are provided by the Faculty of Material Science and Applied Chemistry, which has the appropriate equipment for carrying out practical and laboratory works in chemistry and material science. Teaching staff from the Faculty of Electronics and Telecommunications providies course in Electrical processes and equipment in biotechnology (EEM792). Similarly, the Computer Science and Information Technology Faculty and the Faculty of Engineering Economics and Management are involved in the implementation of the programme. Centralized intranet portal ORTUS is provided to all IT users (https://ortus.rtu.lv).

General characteristics of the Library of UL

The Library of the UL is included in the Register of Libraries of the Ministry of Culture (BLB1000) and have been accredited as the State significance library till 2022.

General characteristics of the Library of RTU

The RTU Scientific Library (https://www.rtu.lv/lv/studijas/biblioteka) is a library of national importance which has acquired its status as a result of the accreditation of libraries. The RTU Scientific Library provides the RTU study process and research activities with the necessary information, perform the librarian, bibliography and informational services for students, teaching staff.

Opening hours of the Library, accessibility to information resources and services

The basic principle of the library operation is the availability of its services for all users.

Services are provided in the eight sector libraries of the UL Library following the rules of use of the UL Library.

The opening hours of the eight sectoral libraries of the UL Library are adjusted for the convenience of students. Opening hours for the Library clients are from 9:00 until 21:00, in some sectoral libraries – from 9:00 until 18:00 and from 9:00 until 17:00 on Saturdays. The Library of Natural Sciences and the Library of the House of Science is available seven days a week, 24 a day. Three sectoral libraries are open for their clients throughout the year, also in summer.

RTU Library is open for users from Monday to Friday (https://www.rtu.lv/lv/studijas/biblioteka/darba-laiki-un-kontakti). There is a 24 h reading room. At the request of students in December 2019 and January 2020 during the session, users had access to five Central Library floors with the stock at 24 h. During the summer period, the Central Library shall be open each working day with a shortened working time.

In the UL Library of Naturals Science, throughout the day, UL staff have the possibility to use: free-access inventory, self-service books for home, extension and transfer of usage, computers, mobile phone charges. In the House of Science Library, throughout the day, the UL staff can use: free-access stock, two self-service facilities for issuing books at home, extending and transferring usage times, and a self-service wall for using portable computers. The UL Library is the first in the Baltic States where such facilities and services are provided. The self-service equipment is equipped with 36 portable computers. UL personnel can take portable computers and use them for 6 hours in the library area and throughout the building, using student or employee certificates.

The UL Library of Naturals Science premises, in which the biotechnology and bioengineering field books are stocked, are open for students at comfortable times 24/7. A free-access item is available for users. The Natural Sciences Library is located on the premises of the UL Academic Centre House of Nature (Jelgava Street 1), with a total area of 662,80 m ².
More than 100 working places are available to users in the Natural Sciences Library, including 20 working places to work with a computer.
The RTU Library has 1.4 million printed documents and e-resources in databases relevant to the RTU fields. In 2016, significant investments were made in the development of the infrastructure of the library, building an additional area of room 2240 m2 to the Central Library. The total area of library rooms shall be 6393 m2, of which the readership room 3417 m2. Library users have 713 workplaces. The library has four group rooms and six individual cabs, a rarity reading room, a conference room. The Library is available to people with disabilities.

Free of charge basic services

- Electronic ordering/reservation/extension of the use of information resources from state significance union catalogue and receipt of information resources for on-site use in the library reading room or for use at home.

The service is available to users registered at the UL Library by using Union Catalogue on any mobile device from any place with internet access.

The RTU Library resource search is supported by the Primo Discovery search tool. This enables you to search at one time for information in the library directory, in the subscribed databases, as well as in the databases created by the RTU Scientific Library. While searching for information in the electronic joint catalogue, information on available resources can be obtained in 13 Latvian libraries.

- Delivery of information resources

When ordering resources in Union Catalogue from any library, the UL academic personnel, researchers and doctoral students have the option to indicate the most convenient place to receive the reserved information resource – the sectoral library, this option is available for other users by ordering information resources only from the Repository.

- Self-service

All sectoral libraries offer self-service scanning services; five sectoral libraries offer self-service devices for receiving/submitting books or extending the period of use of books. The UL students, academic and general personnel, can receive laptops at the Library of the House of Sciences by using the laptop usage self-service device with 36 laptops.

The RTU Scientific Library ensures that the resources of the Library can be reserved remotely in both the electronic catalogue and the RTU portal ORTUS, and remote access to the databases is also ensured. Since the introduction of Radio Frequency Identification Technologies, users have been able to use the five-book issue-transfer self-service machines and transfer books to a transfer-sorting machine throughout the day. The term of use of books may be extended remotely.

- Use of open access reading rooms, computers and internet

It is possible to use a collection of reference literature and periodicals, stationary and portable computers (both the UL Libraries and users' personal) in the reading rooms, as well as Internet connection, including WI-FI, which is operating in all UL buildings. More than 100 workstations are available to users in the Library of Natural Sciences (20 computerised and over 100 non-computer workstations).

- Night subscription, booking of information resources in advance

the "Night Subscription" service is offered, the aim of which is to provide users – students, lecturers and employees of the University of Latvia with the opportunity to borrow a certain on-site information resource from the library in the time period from the closure of the library until the opening hour or to book it in advance for a certain number of hours. The service is free of charge, but if the information resource is not returned on time, a contractual penalty is applied for the delay of the loan period by the price list of paid services of the UL Library.

- Supply of information resources in the summer

This offer allows users to receive necessary information resources once a week at the most convenient sectoral library (Library at Kalpaka Boulevard, Library at Raiņa Boulevard, Library of Natural Sciences, Library of the House of Science).

- Inquiries and consultations

One of the main functions of the library is providing information to the users – consulting, providing information, user training and support in research. The consultant of the Library and staff of branch libraries provide bibliographic, thematic, factual, addressive, specific and other

information and consultations to the students, academic, scientific and general staff of the University of Latvia.

The main consultant of the UL Library (the Library at Aspazijas Boulevard) provides the official and general information services of the Library. The users can also receive individual consultations and information in the library, by e-mail: info-bibl@lu.lv, by phone: 28623551, using Skype – address: LU Bibliotēkas konsultants. Consultations are also provided by any employee of the sectoral library staff at the library or by phone or using Skype.

In case of any questions, the users may also use the options available in the UL Library portal: "Ask the librarian", "Frequently asked questions", "Submit your feedback".

- Training for users

Training is organised to develop users' skills to work independently, find, evaluate and use information resources and e-environment tools. The Library actively works with the target audience – students of all levels of studies, academic, scientific and general staff, to ensure not only information literacy but also to provide thorough knowledge and skills in working with electronic resources.

The Library makes presentations and organises training in auditoriums and computer classes. Organise practical study tours in the Library so that users acquire skills to work with open access repository, self-service equipment and office equipment – self-service scanners, copiers, thus improving independent learning competencies.

Special attention is paid to international students. The Library has prepared and organises presentations in English "Step by step, the library of the UL – for you!", whereas skills with e-resources are taught in computer classes.

For the bachelor's study programme students: presentation "Step by Step: Library for You", the lesson "Electronic Union Catalogue and Primo for Successful Studies" (90 min) and the lesson "Get to Know E-resources" (90 min) "E-resources in the Sector" (90 min), e-course "Introduction to information literacy" (elective course).

In turn, for the master's study programme students and residency students, there are classes that provide in-depth skills in working with electronic resources of the relevant sector – "E-resources in the Sector" (90 min).

For the students of doctoral study programmes, there are the following lessons: "Introduction to Scientific Publication Process" (90 min), "Bibliography and Citation Management Tools" (90 min), "Use of Databases Web of Science and Scopus for Studies and Research" (90 min).

Whereas the following classes are addressed to the academic and research staff: "Bibliography and Citation Management Tools" (90 min), "Use of Databases Web of Science and Scopus for Studies and Research" (90 min), "Registration of Publications and Editing of Publication List in LUIS" (90 min), "Deposit of Research Results in the Repository of the UL E-resources" (90 min).

Employees of the Library also organise classes in classrooms and computer classrooms at the UL branches throughout Latvia: in Alūksne, Bauska, Cēsis, Jēkabpils, Kuldīga, Madona, Tukums.

Paid services

The list of the UL Library paid services, and price list is approved by the UL Rector's Order of 10.08.2021 No. 1-4/387 "UL Library Charges for paid services".

- Compilation of a list of information resources

Specialists of the UL Library compile a list of information resources on the topic required for the user as soon as possible, for example, during the process of developing a term paper or other type of work. The user can order the list by filling in the electronic application form electronically.

- SBA, SSBA services

The UL Library offers its users to order information resources that are not available at the UL libraries from other libraries and document repositories in Latvia by using interlibrary lending service and from abroad by using international interlibrary lending service, as well as receive electronic copies of scientific articles in printed form or by e-mail.

Collection of the Library, the procedure for collection replenishment

The collection of the UL Library is created in accordance with the study and research fields of the University, the requirements of study programmes, thus providing information for all study levels of the University of Latvia – bachelor's, master's, doctoral, as well as scientific research areas. When replenishing the collection with information resources, the purchase of e-resources has been set as a priority.

Acquisition of new resources to the collection is carried out in accordance with the centrally allocated funding of the University of Latvia, which is approved annually by order of the University of Latvia. The granted funding is used to purchase necessary books and pay for a subscription to sectoral databases and periodicals.

The UL Library ensures the acquisition of information resources, based on orders of academic personnel, proposals from the student council or employees of the Library, which are submitted to LUIS and approved by the Dean of the Faculty or the Executive Director.

In 2021, there are 1.8 million information resources available for Library users. In accordance with the UL study and research infrastructure, the collection of the UL Library is located in 8 sectoral libraries and the Repository.

Literature available in the Library to implement the Study field

In the collection of the UL Library, the are 2083 copies of the expenditure with the eligibility of the information resources for the study field. From November 15, 2019, to October 1, 2021, the UL Library collection has increased by 431 copies (Table 1).

Table 1. Printed editions (copies) in the collection of UL Library (total)

Bachelor study programme "Biotechnology and Bioengineering" (total in the collection of UL Library 15.11.2019.-01.10.2021.)									
Printed editions (copies)					*Language (copies)*				
Study courses of the Study programme	Books	Periodicals other types of publications	Other types of expenditure	Total	Latvian	English	Russian	German	Other
Microbiology	522	9	5	536	257	213	59	7	0
Molecular biology	790	215	31	1036	139	610	83	204	0
Gene engineering	114	2	7	123	14	72	25	10	2
Biotechnology	24	0	0	24	9	13	2	0	0
Genetics	276	88	0	364	95	76	103	86	4
TOTAL	**1726**	**314**	**43**	**2083**	**514**	**984**	**272**	**307**	**6**
Total in the study field**: 2083** copies									

Together, for the RTU study field “Chemistry, Chemistry Technologies, and Biotechnology”, a new 155 book titles have been purchased by Library in the period 2013-2021 for an amount of EUR 14070. According to an order from the Biotechnology and Bioscience study program, a new 22 book titles for the sum of 1496.4 EUR have been purchased during the period 2013-2021. At the same time, it should be noted that part of the study courses provided by the RTU comes from sectors that are not reflected in the Biotechnology classification, such as electrical

engineering, mathematics, computer sciences. Every month, all new literature received by the RTU is reflected in the newsletter of the new literature received by Library. (https://www.rtu.lv/lv/studijas/biblioteka/jaunieguvumi).

Level of digitisation of the collection

In cooperation with the UL Information technology department, the UL Library provides its clients the possibility to use the UL e-resources repository http://dspace.lu.lv. A mobile version of the Repository is also offered for user amenities. The Library, authors of publications, the UL structural units or representatives of the UL publications regularly place electronic versions of their publications, digitised information resources with cultural and historical value, doctoral dissertations of the UL teaching staff and their summaries in the Repository of the UL e-resources, to ensure an open and constant online access to the UL scientific achievements. The Library offers digitised publications subject to copyright protection for use in on-site reading rooms.

Currently, in the study field "Wildlife Sciences", there are more than 47 004 publications.

Databases

Following the UL Strategic Plan, the UL Library increases the proportion of e-resources and develops remote access options.

By upgrading the availability of electronic resources, the UL Library introduces the latest technology web service Primo Discovery and SFX.

In 2021, the University of Latvia subscribed to 42 e-resource platforms (with e-books - *VLeBooks, ProQuest Ebook Central*, e-journals databases - *Cambridge Journals Online* archive till 31.12.2018.), *Emerald eJournals Premier* (archive till 28.02.2020.), *JSTOR I-XII, XIV, XV and Life Sciences Collections, HeinOnline, Oxford Journals Online, Sage Journals, ScienceDirect, SpringerLink Contemporary Journals, Taylor & Francis Social Science & Humanities Library, Physical Review Journals, Westlaw, Wiley Online Library E-Journals Full Collection*, e-journals – for example, *Nature*, information resources, tools, multimedia, statistics, as well as mixed-format databases (*Scopus, ScienceDirect, Web of Science*)). On these platforms, there are 17 477 full-text e-journals (including individually subscribed), 208 123 e-books, almost 5 million full-text global dissertations and master's theses. There are 174 tested open access databases with multi-format materials available at UL.

RTU subscribes to databases such as 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. Also available to the RTU Scientific Library, databases funded by the Latvian Ministry od Education and Science: ScienceDirect, SCOPUS (Elsevier), Web of Science. Latvian databases are LETA, Letonica, Latvian standards database (available only in library rooms).

Every year, the UL Library offers an average of 110 new electronic resources. As of 01.10.2021, the UL Library has purchased 1536 e-books, and there are approximately 208 123 e-books available in the subscribed ProQuest Ebook Academic Complete collection.

At the same time, the UL Library regularly offers its users trial access to various databases. Within the scope of granted co-funding, the number of databases is evaluated, and the usability of subscribed databases is analysed.

E-books available at the UL Library, which include materials in the study programme

VLeBOOKS – the platform of e-books that includes **145** editions from e-books purchased by the UL Library, including materials for the study programme from the world's leading publishers (for example, *John Wiley & Sons, Elsevier, Academic Press, Springer, Oxford University Press*).

ProQuest Ebook Central Academic Complete Collection – the platform of e-books with **62 810** publications from e-books and **160** separate e-books purchased or subscribed by the UL Library in accordance with the study programme from the leading world publishers (for example, *John Wiley & Sons, Elsevier, Pearson Education, Cambridge University Press, McGraw Hill, Springer*).

Infrastructure and logistical support

The study programme is implemented both at the UL and RTU premises.

The UL study process takes place in the House of Nature and the House of Sciences. The House of Nature was commissioned in 2015. The total indoor area is 18540 m^2, comprising 30 audiences, 45 student training laboratories and 69 research laboratory premises. All audiences have a projector and portable computer for presentations, whiteboards. Some audiences also have interactive blackboards. The large auditoriums are on the 1st floor of the House of Nature; they

also have access to tune-in techniques and recording capabilities. The House of Science was commissioned in 2019. The total indoor area is 20018 m2, with 15 audiences, eight workshop rooms, 78 scientific and training laboratories.

The seventh floor of the House of Nature has a greenhouse available for carrying out scientific research and student training. The greenhouse is equipped with modern equipment for optimal plant growth conditions and automatic regulation. Training laboratories intended to implement the study programme have access to microscopes connected with stationary computers, individual workplaces with micropipettes kits. The laboratories contain freezers (both -20 ºC and -80 ºC) to store samples and reagents. Equipment purchased within the framework of project No 8.1.1.0/17/I/010 "Modernisation of the infrastructure and concentration of resources of STEM studies of the University of Latvia" to ensure the possibilities for the realisation of practical works of biotechnology: set of fermentation equipment Sartorius Biostat (8 fermentators with equipment); UHPLC ("Watchers") and gas chromatography ("SCION Instrument") systems for the analysis of the fermentation metabolites; spectrophotometer; laboratory table centrifuge for processing fermentation samples; as well as other laboratory equipment necessary for carrying out practical work (incubator-shaker, scales, thermostats, plate readers, autoclave). Room 432 of the UL House of Nature is a fermentation training laboratory for the practical works of student groups with a set of Sartorius Biostat fermentators. The laboratory allows teaching fermentation processes for groups of up to 20-24 students. For the study programme, training laboratories that are already in use for biochemistry, molecular biology and microbiology laboratory work under the Biology study programme will also be used. The House of Nature has five computer classes (the largest with 20 working stations). Both Windows and Linux operating systems are available in computer classrooms. Microsoft Office software, statistical software (R, SPSS, PC-Ord), field-specific software is available. Wireless network coverage is provided throughout the building. The House of Nature includes a café, the Natural Science Library, individual work booths. The building is accessible to people with reduced mobility – the building has several elevators, sanitary facilities have been properly installed. For students, the first two floors of the House of Nature are available 24 hours a day.

RTU studies take place in Ķīpsala, where the RTU Ķīpsala Campus is located. Its construction was launched in 1965, with the aim of building a single studio and science center. Construction is ongoing and is planned to concentrate the majority of students at the University in Ķīpsala by the end of 2022. Once construction is completed, the RTU Ķīpsala Campus will become the most advanced engineering study centre in the Baltic. The

development of a student Campus is intended for sustainable development. In demonstrating its concern for sustainable environmental development and its willingness to contribute to its promotion, the RTU joined the Sustainable Development Solutions Network, which aims to meet the 17 UN targets for sustainable global development in 2030.

The RTU buildings are equipped with modern climate support equipment, technical solutions that are controlled remotely and can follow energy consumption to make buildings more comfortable for students, teachers, scientists and guests. One of the results achieved in the development of the RTU infrastructure is the participation in the Green Metric rating, where the RTU Ķīpsala Campus is recognised as the 59th greenest in the World, while the RTU is the 129th greenest y in the World, thereby demonstrating links to the study programme "Biotechnology and Bioengineering". In the Baltic region, RTU is a leader with a green thinking infrastructure. The infrastructure of the RTU Ķīpsala Campus is provided with all the necessary for instructors, employees and guests so that they can park their bikes, cars and use drinking-water points without paying for it. The development of infrastructure involves all groups of people, including:

for people with special needs: each building provides parking places, access to audiences, laboratories and other spaces without encumbrance, a braille article for reading information and viewing buildings, all sanitary nodes being created in accordance with the requirements. The association of disabled people and their friends "APEIRONE" (https://www.apeirons.lv/) has welcomed the progress made by the RTU on infrastructure issues related to providing people with special needs.

At the RTU Ķīpsala Campus there are 54 audiences, 187 laboratories, 19 special audiences, 10 computer classrooms, 12 workshops and a number of state importance research centres available for the implementation of various study programmes, including Biotechnology and Bioengineering. The student town also houses a student service hotel with 950 bed sites and a special block for people with special needs to ensure a friendly and comfortable living. Other components of the RTU infrastructure – canteens and cafes, joint shops, student hotels, RTU sports and recreation centres, swimming pool, etc. – are also available for students and teaching staff. The RTU premises are equipped with vending machines for the purchase of various beverages and snacks. The RTU Water Systems and Biotechnology Institute provides the necessary hardware (e.g. microscopes, bioreactors) and materials for laboratory work and research. Similarly, during course developments, students are offered the opportunity to go on training tours, such as sewage treatment plants, production companies.

UL offers students and employees a free subscription to the Microsoft Office 365 ProPlus and SPSS software for a private computer for a period of study (or work agreement).

Both students and lecturers have access to Microsoft Teams software for remote studies, which is linked simultaneously to the UL e-studies system. For each study course in the Teams environment, a group has been set up that automatically adds all students registered for that particular course in the UL information system.

Description of the financial base

The financial base which is necessary for the implementation of study programmes, are ensured by revenue from student fees and state budget funding for studies. The financial base of UL and RTU is sufficient to ensure the study process in the study programmes that have been carried out so far. The financial situation is regularly monitored by reviewing the costs of study programmes, the relevance of staff assignments to the actual number of students and workload. The calculation of the study programme implementation costs for UL, which was carried out using the tool developed for cost calculation by the UL Academic department and the UL Department of Finance and Accounting, showed that the programme's cost is EUR 2987 per student per year. The calculation is made on the condition that an average of 82 students (30 in the first year of study) are studying in the study programme; ten of them are state-funded students, and more than 50% of students are from non-EU countries. In that case, the programme realisation is cost-effective, and the actual return of the programme is EUR15 per student per year.

The study programme will have 18 state-funded study places from 2022./2023. ac.year.

In addition to the costs of teaching staff, the cost calculation also includes the costs for the general person – EUR 544 per student per year, infrastructure expenditure – EUR 409 per student per year, services – EUR 32 per student per year and EUR 777 is the indirect costs of UL.

3.2. Analysis and assessment of changes in the composition and qualifications of the teaching staff during the reporting period

Since the licencing of the study programme, five member of teaching staff have been added to the implementation of study programme at UL: assoc.professor Ģirts Barinovs (Biophysics course), senior researcher Jeļena Kosmača (Biophysics), lecturer Ilona Mandrika (Introduction to cell and gene engineering, Metabolism, Biomolecules and Cells), instructor Kārlis Švirksts

(Cultivation and physiology of microorganisms) and instructor Zane Ozoliņa (Gene and cell Technologies). Also four new members of teaching staff have been added for RTU: Brigita Daļecka (Vertically integrated projects), Andrejs Podgornovs (Electrical processes and equipment in biotechnology), Igors Uteševs (Electrical processes and equipment in biotechnology) and Krista Gulbe (Biomolecules and cells, Fermentation – product identification and purification, Introduction to industrial and environmental biotechnology). In addition, the newly added lecturers (excluding the Biophysics course) operate in parallel with the responsible lecturers of the study courses, while at the same time partly reducing the pressure on the leading specialists, as well as gaining experience in teaching specific courses, so that a second lecturer can be replaced if necessary. The qualifications of all newly added lecturers are appropriate (there is an experience in academic work, or work experience in the execution of scientific projects, in the preparation of scientific publications) so that the recruitment of new lecturers does not reduce the qualification for teaching the study programme. Three out of the five added lecturers have English proficiency according to level C1 and two to level B2.

Teaching staff continues to complement foreign language (English) knowledge in the framework of the specific support project 8.2.2 "Renewal of academic staff and capacity building at the University of Latvia". Since the licensing of the study programme, certificates on completion of English courses, passage of examinations and compliance of English knowledge with level C1 have been received by Didzis Elferts, Uldis Kalnenieks, Agris Berzinš and Jeļana Kosmača.

Teaching staff of RTU continues to complement foreign language (English) knowledge in the framework of the specific support project 8.2.2 “Strengthening the academic staff of higher education institutions in areas of strategic specialisation”, where courses are offered by both the RTU Institute for Applied linguistics and RTU Riga Business School.
A list of the teaching staff involved in implementing the study programme is given in Annex 3. A newly attracted lecturers' CV are added in Annex 5.

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

During the licensing process of the study programme, experts made six recommendations to be implemented until the accreditation of the study field. Of the six recommendations, one has

undertaken an implementation analysis, four are implemented, and one recommendation will be implemented when international students are present.

1. Providing students with information from the first day of study that the courses to be studied require maximum attendance and the non-attendance of classes, even because of medical indications, is not possible.

The recommendation has been implemented and will be continuously implemented: before the beginning of each academic year, students have an informative meeting with the programme directors of the two participating universities, part of the teaching staff involved in the first semester. During the meeting, students are informed of the study programme, its objectives, the planned study courses, the general requirements, the opportunities offered for the resources available. At the same time, it should be stressed that students have the possibility, for justifiable reasons (such as medical indications), also to delay one of the practical or laboratory works and then do so at another time, agreed with the lecturer.

2. Drawing attention to the possibilities for developing the language competencies of the teaching staff involved, taking into account the plan of the planned programme on foreign learners from both the EU and non-EU countries.

The recommendation has been implemented and will be continuously implemented – teaching staff continues to complement foreign language (English) knowledge in the framework of the specific support project 8.2.2 "Renewal of academic staff and capacity building at the University of Latvia". Since the licensing of the study programme, certificates on completion of English courses, passage of examinations and compliance of English knowledge with level C1 have been received by Didzis Elferts, Uldis Kalnenieks, Agris Berzinš and Jeļana Kosmača.

3. In response to what the study programme directors say about the fact that most of the leading professionals in the sector are involved in the programme and will be teaching staff, it is necessary for the sustainability of the study programme to ensure that all teachers have access to qualified substitutes.

The recommendation has been implemented: since the opening of the study programme, five teaching staff members at UL have been added to the implementation of the study programme: assoc.professor Ģirts Barinovs (Biophysics course), senior researcher Jeļena Kosmaņa, lecturer

Ilona Mandrika (Introduction to gene and cell engineering, Metabolism, Biomolecules and cells), instructor Karlis Švirksts (Cultivation and physiology of microorganisms) and instructor Zane Ozoliņa (Gene and cell technologies). Also four new members of teaching staff have been added for RTU: Brigita Daļecka (Vertically integrated projects), Andrejs Podgornovs (Electrical processes and equipment in biotechnology), Igors Uteševs (Electrical processes and equipment in biotechnology) and Krista Gulbe (Biomolecules and cells, Fermentation – product identification and purification, Introduction to industrial and environmental biotechnology). In addition, the attracted lecturers (excluding the Fizi1087 Biophysics course) operate in parallel with the responsible lecturer of the study courses, while at the same time partly reducing the pressure on the leading specialists, as well as gaining experience in teaching specific courses, so that a second lecturer can be replaced if necessary. In the last couple of years, the UL Faculty of Biology has attracted several young lecturers who are not currently directly involved in the realisation of the study programme but could be involved if such a need arises, such as the lecturer Andris Avotiņš (Data analysis and mathematical statistics course), docent Ilze Elbere (Genetics and genomics, Introduction to gene and cell engineering).

Three out of eleven courses provided by the RTU, in addition to the responsible teaching staff, other teaching staff (Biological reactor, Electrical processes and equipment in biotechnology, Introduction to industrial and environmental biotechnology) are involved, and new specialists are involved in two courses. (Vertical integrated project, Fermentation – identification and purification of finished products).

4. In the context of the new study programme, increased attention should be paid to providing feedback from international students on the quality of the study programme to improve its implementation.

Based on the processes occurring in the external environment during the previous years of implementation, international students are not admitted. Basic reason: the study programme is only in the status of a licensed programme, which does not seem binding on international students; to make sure that the content is in line with students' wishes; clarify mutual cooperation between the two participating universities (LU and RTU); most of the study time has been spent so far in remote studies, where foreign students would be much less interested in applying for a study programme, which provides for an emphasis on practical and laboratory work, but which is not possible to attend.

In the same way as for studies already being carried out in the Latvian language, following the commencement of the study programme in English, the students are scheduled to meet both at the beginning of the study process to inform about the requirements of the study programme, the content, the expected results, as well as to make regular appointments (mid-term and end of the semester) to obtain feedback on the progress of study courses, their content, and identify potentially improving things.

5. Consider the possibility of attracting a larger number of highly qualified guest lecturers, if not otherwise practicable, virtually.

The recommendation is implemented: in September 2021, UL, RTU and Cartagena Polytechnic University (Spain) signed a trilateral agreement on academic cooperation. One of the types of cooperation is to attract guest lecturers to the study courses implemented by each university, for example, in the spring semester of 2021/2022, Julia Wess and Marcos Egea Gutiérrez-Cortines will participate in the UL study course Genetics and genomics as guest lecturers from Spain.

In the spring semester of 2021/2022, part of the activities of the RTU study course "Biological Reactor" is conducted by visiting docent from the University of Porto, Nuno Azevedo, and Rita Sobral Santos, as well as in 2022/2023 ac.year, the lectures from Cartagen Polytechnic University in the course "Basics of Microbiology" will be provided.

6. Consider the possibility of supplementing the study programme in future with personality-forming courses, such as the history of philosophy, the history of art and literature, etc.

Work is underway on the analysis of the implementation of the recommendation – evaluation of the existing content of the programme and inclusion of potential new study courses in the study programme is planned after the conclusion of the first full cycle (from the admission of students to their graduation), when in general feedback on the existing study courses will be visible and suggestions on the necessary improvement in the study programme will be received from all interested parties, i.e., from students, graduates and employers .

Despite the planned activities, currently students have the opportunity to choose personality-forming courses from the wide range of free choice courses. For example, in the autumn semester of 2021, students of the study programme have chosen such free choice courses as the

Basic Italian Language Course I, French II, Spanish I, German I, Basics of Psychophysiology, Critical Thinking and Visionary Culture.

In general, all recommendations that are not related to processes occurring in the external environment have been fulfilled.

An overview of the implementation of recommendations during the licensing process is given in Annex 7.