

## APPLICATION

Study field "Chemistry, Chemistry Technologies, and Biotechnology" for  
assessment

Study field	<i>Chemistry, Chemistry Technologies, and Biotechnology</i>
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# **Self-evaluation report**

Study field "Chemistry, Chemistry Technologies, and  
Biotechnology"

University of Latvia

<b>Self-evaluation report</b>	2
<b>Study field</b>	4
1. Information on the Higher Education Institution/College	4
2.1. Management of the Study Field	15
2.2. Efficiency of the Internal Quality Assurance System	34
2.3. Resources and Provision of the Study Field	47
2.4. Scientific Research and Artistic Creation	70
2.5. Cooperation and Internationalisation	90
2.6. Implementation of the Recommendations Received During the Previous Assessment Procedures	98
<b>Annexes</b>	101
<b>Other annexes</b>	102
<b>Chemistry (45441)</b>	103
<b>Study programme</b>	106
3.1. Indicators Describing the Study Programme	106
3.2. The Content of Studies and Implementation Thereof	114
3.3. Resources and Provision of the Study Programme	126
3.4. Teaching Staff	132
<b>Annexes</b>	138
<b>Chemistry (43441)</b>	139
<b>Study programme</b>	142
3.1. Indicators Describing the Study Programme	142
3.2. The Content of Studies and Implementation Thereof	149
3.3. Resources and Provision of the Study Programme	163
3.4. Teaching Staff	167
<b>Annexes</b>	173

# 1. Information on the Higher Education Institution/College

## 1.1. Basic information on the higher education institution/ college and its strategic development fields,.

University of Latvia (hereinafter – UL) was founded in 1919 and is the only classical university in Latvia. The University of Latvia is a university of science, incorporating and developing the country's main study and scientific research potential in the field of humanities, natural, technical, and social sciences. UL serves science and fatherland. By participating in worldwide research and educational processes, it contributes to the growth and sustainability of the Latvian state and nation. UL retains its status as the largest higher education institution (hereinafter – HEI) in the country in terms of the number of students.

**Mission:** The mission of the UL is expressed in its motto “For Science and Fatherland”. The UL contributes to global science, higher education, knowledge, technology transfer and innovation, and ensures the growth of Latvian democracy and culture, the development of the Latvian language and the prosperity of the national economy.

**Vision:** Space for excellence, environment for development, time for responsibility. The UL is a university of science of high international standing. The UL creates an interdisciplinary, open, and innovation oriented excellent work and study environment. Activities of the UL form the basis for the sustainable development and economic transformation of Latvia.

### Values:

- University community;
- Excellence;
- Science-based development;
- Openness;
- Cooperation;
- Academic freedom.

UL plays a significant role not only in the development of the higher education system in Latvia, but also in the growth of the country's economy, providing cutting edge studies and research, based on the unity of higher education and science. The UL actively participates in solving topical problems of the state and society, and is the centre of intellectual life in Latvia, where new knowledge is created, while nurturing the national language, culture and promoting the development of the state and society. The UL focuses its efforts on providing quality studies and developing scientific excellence, creating structures open to interdisciplinary and transdisciplinary research and studies, ensuring a high return on invested resources, sustainable and environmentally friendly use of resources. The UL is evolving as a modern international academic centre, creating an environment and infrastructure for excellence in studies, research, and innovation.

The study process at the UL is implemented at [13 faculties](#), [7 regional branches](#) (available only in Latvian) and [3 medical colleges](#). Research activities are also performed at [18 research institutes](#), and various research, training and consulting activities are conducted in [27 study centres](#). The UL [Regional Centre](#) (available only in Latvian) coordinates and supervises the activities of the UL regional branches, as well as promotes cooperation between the UL and local authorities in the fields of human resources development, education and interdisciplinary research. The UL has more than [200 bilateral cooperation agreements with universities in 51 countries](#). The [UL Culture](#)

[Centre](#) (available only in Latvian) is represented by more than 20 amateur arts groups – choirs, dance groups, vocal ensembles, early music ensembles, theatre, a brass band, and a ceramics studio. The [UL Sports Centre](#) organises UL sports activities for up to 40 different sports classes in 11 sports – basketball, wrestling, group fitness classes, football, floorball, table tennis, kendo, general fitness, volleyball, cheerleading and self-defence. Within the UL regular activities are also performed by basic structural units: [Museum of the UL](#), the [UL Botanical Garden](#), the [UL Experimental Rhododendron Breeding Nursery "Babīte"](#), the [University of Latvia Press](#), and the [UL Baldone Observatory](#) (available only in Latvian). The UL foundations are also operating successfully: [UL Foundation](#) and the [Alumni Club](#) (available only in Latvian).

As of 1 October 2022, the UL has 3087 employees, including 1396 – the UL academic staff and 1691 – the UL general staff. The UL financial performance is characterised by a turnover of EUR 98 million. The University's EUR 135 million equity represents 69% of total assets. The main activity of the UL takes place in Riga, at 19 Raina Boulevard and the UL Academic Centre in Tornkalns, as well as in several locations in Riga and in the UL regional branches in Aluksne, Bauska, Cesis, Jekabpils, Kuldīga, Madona and Tukums.

In the world university ranking *Times Higher Education* for excellence in science, the UL is ranked 482<sup>nd</sup>, with an overall ranking of 800-1000 (2022).

The UL implements study programmes at all levels, covering 28 branches of science and 22 study fields. The UL 13 faculties offer 140 study programmes. See Table 1.1.1. for the study fields, the number of study programmes and the accreditation periods.

Table 1.1.1

**Study fields implemented in the UL, number of study programmes and accreditation periods (01.11.2022.)**

No	Study fields	Number of study programmes	Accreditation period
1.	Architecture and Construction	1	08.06.2022-09.06.2028.
2.	Life Sciences	4	29.05.2013-31.12.2023.
3.	Economics	8	08.09.2021-09.09.2027.
4.	Physics, Materials Science, Mathematics and Statistics	7	29.05.2013-31.12.2023.
5.	Geography and Earth Sciences	6	24.04.2017-24.04.2023.
6.	Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management, and Computer Science	5	29.05.2013-22.08.2023.
7.	Internal Security and Civil defence	3	05.06.2013-31.12.2024.
8.	Information and Communication Sciences	5	16.06.2021-17.06.2023.

9.	Education, Pedagogy and Sports	24	12.06.2013-31.12.2024.
10.	Chemistry, Chemical Engineering and Biotechnology	3	24.05.2013-31.12.2023.
11.	Arts	1	24.11.2021-25.11.2027.
12.	Psychology	3	21.06.2019-21.06.2025.
13.	Sociology, Political Science and Anthropology	9	12.06.2013-31.12.2024.
14.	Social Welfare	2	14.09.2022-13.09.2028
15.	Religion and Theology	3	22.05.2013-31.12.2023.
16.	Law	4	21.06.2019-21.06.2025.
17.	Translation	2	14.05.2013-31.12.2024.
18.	Management, Administration and Real Estate Management	8	29.09.2021-30.09.2027.
19.	Language and Culture studies, Native Language Studies and Language Programmes	21	26.06.2013-31.12.2024.
20.	Healthcare	13	31.05.2013-31.12.2022.
21.	History and Philosophy	6	24.05.2013-31.12.2023.
22.	Environmental Protection	3	05.06.2013-31.12.2024.

The UL study programmes in several study fields are also available in seven UL branches located in the regions of Latvia. In the academic year 2022/2023, 7 different study programmes in 2 study fields, ranging from short cycle professional higher education study programmes, professional bachelor study programmes to master's study programmes, are being implemented in the regional branches. See Table 1.1.2. for the number of study fields and study programmes in the regional branches.

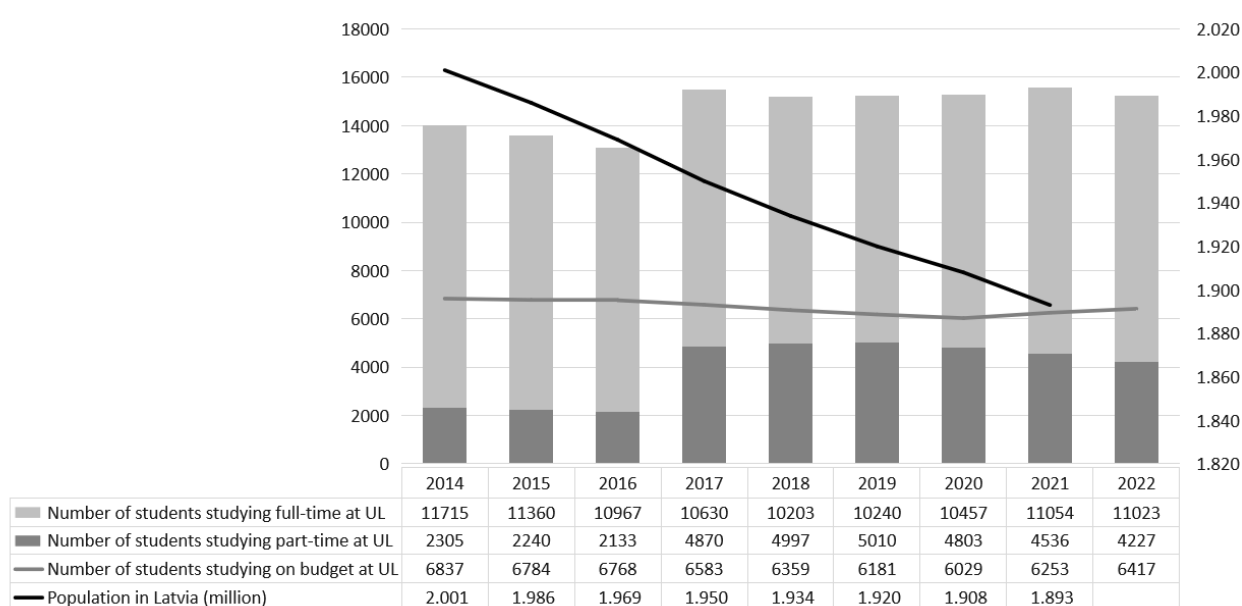
*Table 1.1.2*

***Number of study fields and study programmes implemented in the regional branches of the UL, data as of 2022***

Regional branches	Aluksne	Bauska	Cesis	Jekabpils	Kuldiga	Madona	Tukums
Number of study fields	2	2	2	1	2	1	1

Number of study programmes	4	4	6	5	7	2	5
Number of students	80	194	480	131	298	74	316

As of October 1<sup>st</sup>, 2022, the total number of students studying at the UL is 15 250, 42% of whom are financed from the state budget. Around 10% of students study at the UL regional branches. In total, almost five thousand new students are enrolled every year. See trends of the number of students over a period of nine years in Figure 1.1.1.



**Fig. 1.1.1.** Number of students at the UL compared to the population of Latvia, 2014-2022

UL medium-term development strategy for the period from 2021 to 2027 ([the UL Strategy 2021-2027](#) in Latvian and English) was approved on June 28<sup>th</sup>, 2021, by the Senate decision No 2-3/90. With the cooperation of the involved parties and the analysis of the national and international competitiveness of the UL, the mission of the UL has been revised and strategic goals have been defined in six development directions—three in each—in the core business and institutional areas. Development goals have been set for science, studies, public education, as well as in the domains of staff and organisational culture, environment, and governance. *The UL Strategy 2021-2027* envisages the further development of the UL as an internationally recognised science centre, the development of unique study and lifelong learning programmes, as well as the offer of competitive working and study conditions. The UL continues the work initiated in the previous strategic period to achieve the highest level of scientific excellence, as well as to promote student-centred learning and develop a modern study environment. The involvement and contribution of the UL to the society of Latvia is being purposefully promoted. The UL is improving the working conditions and environment necessary for talent development. Sustainable growth is playing an increasingly vital role and is becoming a crosscutting principle in all its areas of activity. Significant attention is paid to ensuring academic integrity and strengthening the value-oriented organisational culture of the UL. See Table 1.1.3. for the current strategic goals and development directions of the UL.

Table 1.1.3

### ***The UL Strategic Goals Map, 2021-2027***

<b>Development directions</b>	<b>Strategic goals</b>
<b>Development of principal activities</b>	
1.D. Scientific excellence	1.G. Internationally recognized research university
2.D. Development of studies	2.G. Unique study offer and high competitiveness of graduates
3.D. Contribution to society	3.G. University activities as a basis for the growth of Latvia
<b>Institutional development</b>	
4.D. Talent development	4.G. Development- and excellence-oriented HR policy
5.D. Environment and governance	5.G. Green thinking, attractive, sustainable university environment, and effective administrative support
6.D. Organisational culture	6.G. Inclusive, cooperation- and innovation-focused culture

The outcomes of the implementation of *the UL Strategy 2021-2027* will be measured by twenty-one performance indicators, five of which have been designated as *the UL Key Performance Indicators*. They are – research funding from foreign sources per full-time equivalent of academic staff in EUR, co-publications with foreign partners in *Scopus* and *Web of Science* databases (%), the percentage of graduates who are satisfied (rated at least ‘good’) with the quality of their studies (%); the percentage of foreign students at UL (%), as well as the commercialisation revenue (EUR/thousands).

#### **1.2. Description of the management structure 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 main decision-making bodies of the UL are the Constitutional Assembly, the Senate, the Council, the Rector, and the Academic Arbitration Court. See Table 1.2.1 for the proportion of the composition of the main decision-making bodies of the UL and the terms of the elections.

*Table 1.2.1*

#### ***Characterisation of the terms of election, proportion of the composition, and authority of the main decision-making bodies of the UL***



Decision-making Body	Term of Election	Total Number of Participants	Representation of Academic Staff	Representation of General staff	Student Representation
Constitutional Assembly	3 years	200	65%	10%	25%
Council	4 years	11	45.5%*		
Senate	3 years	50	76%	4%	20%
Rector	4 years	1	100%		
Academic Arbitration Court	3 years	5	80%		20%

\*In the UL Council there are 11 members, of whom: five, selected in accordance with the procedure laid down in the Constitution of the University, are nominated by the Senate (45,5%); one, an eminent academic outside the University, is nominated by the President of the Republic (9%); five representatives of the public in accordance with the procedure established by the Cabinet of Ministers, involving the public in the selection process (including graduate organizations, industry associations and employers, representatives of academic, research and creative organizations, persons with internationally significant achievements in science, arts or business, representatives of sectoral ministries and local governments), shall be selected by the ministry under whose supervision the higher education institution is placed and nominated by the Cabinet of Ministers (45,5%).

For characterisation of the authority of the main UL decision-making bodies, see chapter 1.2. of *the UL Quality Management Handbook*. (*The Quality Management Handbook* is available in the section *Other attachments*)

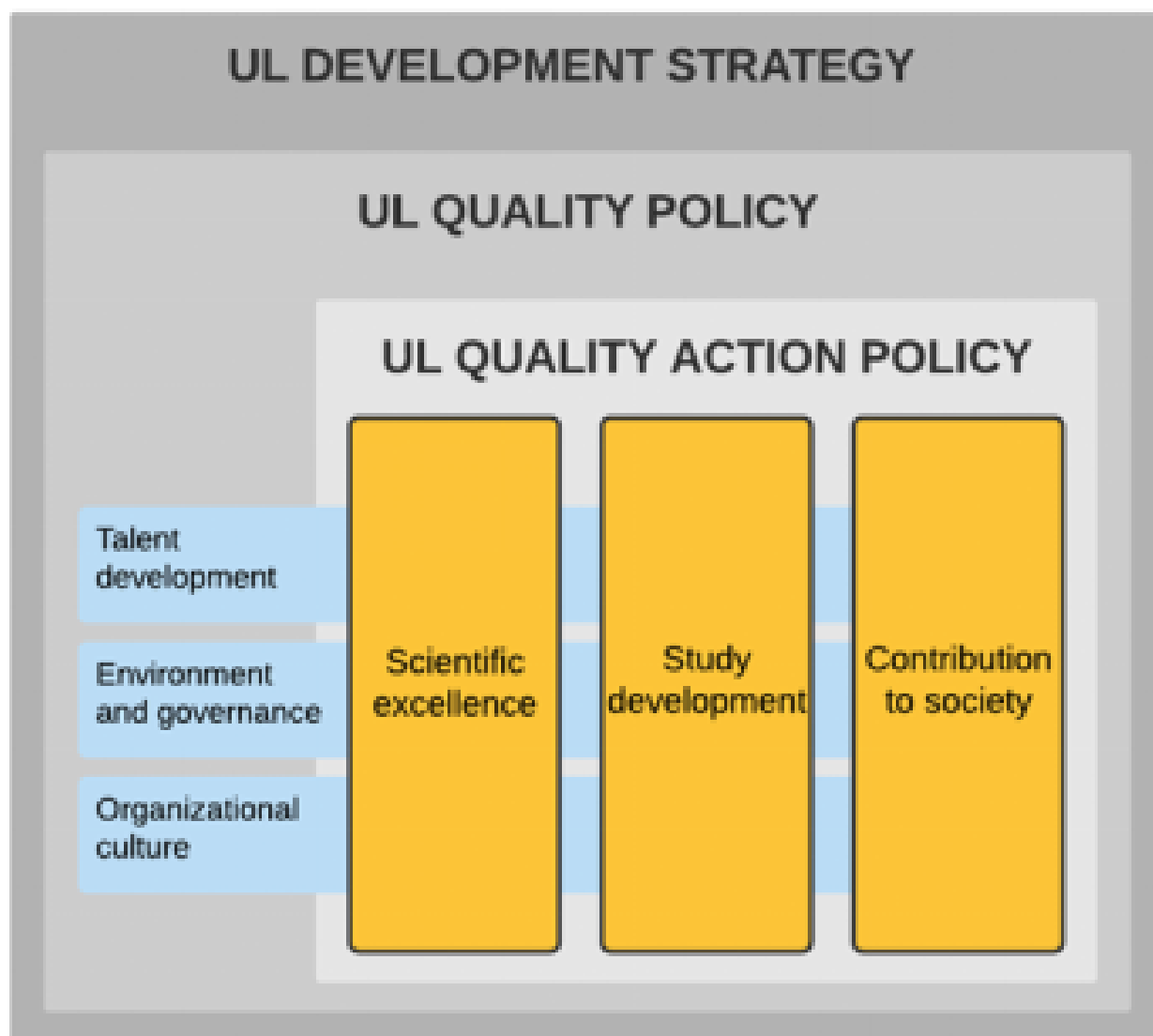
The governance structure of the UL: [LV](#), [ENG](#)

### **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. Description of the stakeholders involved in the development and improvement of the quality assurance system and their role in these processes.**

The [Quality Policy](#) and the resulting [Quality Action Policy](#) are a set of quality-related principles, objectives and the actions necessary for their achievement. UL quality is defined as a measure of excellence, which characterises the ability to meet and exceed the visible and future needs of the involved parties, as well as to ensure the compliance of processes with the regulated requirements of the relevant sector, and international standards recognised in the organisation management.

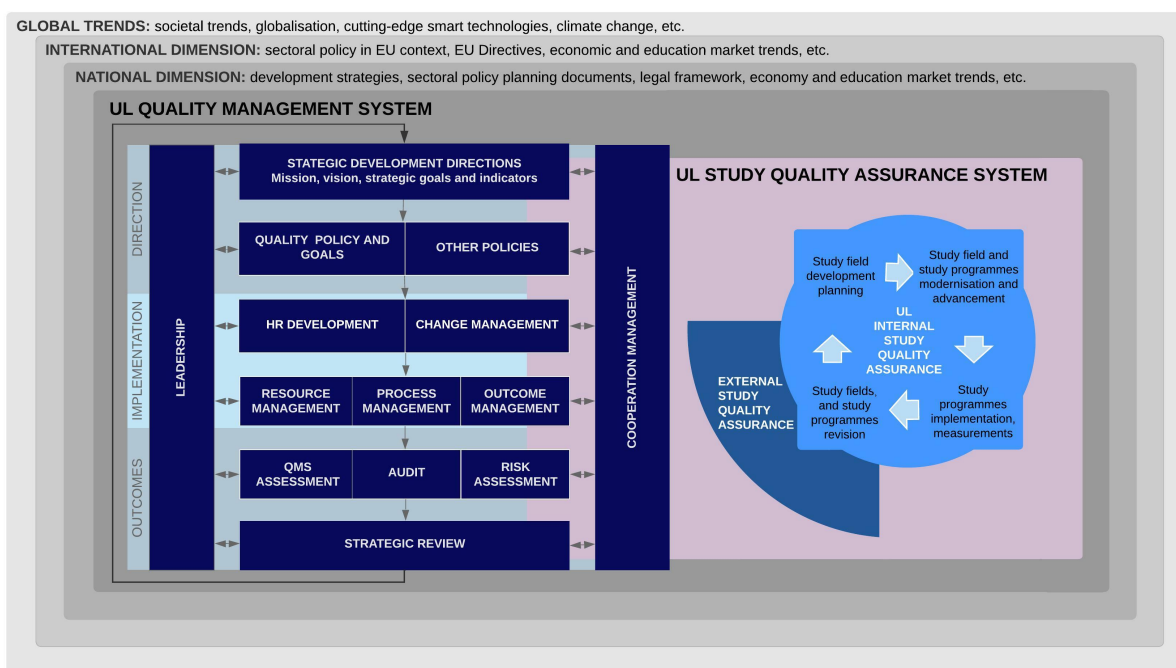
**The quality management system** of the UL is implemented in accordance with the principles of the *Total Quality Management* (TQM), integrating the approach of excellence into the corporate culture of the UL. For the implementation of total quality management, the UL uses an internationally recognised and applicable quality management methodology – the *European Foundation of Quality Management* (EFQM) excellence model. In the core activities the quality management system is deepened by developing internal quality assurance systems integrated into

the quality management system, which are based on current sectoral standards and frameworks. The internationally recognised *Results-Approach-Deployment-Assessment-and-Refine* (RADAR) methodology is used to ensure the cycle and continuity of quality management at the UL; the *Plan-Do-Check-Act* (PDCA) approach is used in quality assurance systems.



**Fig. 1.3.1.** *Hierarchy of the Quality Policy and Action Policies at the UL*

Figure 1.3.2 provides a diagram of a quality management system with an integrated quality assurance system for studies. For a more detailed description of the UL Quality Management System, see Chapter 2.1 of the *UL Quality Management Handbook*. (*The Quality Management Handbook* is available in the section *Other Attachments*)



**Fig. 1.3.2.** *The UL Quality Management System and Principles of the Study Quality Assurance System of the UL*

To ensure the quality of higher education, the UL implements the Quality Assurance System for Studies, which includes procedures for planning, ensuring, measuring, and evaluating the quality of higher education in accordance with the requirements of legislation of Latvia, *the European Standards and Guidelines (ESG) for quality assurance in the European Higher Education Area (EHA)*, as well as for internal needs. In the UL planning for the development of the study field and improvement of the study programmes for a period of 6 years is ensured. The procedure for the implementation of study programmes is established in the internal legal acts of the UL, including regulation of the development of new study programmes, admission requirements, matriculation and registration for studies, development, implementation and review of study courses and modules, planning, implementation and assessment of study internship, organisation of assessments and final examinations, and rotation, the principles of academic integrity and their observance, exmatriculation, awarding of diplomas and certificates, the recognition of knowledge, skills, competence acquired through non-formal and extra-curricular education or in professional experience, recognition of learning outcomes achieved in the previous education, and referencing of academic activity, the procedure for conducting surveys, submission of student proposals and complaints, contestation of administrative decisions, doctorate promotion process, etc. UL ensures that the measurements and data necessary for quality assessment and improvement are collected and used for both immediate corrective action and regular evaluation and planning of further improvement. The 6-year study field development plan is monitored annually, the measurements are analysed, and the SWOT is discussed, if necessary, by introducing changes to the operational study programme implementation plans, to the study field plan or, when assessing the overall development of study fields within the framework of the UL Strategic Control, by making amendments to the UL Strategic Action Plans. For more information on quality assurance of studies, see Chapter 3.1 of *the UL Quality Management Handbook*. For the breakdown of responsibilities for quality management and assurance, see Section 2.5 of *the UL Quality Management Handbook*.

The UL quality assurance system is based on the participation of key stakeholders in the quality assessment and improvement of the UL activities. Stakeholders of the UL are natural or legal persons, domestic and international, who use the services of the UL or whose socio-economic situation is affected by the activities of the UL. The key stakeholders are defined in Article 12 of *the UL Quality Policy*. For the description and examples of the roles of key stakeholders in quality management, see Section 3.2, subsection 1.2 (Table 3.6) of *the UL Quality Management Handbook*.

**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 2(1) of the Law on Higher Education Institutions 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 justification.**

1.	The higher education institution/ college has established a policy and procedures for assuring the quality of higher education.	<p>The UL has formulated the Quality Policy, which is detailed in the Quality Action Policy in line with its strategic core activities.</p> <p>For quality assurance of higher education, the UL Studies Quality Assurance System (in compliance with ESG) has been implemented and integrated into the UL Quality Management System (in compliance with EFQM). For more information, see Part I, Section 1.3 of this document and Section 3.1 of the UL Quality Management Handbook (The Quality Management Handbook is available in the section Other attachments)</p> <p>The establishment, maintenance, and improvement of the UL quality management system are performed by the management and heads of core structural units (deans of faculties) and their delegated employees. The Academic Department is responsible for the establishment, implementation, and improvement of the study quality assurance system, in close cooperation with the heads of study fields and directors of study programmes. Two collegiate committees have been established for quality assessment with the participation of the UL stakeholders: The Quality Advisory Committee and the Study Programme Quality Assessment Committee. For more information, see Section 2.5 of the UL Quality Management Handbook.</p>
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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.	<p>The development and internal approval of study programmes are stipulated in the Regulations of the University of Latvia on Study Programmes and Continuing Education Programmes (the UL Senate Decision No 102 of 24.04.2017). For more information, see Section 2.4 of this report, as well as subsection II of Section 3.1 the UL Quality Management Handbook.</p> <p>Periodic quality review of study programmes is stipulated in the Procedure for Preparation of Annual Reports on UL Study Fields (the UL Order No 1/290 of 14.07.2020). For more information, see Section 2.4 of this report, Section 3.1, subsections IX, and X of the UL Quality Management Handbook.</p>
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.	<p>Information related to learning outcomes, including assessment, is contained in study course descriptions, the preparation and updating of which, as well as the rules for their publication, are stipulated in the Procedure for the Development and Actualisation of Study Courses at the University of Latvia. Process and assessment of entrance examinations and final examinations, as well as the assessment and recognition of learning outcomes achieved in previous education or professional experience, are regulated by the relevant regulations of the UL. For more information, see Part II Section 1.4. of this report.</p> <p>The desired ethical and fair conduct and justice are ensured at the UL by internally regulating issues related to the academic freedom and academic integrity, electing, and ensuring the Academic Arbitration Court, and ensuring the operation of the Academic Ethics Committee, as well as regulating the principles of protection of intellectual property rights. For more information, see the Quality Management Handbook, Section 3.2, subsection 2.1.</p>
4.	Internal procedures and mechanisms for assuring the qualifications of the academic staff and the work quality have been developed.	<p>The principles of personnel management at the UL in the areas of personnel selection, labour relations, motivation system and personnel development are defined in the UL Personnel Management Policy. Accordingly, the development of academic staff is planned for the medium-term, and training plans are drawn up for the year. The qualification requirements of the staff are defined in the internal regulatory enactments of the UL in accordance with the external regulatory enactments, however the requirements for ensuring the quality of work – within the framework of regular staff appraisal, including the analysis of students' satisfaction with the delivered study courses, as well as the results of scientific activity. For more information on attracting, engaging, developing, and retaining staff: see the UL Quality Management Handbook, Section 3.2, subsection 3.2.</p>

5.	<p>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.</p>	<p>Information on students' grades is accumulated in the information system of the University of Latvia (hereinafter – ULIS) and analysed in the framework of study course implementation (including student-centred approach) and study programme improvement. Satisfaction of students and graduates with the study programme is monitored through communication activities of staff involved in the implementation of study programmes, representation of students and graduates in decision-making and advisory bodies, as well as by conducting surveys in accordance with the Procedure for the Organisation of Regular Surveys to Evaluate the Study Process at the University of Latvia (the UL Order No 1/334 of 22.08.2016). For more information on the involvement of stakeholders in quality assurance see Section 3.2, subsection 1.2 of the UL Quality Management Handbook.</p> <p>Issues related to the efficiency of academic staff, available study resources and their costs are monitored in the core structural units (faculties, institutes, etc.) as well as centrally. For more information on study information management, see Section 3.1, subsection VII of the UL Quality Management Handbook.</p> <p>The performance management system of the UL results had been introduced and implemented at the UL, within which the key performance indicators of the UL are monitored according to which further strategic decisions are made. For more information, see Section 3.2, subsection 7 of the UL Quality Management Handbook.</p>
6.	<p>The higher education institution/ college shall ensure continuous improvement, development, and efficient performance of the study field whilst implementing their quality assurance systems.</p>	<p>The development of each study field is planned in accordance with the 6-year development strategy of the UL. The monitoring of the plan and the evaluation of its effectiveness are conducted within the framework of the annual self-assessment of the study field. These processes take place at the level of the respective Study Field Council, the core structural unit(s) implementing the study field (a study field may be implemented by several faculties), as well as at the level of the administration and the Senate.</p> <p>The UL provides the external evaluation required by the legislation, obtaining additional external quality certificates for individual programmes. For more information, see Part II, Section 2.4 of this report.</p> <p>To promote the quality and competitiveness of the study programmes of the UL, UL creates and finances internal grant projects (Fund for improvement of the study quality of the UL), as well as attracts external funds (European Social Fund (<a href="https://www.ozolzile.lu.lv/projekti/eiropas-socialais-fonds/">https://www.ozolzile.lu.lv/projekti/eiropas-socialais-fonds/</a>)) (available only in Latvian), Erasmus+ (<a href="https://www.ozolzile.lu.lv/projekti/erasmus/">https://www.ozolzile.lu.lv/projekti/erasmus/</a>)).</p>

## 2.1. Management of the Study Field

**2.1.1. Aims of the study field and their compliance with the scope of activities of the higher education institution/ college, the strategic development fields, as well as the development needs of the society and the national economy. The assessment of the interrelation of the study field and the study programmes included in it.**

The UL study direction “Chemistry, chemical technology and biotechnology” implements the academic Bachelor study programme “Chemistry” (BSP “Chemistry”) and academic Master study programme “Chemistry” (MSP “Chemistry”). The Doctoral (PhD) study programme “Chemistry” had been implemented separately until 2022 when it was incorporated (as one of the strands) in the merged science PhD study programme “Natural Sciences (Chemistry)” (licenced in 2021, the study field “Life Sciences”). The new PhD study programme preserves methodologically and content-wise all the doctoral study courses in chemistry and additionally offers a broad interdisciplinary collaboration. This means that chemistry studies continue to maintain the continuity between the three academic levels, in line with the three-cycle degree system of the Bologna Process. See Table 6 for the programmes in the field of study. The Bachelor and Master programmes were first accredited in 2001, then again in 2007 and 2013. The term of accreditation of study programmes in the field of study has been extended from 2019 until 31 December 2023, in accordance with the amendments to the Law on Higher Education that entered into force on 01.01.2019 and in accordance with the amendments to Article 48 and Article 48.1 of the Transitional Provisions of the Law on Higher Education that entered into force on 23 January 2019. Since 2013, various changes had been gradually made to the MSP “Chemistry”, so in 2021 they were submitted and approved (Decision of the Academic Information Centre's Study Quality Commission (SQC) “On changes in the study field and programme” No. 2021 /16-I (13.10.2021).

Table 6.

*Study programmes in the study field “Chemistry, chemical technology and biotechnology”*

No.	Level and title of the study programme	LRE code	Duration and scope (CP)	Type and form of studies	Language/s of instruction	Awarded degree and/or qualification	Place/s of implementation
1.	Academic Bachelor's study programme "Chemistry"	43441	3 years; 120 CP	Full-time studies	Latvian	Bachelor in science degree in chemistry	Faculty of Chemistry
2.	Academic Master's study programme "Chemistry"	45441	2 years; 80 CP	Full-time studies	Latvian English	Master in science degree in Chemistry	Faculty of Chemistry

3.	Doctoral study programme "Chemistry"	51440	3 years; 144 CP	Full-time studies	Latvian	Doctor in science in Chemistry	The programme is incorporated in the UL Science Doctoral study programme "Natural Sciences" (licensed in 2021, the study field "Life Sciences")
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**The aim of the study field** is to prepare academically educated specialists in the field of chemistry at bachelor and master level, according to the needs of society and the specifics of the labour market, as well as to provide students with the opportunity to acquire theoretical knowledge, practical skills and participate in innovative, internationally competitive research and production, promoting the development of chemical science, thus contributing to the growth of the society of Latvia and the country.

The objectives and tasks of the development plan of the study field and its programmes have been developed in accordance with the development strategy of the University of Latvia ([the UL Strategy 2021-2027](#)) and the National Education Development Guidelines 2021-2027 "Future Skills for the Future Society" ([Cabinet Order No. 436 of 22.08.2021.](#)) (*in Latvian*) and national economic development trends and labour market needs in the chemical industry, both in research institutes and production companies, and they are as follows:

1. To ensure international recognition of the study field and research,
2. To implement student-centred, individualized and inclusive science-based studies,
3. To develop the study field as a knowledgeable, reliable and supportive partner for the society,
4. To guide the staff towards the excellence and cooperation in science, industry, society and delivering study courses,
5. To ensure sustainable, cooperation-directed study and research environment,
6. To promote the use of creative and innovative competencies, methods and tools in academic work.

The development plan of the study field (see Annex 3) provides for the promotion of the visibility and prestige of the field of study, strengthening the material and technical support of the relevant study programmes, as well as active research in the relevant subfields of science. Overall, this is in line with the [Education Development Guidelines 2021-2027](#) (*in Latvian*) Izglītības attīstības pamatnostādnes 2021. – 2027. gadam "Nākotnes prasmes nākotnes sabiedrībai", Ministru kabineta 2021. gada 22. jūnija rīkojums Nr.436 [National Education Development Guidelines 2021-2027 "Future Skills for the Future Society" (Cabinet Order No. 436 of 22.08.2021.)] which envisage the promotion of excellence in higher education, the strengthening of institutional governance and the strengthening of the quality of the academic staff.

Since 2012, the update and implementation of study programmes have taken into account the guidelines developed by the European Chemistry Thematic Network (ECTN) for the development of quality chemistry study programmes (<http://ectn.eu/committees/label/labels/>). The "Chemistry Eurubachelor" quality label has been renewed twice (2017 and 2021) for the Bachelor study programme. The "Chemistry Euromaster" quality label has been awarded for the Master programme from 2017 to 2021, and is now up for renewal for the updated Master programme.



**2.1.2. SWOT analysis of the study field 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 field 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 field for the next assessment period shall be provided.**

The SWOT analysis of the study field "Chemistry, chemical technologies and biotechnology" (see Table 7) and the Development plan of the study field have been developed with the participation of both staff and students of the Faculty of Chemistry (FC), and taking into consideration the employers' assessments. For the preparation of the self-evaluation report of the direction, a 12-member working group (Study Field Accreditation Working Group (SFAWG)) was established in October 2021, consisting of lecturers, representatives of employers and graduates, an administration representative and student representatives (membership approved at the Faculty of Chemistry Council meeting, 08.10.2021), which assessed the programmes and participated in the SWOT analysis and the development of the plan. The SWOT analysis and the Development plan of the study field were approved by the Study field "Chemistry, chemical technologies and biotechnology" Council and the Council of the Faculty of Chemistry.

The SWOT analysis shows the strengths, weaknesses, opportunities and threats of the study work and scientific work of the study field, analysing the impact of various internal and external factors on the outcomes to be achieved. On the basis of the SWOT analysis, a Development plan for the study field has been developed (Annex 3 "Development plan for the study field "Chemistry, chemical technologies and biotechnology"). It provides concrete measures and deliverables for the development of the study field in accordance with the Strategy of the University of Latvia.

*Table 7.*

*SWOT analysis of study field "Chemistry, chemical technologies and biotechnology"*

## Internal factors

### Strengths

### Weaknesses

<p>1) The most comprehensive higher education in chemistry in Latvia; broad representation of the main chemistry sub-disciplines and opportunities for specialisation;</p> <p>2) The study programmes included in the study field, together with the chemistry strand of the PhD programme "Natural Sciences", ensure the compliance with the three-cycle academic degree scheme of the Bologna Process;</p> <p>3) Experienced, highly qualified, creative and professional academic staff with extensive research and teaching experience and the use of modern technologies in the study process;</p> <p>4) The outcomes, content and methodology of study programmes are designed in line with the recommendations of the student-centred approach in European countries;</p> <p>5) The Academic Centre of the University of Latvia in Tornakalns - a modern study and research environment with significant laboratory and equipment capacity and extensive opportunities for the use of information technologies;</p> <p>6) Qualitative library resources and access to a large number of worldwide electronic databases of publications and e-resources;</p> <p>7) Development of research activities of the academic staff and students, the opportunity to participate in the implementation of Latvian and international research projects;</p> <p>8) Close cooperation with higher education institutions of Latvia, research institutes and production companies;</p> <p>9) High labour market demand;</p> <p>10) Active cooperation with chemistry teachers and their organisations, promoting student recruitment.</p>	<p>1) Relatively high drop-out rates - the number of students who do not complete their studies;</p> <p>2) A large number of Master's students have heavy workloads due to the need to work alongside their studies, which limits their time for studying and also for participating in exchange programmes;</p> <p>3) A low number of foreign lecturers in the academic staff;</p> <p>4) Relatively low number of foreign exchange students;</p> <p>5) The technical and material base lags behind the leading universities in Europe and the largest research centres in Latvia.</p>
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## External factors

### Opportunities

### Threats

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| <ul style="list-style-type: none"><li>1) The use of the Centre for Life Sciences Studies at the University of Latvia allows for a significant strengthening of interdisciplinary studies and research, as well as for greater cooperation with other universities;</li><li>2) Attracting EU funding to improve the quality of studies, as well as access to EU and national funding for the development of natural sciences study programmes and research projects;</li><li>3) The "<i>Chemistry Eururobachelor</i>" quality label for the Bachelor programme and the renewal of the "<i>Chemistry Euromaster</i>" quality label for the Master programme, and teaching of programme courses in English could contribute to attracting foreign exchange students and full-time students;</li><li>4) More advertising of study programmes on social portals, on the UL website and other websites, as well as in schools;</li><li>5) Increased involvement of graduates who are working in research and industry and employers in the study process;</li><li>6) Attracting qualified Latvian and foreign guest lecturers using EU funds;</li><li>7) Offering the full-time Master programme in English to expand the internationalisation of the programme;</li><li>8) Expanding cooperation with foreign universities and promoting studies and internships abroad through various exchange programmes.</li></ul> | <ul style="list-style-type: none"><li>1) The demographic situation in the country (including emigration) may affect the number of graduates in the coming years;</li><li>2) Significant gaps in the chemistry knowledge of school leavers, which will emerge in the coming years as a result of education reforms;</li><li>3) Continuing increases in infrastructure costs, which are becoming increasingly difficult to compensate;</li><li>4) The unpredictability of the funds allocated (attracted) to studies, and in particular to scientific research, can undermine the intensity and continuity of research;</li><li>5) Due to financial constraints, it is difficult to attract both highly qualified foreign lecturers and talented young scientists to work in the Chemistry programmes.</li></ul> |
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The evaluation of the strengths and weaknesses of programmes of the study field "Chemistry, chemical technologies and biotechnology" allows concluding that strengths dominate. The study programmes of this field offer topical studies based on core European values and a wide range of specialisation options in chemistry, as evidenced by the stable enrolments of students, however, at the risk of decline. Graduation rates are affected by a relatively high drop-out rate. In order to overcome this threat, the development plan of the study field foresees the implementation of a student-centred study process, systematic improvement of the course content, providing of a variety of innovative ways of course delivery, and establishing a support system for first-year students. It is also important to ensure feedback mechanisms, therefore, in order to find out students' and graduates' satisfaction with the study process, the development plan of the study field includes both student survey evaluations of study courses and regular graduate interviews as achievable indicators. In order to attract new students, active cooperation with Latvian schools ("Young Chemists' School" and other events) is ongoing and it is planned to continue this cooperation both through regular classes for pupils and through organizing professional development courses for teachers.

An important objective of the development plan is to ensure the international recognition of the

study field and research. Studies in the Latvian language contribute to the training of local young professionals, but one of the weaknesses of the field so far is the relatively low number of incoming exchange students and guest lecturers. To solve this issue, MSP "Chemistry" plans to introduce additional courses delivered in English and to attract full-time foreign students, thus creating a favourable environment for exchange students, as well as promoting the possibility for local students to take certain advanced courses in English. The lack of funding is one of the factors that hinders the long-term and regular attraction of foreign guest lecturers, however, the SAM 8.2.2 project "Renewal and Competence Development of Academic Staff at the University of Latvia" provided the basis for attracting one guest professor and gave the opportunity to involve two PhD students in teaching.

The strength of the study field is its experienced, highly qualified, creative and professional academic staff with extensive research and teaching experience, but its commitment to excellence and collaboration in science, industry and society remains important. Since the beginning of the study field, close cooperation with employers has been established, and it is planned to continue this cooperation in the future through contract work, research, and developing students' final theses. Nine cooperation agreements have been concluded (see Annex 15 "List of cooperation agreements"), as well as to encourage the placement of programme staff (internships) in both local and foreign institutions. The academic staff of the programmes have so far actively participated in the development of various international research projects and the potential in this respect is great (see Chapter 2.4. Scientific research). The Development plan of the study field therefore also envisages the increase in co-publications with foreign partners and the promotion of local projects and attracting the international funding through regular project applications.

There are many options for further development of the study field, which will likely help to avoid and overcome threats. The study field is being developed in such a way that students receive the best possible quality education in chemistry.

**ANNEX 3** Development plan for the study field "Chemistry, chemical technologies and biotechnology" 2021-2027

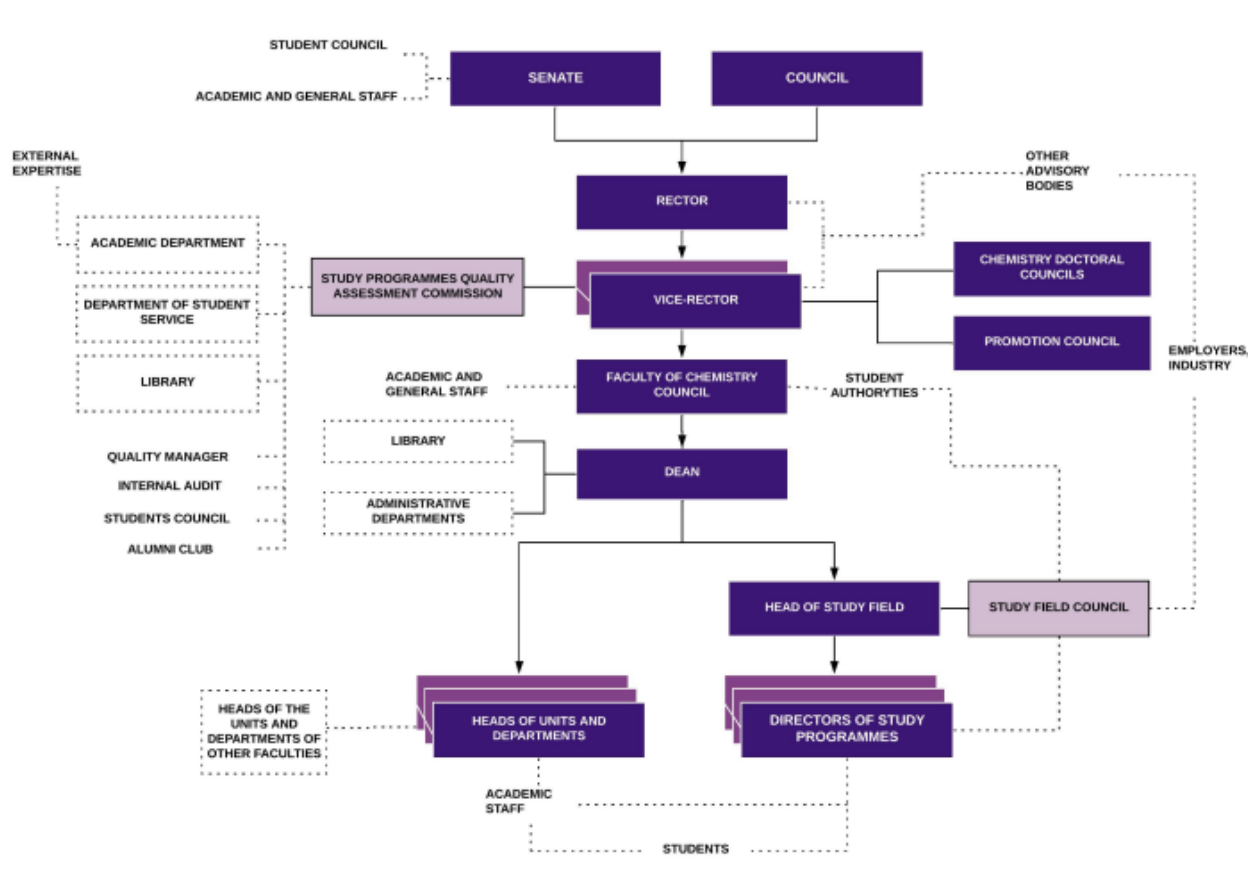
**2.1.3. The structure of the management of the study field and the relevant study programmes, and the analysis and assessment of the efficiency thereof, including the assessment of the role of the head of the study field and the heads of the study programmes, their responsibilities, and the cooperation 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 field.**

Collegiate responsibility for the administration of the study field lies with the UL decision-making bodies - the Senate, the UL Study Programme Quality Assessment Commission (headed by Vice-Rectors), Faculty Councils and Study Programme Councils, which evaluate study quality and decide on study quality assurance measures.

The governance of the University of Latvia is responsible for the quality of studies, delegating responsibility for the functioning of the study quality assurance system to the Academic Department.

Responsibility for the quality of the study field and the study programmes implemented therein lies with the head of the study field and dean, study programme directors, and sub-programme

The students' responsibility is defined in their rights and obligations to promote the achievement of UL goals and excellence in studies, participating in the UL collegial institutions and regularly expressing their opinion in student surveys. The governance scheme of the UL study field “Chemistry, chemical technologies and biotechnology” and study programmes included therein are presented below (see Fig. 4).



*The Regulations on the Management of Study Fields at the University of Latvia* (approved by the decision No.70 of the Senate, 27.01.2020) determine the procedure for the management, quality assurance and development of study fields at the UL, the functions and operating principles of the Study Field Council, qualification requirements, duties, responsibilities and rights of the head of the study field and director of the study programme.

Each UL study programme has a **study programme director** who directs the development and implementation of this study programme. The director of the study programme is approved by the Senate on the proposal of the Faculty Council representing the respective branch of science. The director of the study programme is a member of the Study Field Council of the respective branch and coordinates his/ her activities with the Head of the Study Field and Study Field Council. The director of the study programme is accountable for his/ her activities to the dean of the faculty. The responsibilities of the study programme directors include ensuring a well-functioning, sustainable operation of the study programme in accordance with the procedures specified by the University of

Latvia and other responsibilities. If the study programme covers several sub-programmes providing a specific qualification or specialisation, then each sub-programme may have their own head. In this case, part of the study programme director's duties is performed by the head of the sub-programme. The head of the sub-programme is approved by the Faculty Council. The head of the sub-programme is responsible for his activities to the director of the study programme.

The competence of **the head of the study field** (hereinafter - head of the study field) is to ensure the management and development of the study field. The Head of the study field is approved by the Rector on the proposal of the Dean of the faculty. The Head of the study field is accountable to the Study Field Council and the Dean. The heads of study fields, in co-operation with the study programme directors and the director of the UL Regional Centre, in cases when the study programmes included in the study field are implemented in the UL branches, ensure the revision, development planning and implementation of study programmes included in the study field. The heads of study fields organize the work of study field councils, as well as regularly organize the development of annual study field reports and their promotion for review and approval by the Study Programme Council and the Faculty Council. The heads of study fields in co-operation with the study programme directors and the UL Academic Department ensure the accreditation and re-accreditation of the study field and perform other duties.

**The Study Field Council** (hereinafter - the Study Field Council) is a collegial study field management body, which supervises academic, professional (including residency) and doctoral study programmes of all levels within one study field. The head of the study field, all the directors of the study programmes corresponding to the study field, the representatives of the students in the respective programmes (not less than 20% of the composition of the Study Field Council, promoting the representation of all levels of study programmes, as well as the largest possible number of study programmes, nominated by the Student Council), representatives of employers and co-operation partners of the study field (candidates are nominated by the heads of structural units, heads of fields, directors of study programmes and heads of sub-programmes). The composition of the Field Council may be complemented by involving graduates of the study field programme who are not involved in the implementation of the study field, as well as by field professors, associate professors and other qualified specialists (candidates are nominated by the heads of structural units, heads of study fields and study programme directors). The Field Council approves the development plan of the study programmes, evaluates the conceptualisation of new study programmes, changes in study programmes as well as approves the annual reports of study fields, the licensing and accreditation applications and related documents.

**The Faculty of Chemistry Council** (FCC), consisting of representatives of the academic and general staff, elected for three years, and student representatives, who make up at least 20 per cent of the councillors, decide on academic, economic, financial, and other activities of the faculty that are within the competency of the faculty or may be passed on to the Senate.

**The Study Programme Quality Assessment Commission** (hereinafter - SP QAC) assesses the performance of UL study fields and study programmes, as well as makes proposals to the Faculty Council and UL governance on the further development of the programmes. This commission reviews and provides opinions on study programmes, incl. evaluates applications for new study programme concepts, new study programmes and closure proposals, significant changes in accredited study fields that require a decision of the SP QAC, as well as applications for new study modules and sub-programmes. When evaluating the concepts of new study programmes, annual reports of study programmes and study fields, the SP QAC is guided by the opinion of anonymous, independent experts. The SP QAC consists of Vice-Rectors, Chairman of the Academic Commission of the Senate or his authorized representative, Director of the Academic Department, Representative of the Department of Student Services, Internal Auditor, Head of Quality,

representative of the UL Library, a representative delegated by the Student Council (hereinafter SC) and a representative delegated by the UL Alumni Club.

Starting the implementation of the UL Strategy 2027, based on the efficiency audit of the administrative structural units performed in 2021, in November 2021 the UL Administration was significantly reorganized, thus strengthening the strategic and quality management functions in the structural units of the Administration. One of the most significant changes is the integration of the Department of Studies of the University of Latvia and the Department of Science of the University of Latvia, forming the Academic Department, thus strengthening the unity of higher education and science.

The UL Administration includes the following units: Academic Department, Department of Study Services, Department of Communication, Legal Department, Department of Human Resources, Department of Information Technology, Department of Finance and Accounting, Document Management Division, Infrastructure Management Division, Real Estate Revenue Division, Institutional Data Analysis Centre, Project Support Centre, Academic Centre Development programme, Study Development and Management Improvement Programme. The Chancellor of the University of Latvia, the internal auditor, the quality manager, the head of the work safety system, and the information technology security manager also work in the administration. The study process is also supported by the Culture Centre, the Sports Centre and the Pre-study Training, which are under the supervision of the Head of the Administration.

**The Academic Department** has the most important role in the management of the field of study. The Academic Department consists of the Academic Policy Division, the Science Projects Division, the Study Quality Assurance Division and the Lifelong Learning Division. The competence of the Academic Department is to monitor the requirements of the regulatory enactments in force in the Republic of Latvia and changes therein, national and European Union development policy documents, as well as standards and good practices in the field of academic activities and lifelong learning. The Academic Department ensures the UL functional strategy, development of regulations and supervision of their implementation in these fields, to ensure the development, implementation of studies, as well as scientific quality assurance systems (or processes), monitoring and continuous improvement of their implementation, Ensuring regular review of academic and lifelong learning processes and risks, necessary control and identification and provision of preventive measures in accordance with the practice implemented by the University of Latvia, it ensures analytical identification of the results of academic activities and lifelong learning and the opportunities for their improvement, development of proposals for the Governance of the University of Latvia.

**The Department of Study Quality Assurance** monitors the observance of all study levels and internal regulation of lifelong learning, coordinates the medium-term development plan of studies and lifelong learning in cooperation with faculties, manages its implementation, monitors and provides methodological support in developing new study programmes and implementing and improving existing programmes; processes in studies and lifelong learning, organizes and coordinates external quality assessment, ensures centralized administration of doctoral student admission, doctoral studies and promotion process, provides support in the process of implementation and improvement of studies and lifelong learning at all levels, evaluates study and lifelong learning programme results and competitiveness, and participates in resource evaluation.

**The Department of Study Services** consists of the Academic Services Division, the Admissions Division and the Mobility Division, which are competent to organize and ensure the matriculation and exmatriculation of national and international students, the circulation of study documents and their registration, maintain the graduation documentation (qualification) register, including diplomas and graduates register, to provide students with social, cultural and other support

functions, as well as to provide consultations and information to students on social security, to inform potential applicants and candidates about the study process and study organization, as well as to ensure the administration and implementation of mobility programmes.

The Head of UL Quality control and Internal Auditor also participate in the development, maintenance, implementation, evaluation and improvement of the study quality management system.

According to the new *Regulations of the Administration of the University of Latvia*, the Department of Human Resources established **the Department of Academic Competence Development of the University of Latvia**, the functions of which will include the development and improvement of personnel development, career and succession planning systems, the implementation of personnel development measures, as well as the methodological management of academic personnel management issues by UL departments.

Cooperation with the **students' self-government of the faculty**, which represents the interests of the students in the activities of the faculty, including in solving the issues of the academic, social and cultural environment, plays an important role in the management of studies. Members of the Student Self-government are represented in the **UL Student Council**, thus participating in the management of the UL.

Study quality issues are regularly discussed in the Chemistry Study Field Council, chaired by associate professor J.Švirksts. According to *The Regulations on the Management of Study Fields at the University of Latvia* (approved by the decision No.70 of the Senate, 27.01.2020), the Council is composed of the Head of the Study Field associate professor A. Prikšāne, directors of two study programmes included in the Study Field: the director of BSP "Chemistry" associate professor J. Švirksts, the director of MSP "Chemistry" professor K. Jaudzems. The other members of the Council of the study field are representatives of students of both study programmes, four representatives of employers from two scientific (OSI and "BIOR") and two industrial companies (a/s "GRINDEKS" and a/s "BAPEKS"), as well as representatives of the academic staff of the study field.

The role of the Head of the Study Field is mainly to develop plans for the development of the SF, to facilitate the development of study programmes, to prepare annual self-evaluation reports and the documentation for the accreditation process, which is done in close cooperation with the directors of all study programmes. The study programme directors ensure the success and sustainability of study programmes by ensuring the cooperation with the study programme directors of other fields of study. The administrative staff of the Faculty of Chemistry: the Dean of the faculty, the Executive Director and the support from the study secretaries and methodologists also play an important role in the development of the study field. The governance structure of the study field is clearly oriented towards the development of the study field and the improvement of its programmes.

All decisions regarding the development of the study field and the improvement of programmes are taken in a collegial and efficient manner, in accordance with the established management system, and allow for prompt response to trends in the development of natural sciences, changes in the demand of the labour market and the implementation of student-centred education.

**ANNEX 4.** The management scheme of the field of study "Chemistry, chemical technologies and biotechnology"

#### **2.1.4. 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 options for the students to have their**



**study period, professional experience, and the previously acquired formal and non-formal education recognised within the study field by providing specific examples of the application of these procedures.**

#### **Student admission procedures and requirements:**

- [Terms of Admission at University of Latvia](#)
- [Terms of Admission and Criteria for Undergraduate](#) (available only in Latvian)
- [Terms of Admission and Criteria for Postgraduate Studies](#) (available only in Latvian)
- [Terms of Admission and Criteria for Doctoral Studies](#)
- [The Procedures for the Initiation of Studies in Subsequent Study Stages at the University of Latvia](#) (available only in Latvian)

#### **Normative regulations governing recognition procedures:**

- [Regulations on the recognition of knowledge, skills, competence acquired outside of formal education or in professional experience, recognition of study results achieved in the previous education, and referencing of academic activity at the University of Latvia](#)
- [University of Latvia procedure for recognition of competencies developed outside formal education or through professional experience and learning outcomes achieved in previous education](#)

The admission process at the UL and, consequently, also with the study programmes in the study field “Chemistry, chemical technologies and biotechnology” is regulated by *the Terms of Admission at the University of Latvia* and its subordinate orders, which determine the procedures for the given academic year:

1. Admission requirements and criteria for undergraduate programmes.
2. Admission requirements and criteria for higher-level study programmes.
3. Admission requirements and criteria for doctoral programmes.
4. Admission requirements and criteria for residency study programmes.
5. Admission procedure for the academic year.
6. Registration fee in the admission.
7. Tuition fees for completion of the full study programme.
8. Number of study places for admission.
9. Procedure for the development of entrance examination materials.
10. Composition of the Admission Committee.
11. Composition of the entrance examination boards.
12. Date and place of entrance examinations.

Requirements and criteria for study programmes are reviewed and updated annually, and according to the Article 46 of *the Law on Higher Education Institutions*, they are published on the UL website by November 1<sup>st</sup>. Admission procedures vary by study level.

**Enrolment in undergraduate studies** is centralized through the 'Single Enrolment in Undergraduate Programmes', which integrates the enrolment in 12 universities in Latvia. The competition for study places is based on the results of the centralized examinations or the secondary education certificate grades of the persons who have acquired secondary education before 2004, who have been exempted from the centralized examinations or have completed their secondary education abroad. In the case of study programmes that do not have relevant centralized examinations, additional requirements for specific grades are set, and the programmes

requiring special skills or aptitude set an additional entrance examination. As a result, applicants are ranked according to their scores. Programmes may provide benefits to National Olympiads and other contests winners (for more information on admission requirements, see the description of each study programme).

For BSP "Chemistry" applicants, the competition criteria are based on the time taken to complete secondary education.

**Eligibility criteria for persons who have completed secondary education starting from 2004:**

Option 1 - CE in Latvian\*, CE in English or CE in French or CE in German\*, CE in Mathematics\*, The average assessment of all the CEs passed\* CE in Chemistry\* is taken into account only if the person has passed it.

Option 2 - CE in Latvian\*, CE in English or CE in French or CE in German\*, CE in Mathematics\*, CE in Chemistry\*, Average of all CEs passed\*.

\*The following coefficients shall be applied to ensure comparability between results of centralised examinations:

- a coefficient of 0.75 is applied to the examinations at the optimal level of learning, equating them to the examinations at the highest level of learning;
- a coefficient of 0.50 is applied to examinations at the general level of content acquisition, equivalent to examinations at the highest level of content acquisition;
- centralised examination results obtained before 2022 are equated to the optimal level of learning and are weighted by 0.75, equating them to the highest level of learning.

For persons who completed secondary education before 2008, the centralised examination in mathematics may be replaced by the annual grade in mathematics (or the average grade in algebra and geometry) of the secondary school leaving certificate.

**Eligibility criteria for persons who completed their secondary education before 2004 (not included), persons who completed their secondary education abroad or persons with special needs:**

- annual average grade in Latvian language and literature
- annual grade in chemistry or mathematics (or average grade in algebra and geometry)
- average annual grade in certain subjects.

**Specific requirements:** a pass (minimum grade 4) in physics, chemistry and mathematics (algebra, geometry) in the final year of secondary education;

**Additional points:** 20 points are awarded for the 2023 participants in the School of Young Chemists who have received a certificate;

**Advantages:** 1st - 3rd prize winners of the Latvian National or International Chemistry Olympiad in 2022 and 2023 or 1st - 3rd prize winners of the Latvian National Students' Scientific Conference in the field of chemical sciences in 2022 and 2023.

**Enrolment in Master's degree programmes** is decentralized, at each faculty, but with uniform deadlines. Enrolment is based on grades obtained during undergraduate studies. In programmes that allow for prior education in various fields, the entrance examination is used to determine the correspondence of the candidate's prior knowledge to the field of the study programme.

MSP "Chemistry" has updated the admission requirements following the experts' recommendation

during the evaluation of the changes to the Master's programme in October 2021. The admission requirements are that MSP "Chemistry" admits students with a Bachelor's degree or a second-level, professional higher education (or equivalent) in chemistry, chemical technology, material sciences, natural sciences, pharmacy and food technology. The competition shall take into account the results of previous education. **Calculation formula:** weighted average mark ( $60 \times 10 = 600$ ) + total (or average) mark ( $40 \times 10 = 400$ ) in the final examinations. There are no entrance examinations.

For studies in English English language proficiency (at least B2 level) is required.

The UL provides an opportunity to commence studies also in subsequent study stages, in accordance with the *Procedure for commencing studies in subsequent study stages at the University of Latvia* (the UL 07.06.2022 order No 1-4/332). A precondition for commencing studies in subsequent study stages is the recognition of previously acquired study courses or knowledge, skills, competencies, learning outcomes acquired in previous education, which is regulated by the *Regulations on UL Procedure for Recognition of Competencies Developed outside Formal Education or Through Professional Experience and Learning Outcomes Achieved in Previous Education* as well as the *recognition and alignment of academic activity* (the UL Senate Decision No. 2-3/ 86 of 28 June 2021) (hereinafter - the Regulations) and the *UL Procedure for the recognition of study courses and knowledge, skills and competencies acquired in study courses and outside formal education or through professional experience and learning outcomes achieved in previous education* (the UL Order No. 1-4 / 543 of 04.11.2021).

Applying to commence studies in subsequent stages, the application must be filled in and the necessary documents must be attached. The Recognition Committee for the assessment and recognition of competencies acquired outside formal education or through professional experience and learning outcomes achieved in previous education (hereinafter - the Recognition Committee) or the director of the programme, if the student renews their studies in the same UL programme, evaluates and recognises previously achieved learning outcomes that corresponds to the learning outcomes in the study courses of the respective UL study programme. Final examinations are not recognised.

Recognised learning outcomes are included in the academic obligations fulfilled by the student. Recognition of study courses, recognition of education acquired through non-formal and extra-curricular education, also taking of additional study courses, or taking assessments is a paid service, in accordance with the UL price list of paid services, which is approved annually.

The UL evaluates and recognises knowledge, skills, competence acquired through non-formal and extra-curricular education or through professional experience, and learning outcomes achieved in the previous education. During application, documents confirming the achieved learning outcomes must be enclosed/attached – certificates, employer's statements, recommendations, project results, job descriptions, etc. Learning outcomes achieved through professional experience may be recognised only in the part of the respective study programme that contains an internship or as intended learning outcomes in the study course of the study programme or study module, which confirm acquired practical knowledge. In cases stipulated in the Regulations of recognition, the Recognition Committee may ask the applicant to pass assessments required in the respective study course or in its part.

Study course recognition in undergraduate and postgraduate study programme is conducted mainly when students return from international exchange programmes or resuming or continuing studies at later stages after changing or discontinuing studies started at the UL or other HEI. In certain cases, the recognition of professional experience is done in the s programmes by referencing knowledge, skills and competence acquired in the professional activity to the internship intended in

the study programme.

It is possible to reference academic activity, which is conducted outside of doctoral study programme, to the requirements of the respective doctoral study programme, also to recognise study courses or internship taken at the UL or other HEI, including, international exchange programmes. Requirements for the referencing of academic activity admissible in the doctoral programmes are defined in the recognition regulation and procedure.

Offered opportunity by the UL to perform recognition of learning outcomes achieved through non-formal and extra-curricular education, including, continuing education programmes, is rarely used.

For the UL students, who **study** or undergo **internship** within the framework of various international exchange programmes, the recognition and referencing of learning outcomes achieved during mobility is carried out in accordance with the above-mentioned regulation and procedure regulating recognition at the UL, and the *Procedure for Organising Erasmus+ Programme Mobility at the UL* (the UL Order No1/363 of 18.12.2014). Before going on mobility, the student coordinates the plan of mobility study courses or internship with the study programme director, indicating in it also study courses of the UL, which will be recognised and not required to study after returning to the UL. If changes to this plan are made during the exchange, they are agreed upon with the study programme director. Also, in case of internship mobility, the duration and place of internship, as well as the terms of recognition, are agreed upon with the study programme director. In accordance with the UL regulations, the compliance of learning outcomes achieved during the mobility with the regulations of international exchange programme and requirements of the UL programme are considered in recognition of these learning outcomes. Recognition of learning outcomes achieved and mastered during the mobility is performed by the study programme director of the respective study programme or the Recognition Committee, based on transcript of records from the partner HEI or statement from the internship place. After making positive decision, the recognised learning outcomes are included in the fulfilled academic obligations of the student.

In BSP "Chemistry" the most frequent recognition of study courses takes place in the following cases - when the student returns from an exchange programme (Erasmus+ or other), as well as persons enrolled in the Bachelor's study programme request recognition of study courses acquired during previous studies in other Higher education institutions (more often RTU) or in other faculties of UL, if their scope and content are appropriate to the study programme. Students have every possibility to have their courses recognised if they have not been able to complete their studies at another higher education institution. In such cases, the Programme Director or the Recognition Committee evaluate the scope, outcomes and content of the previously completed courses and decide whether to acknowledge the courses.

In the MSP "Chemistry", the most frequent course recognitions are for students renewing their studies in this programme or returning from exchange studies abroad. Only in few cases, some courses have been recognised for students who have already graduated or studied in another UL MSP programme, e.g. a course acquired in data processing in the MSc programme in Physics was recognised (one student). Students who had completed the 5-year professional pharmacist study programme had the course in chemical toxicology acknowledged (two students).

All chemistry students participating in exchange programmes have to agree on a mobility course or placement plan with the programme director before going on mobility. As chemistry students go on exchange to relevant chemistry programmes, practically all courses are either directly comparable or recognised in the restricted elective part. If a student participates in a mobility placement, the student must agree with the relevant programme director before the mobility departure how the skills acquired in the placement will be recognised. Placements undertaken by students in the BSP and MSP "Chemistry" programmes are normally treated as coursework/research project. During the

reporting period, there have been no problems with the recognition of credit points obtained in exchange programmes.

The opportunity to recognize the results of studies obtained outside of formal education, including further education programs, is very rarely used. MSP and BSP students participate in various summer schools and other international events, their certificates are equated to a course of study only in cases where the appropriate number of credit points has been acquired, for example, the *International Conference-School "Advanced Materials and Technologies"* has been organised in Palanga for many years, but the credit-bearing certificate is received only in 2021, so this allows Bachelor students to equate it to an Elective Part course of 2CP.

Recognition of learning outcomes achieved in professional experience has not been relevant for students in the field during the accreditation period.

In the academic year 2022/2023 in the study field "Chemistry, chemical technologies and biotechnology" there are 14 students out of all active students who have recognised study courses. In the reporting period in both programmes of the study field more than 40 students have recognised or equated study courses completed in other higher education institutions of Latvia and other faculties of the UL, and 39 students have recognized study courses and internships completed in foreign exchange programmes.

**ANNEX 5.** "Certification on continuing the acquisition of education"

**ANNEX 6.** "Certification on the compensation of the losses"

**ANNEX 7.** "Example of the study agreement"

#### **2.1.5. 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.**

In conformity with the *Law on Higher Education Institutions of the Republic of Latvia*, the UL internal regulation "*Procedure for Development and Updating of Study Courses at the University of Latvia*" stipulates that information on the conditions, aims, tasks, requirements for obtaining credit points, study content, organization and tasks of the students' independent work, planned learning outcomes (knowledge, skills, competence) and their assessment methods and assessment criteria are included in all study course descriptions, which are available to students in the UL Information System (LUIS) and UL e-learning environment. The registration and recording of students' grades are done in the UL e-study environment of respective study course. The UL has formulated the learning outcomes for each study programme and for each study course as a set of knowledge, skills, and competence. Courses in study programmes are developed in accordance with the principles of gradation and succession. To ensure that, the mapping of intended learning outcomes is performed on the level of study programme and study courses. (See Annex 25B and 25M for BSC and for MSC "Mapping of study courses for achieving the learning outcomes of the study programme").

At the beginning of studies in the Faculty of Chemistry, students are informed of the organisation and implementation of studies in the relevant study programme, but when commencing the

acquisition of each individual study course, the academic staff inform students specifically about the organisation, content, requirements, learning outcomes, examinations and evaluation criteria, as well as explain the integral quality of the study course for achieving the overall outcomes of the study programme. The students can familiarize themselves with the criteria and conditions for the assessment of student achievement and the binding procedures in the course descriptions and e-learning environment, as well as at the beginning of each course during the first lecture when each lecturer introduces students to the course organization, briefly describes the requirements for intermediate assessments and final examinations, describes grading criteria and examination procedures, without changing these requirements and grading criteria throughout the semester.

The organization of the study course examinations and the assessment of the students' achievements is performed in accordance with the "Law on Higher Education Institutions" and the *"Procedure for Organizing Study Course Examinations at the University of Latvia"* (University of Latvia Senate Decision No 211 of 29.06.2015) elaborated by the UL Constitution and applicable to the assessment of the learning outcomes of full-time and part-time students enrolled in UL study programmes at all levels.

There are two types of assessment in each course: the interim assessment or so-called semester examinations and the final examination. The overall assessment of the acquisition of a study course consists of the overall assessment of interims (not less than 50% of the total score) and the assessment obtained in the examination (not less than 10% of the total score). The tests may be carried out in writing or orally or in a combined form (written and oral). The students' achievements are assessed through tests and the assessment mechanisms corresponding to the teaching methods used in the study process, both during contact lessons and in the organization of students' independent work. Written examinations dominate in the courses of Chemistry study programmes.

Taking an examination is a mandatory requirement for obtaining credits for the acquisition of a study course. The procedures and criteria for the assessment of interims are determined by the responsible department in accordance with the profile of the study course. The study course acquisition rating is calculated in the UL centralised recording system according to the algorithm specified in the course description, taking into account the assessments obtained in the interims and examination, and recorded in the examination report.

Types of interim assessment include quizzes, individual work, practical work, laboratory work, reports, and other types of work according to the profile of the study course. The number and type of interim assessments are specified in the description of the study course. To be assessed on the acquisition of a course, the assessment obtained for the examination is to be positive. In both Chemistry study programmes, students need to have a positive assessment in all interim tests, only then the student is allowed to sit for the examination, and the examination assessment should be positive. Only in this case the learning outcomes have been achieved. The overall assessment for the study course acquisition is calculated in the UL e-study environment according to the algorithm specified in the course description, taking into account the assessments obtained in the interims and examination, and recorded in the examination report.

According to the specifics of the study course, special requirements can be set for the attendance. Most frequently in BSP "Chemistry" and MSP "Chemistry" the attendance of laboratory works and seminars is compulsory.

At the end of each study course there is a final examination: examination or defence (course work, final project, term paper, field course, internship). The procedure of defence and assessment of the course work, final paper is stipulated in UL normative acts..

The learning outcomes are evaluated on a 10-point scale. If allowed by external regulations,

learning outcomes can be assessed as "passed" or "failed" with the permission of the UL Vice-Rector. The course is considered to have been successfully completed, i.e. the grade is positive if the grade on the 10-point scale is not lower than '4' (almost satisfactory) or 'passed'. In this case, the student earns credit for the course.

In the Chemistry study programmes, almost all study courses are assessed on the 10-point scale. The only exception is the common UL study course "*Civil protection*" that is assessed with "tested" or "not-tested". This course is included in the compulsory part of the bachelor programme; master students acquire this course if students have not acquired it in the previous level of studies.

For the assessment of students' knowledge, skills, and competence in each study course in the 10-grade system, the study result criteria described beforehand are used. The basis for formulation of criteria is learning outcomes formulated in each study course and explanations of assessments (see Table 2.1.5.1), which is published in *the Procedure for the Development and Actualization of Study Courses at the University of Latvia* (the UL Order No 1/277 of 10.08.2018).

Table 8

Assessment rubrics		
Acquisition level	Grade notations	Explanation (pursuant to Cabinet Regulations No 141, 512, 240 and the UL Senate Decision No 211 of 29.06.2015)
very high acquisition level	10 (with distinction)	knowledge, skills and competence exceed the requirements of the study programme, study module or the study course and testify to the ability to carry out independent research and deep understanding of problems
	9 (excellent)	knowledge, skills and competence fully comply with the requirements set for the study programme, study module or the study course and the students possess the ability to use the acquired knowledge independently
high acquisition level	8 (very good)	the requirements of the study programme, study module or the study course are completely met, though in certain issues the students do not have an understanding deep enough to use the knowledge independently for solving more complex problems
	7 (good)	in general, the requirements of the study programme, study module or the study course are met but occasionally the inability to use the acquired knowledge independently is established
average acquisition level	6 (almost good)	the requirements of the study programme, study module or the study course are met, but there is a lack of deep understanding of the problem and inability to use the acquired knowledge
	5 (satisfactory)	in total, the study programme, the study module or the study course is acquired but there is insufficient knowledge of certain issues and inability to use the acquired knowledge
	4 (almost satisfactory)	in total, the study programme, the study module or the study course is acquired, however, there is insufficient understanding of some basic concepts and there are considerable difficulties in practical application of the acquired knowledge

<b>low acquisition level</b>	<b>3 (weak)</b>	the knowledge is superficial and incomplete; the student is unable to use it in specific situations
	<b>2 (poor)</b>	superficial knowledge of only some issues; most of the study programme, study module and the study course is not acquired
	<b>1 (very, very poor)</b>	no understanding of the fundamentals of the course and almost no knowledge of the study programme, study module or the study course

The needs of students and the relevance of assessment methods and procedures to the achievement of the objectives of study programmes are analysed and developed, taking into account the experience of academic staff, by analysing the results achieved by students and the results of surveys conducted over several academic years. Students in the surveys recognise the importance of clearly formulating the outcomes of the studies and defining the evaluation criteria, as well as the regular feedback on student achievements in the study process. In order to ensure this, the academic staff systematically analyse their experience, collaborate with colleagues, analyse student achievements and develop course descriptions by investing the description of the results of studies and their evaluation criteria, thereby providing justification for the assessment.

Evaluating learning outcomes, the basic assessment principles formulated in the regulations of the Cabinet No 240 the *Regulations Regarding the State Standard for the Academic Education* (13.05.2014) are observed:

- **the principle of openness of the assessment** – the UL has established a set of requirements for evaluating learning outcomes in line with the aim and objectives of the study programme as well as the aim and objectives of study courses;
- **the principle of the possibility of reviewing the assessment** – the UL has established the procedure for reviewing the obtained assessment;
- **the principle of mandatory assessment** – it is necessary to obtain a positive grade on completion of the entire study programme content;
- **the principle of the variety of types of assessment used in the grading** – different assessment types are used in the assessment of the study programme;
- **the principle of conformity of assessment** – during the assessment student is given an opportunity to demonstrate knowledge, skills and competence in relevant tasks and situations. The content included in assessments corresponds to the content specified in the course programmes.

The basic criteria for the assessment of graduation examinations are determined in the *Requirements for Elaboration and Defending of the Graduation Papers (bachelor's, master's, diploma, and qualification papers) at the University of Latvia* (the UL Order No 1/38 of 03.02.2012). Additional criteria may be determined for the assessment of graduation papers, which are approved by the respective Faculty Council on a proposal from the relevant Study Programme Council.

The evaluation of final papers in the chemistry study field programmes takes into account the quality of the work, the author's report, the quality of the material presented, as well as: scientific novelty of the results, and the relevance of the results to a scientific publication. The results may have already been published or reported at a conference, and this is also taken into account in the evaluation. This is described in "Methodological rules for preparing, designing and evaluation of course papers and final papers" (approved by the FCC, 13.04.2022), which is available in the course descriptions of the relevant courses.

**The set of methods and procedures chosen and used for the assessment of students' achievements is in line with the objectives of study programmes and the needs of**



students.

**2.1.6. Description and assessment of the academic integrity principles, the mechanisms for 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.**

The UL in its activity respects the principles of fair and responsible conduct as stipulated in the *Academic Ethics Code of the University of Latvia* (the UL Senate Decision No 2-3/46 of 26.04.2021) and in the *Regulations on Academic Integrity at the University of Latvia* (the UL Senate Decision No 2-3/48 of 26.04.2021); these regulations are publicly available to staff of the UL and its students.

Academic integrity is carefully monitored in the study process of the field study programmes. These principles are discussed in the course "Introduction to Studies and Research", in the introductory lectures of other courses and especially in working on the course papers and the final paper. One of the most significant breaches of the principles of academic integrity, which has been repeatedly observed, is the submission of identical laboratory reports or calculations to several students, for example, in the BSP "Chemistry" courses "*Physical Chemistry I*" and "*Physical Chemistry II*". Such cases have been discussed with the involved students and they have been reprimanded by the lecturer. The submitted protocols have been cancelled and the laboratory works have been redone.

To prevent the violation of academic integrity, the UL has developed the Unified Computerised Plagiarism Control System (hereinafter – System), (UL Order No. 1/125 of 22.04.2014). The System verifies students' final study research paper (qualification paper, diploma paper, bachelor's thesis, master's thesis, doctoral thesis). The procedure has been established to determine further course of action (UL supplement to Order No. 1/125 of 22.04.2014) in the event of plagiarism.

The UL as the developer of the System and its operator constantly updates the System and provides other higher education institutions with the opportunity to use the System on the basis of a cooperation agreement. Currently, based on the cooperation agreement, seven higher education institutions in Latvia, Daugavpils University, Liepaja University, Latvia University of Life Sciences and Technologies, Riga Stradins University, Rezekne Academy of Technologies, University College of Economics and Culture and Riga International School of Economics and Business Administration use the System.

The system automatically compares the graduation papers uploaded in these HEI systems, including material available on the Internet, and in the event of a certain percentage match, the study programme directors are sent an overview of these test results, whereby the same text snippets from different authors are simultaneously viewed. The programme directors pass this information on to the appointed supervisor and reviewer for review and, in the event of a suspected breach of academic integrity, pass on the results of the analysis to the respective Graduation Examination Commission for final consideration.

Anti-plagiarism tools have been successfully used since 2014 to control the final papers of study programmes in the study field "Chemistry, chemical technology and biotechnology". During the entire period of electronic checking of final theses, the plagiarism control system has not revealed plagiarism of either the Bachelor's, or the Master's theses, which would result in the suspension of students from the defence of their theses. Chemistry students' final theses are dedicated to topical research issues, they are individualised and based on original measurements, calculations

and syntheses. In 2014, there was one case in MSP “Chemistry” where the control system found individual paragraphs in a student's MSc thesis which raised suspicions of self-plagiarism. A committee set up by the Dean of the Faculty and Graduation Examination Commission examined the Master's thesis and found that it was not plagiarised and the thesis was successfully defended.

During the reporting period, in one case (2021), the examination board found fictitious (fabricated) spectrum results in a bachelor thesis and the student received a failing grade. Consequently, the final thesis was worked out the following year on a different topic.

16.12.2022. UL concluded an agreement with the company Turnitin LLC for the implementation and use of the anti-plagiarism tool for the needs of the UL.

The following plan has been developed for the implementation of the process in the UL:

January 2023 – delivery and testing of the plagiarism system in the UL e-study environment with the aim of technically testing the delivered system.

February 2023 – user training for working with the system, seminars, etc.

March 2023 – piloting in the production environment of e-studies.

April-June 2023 – system tests and elimination of the imperfections of the process.

September 2023 – fully completed implementation of the system and handing it over to the UL users.

**The cooperation of several HEI in the field of using the Anti-plagiarism tools promotes more effective control of study works in each HEI and Latvia overall. The System works successfully in practice and promotes the importance of final examinations and their quality.**

## **2.2. Efficiency of the Internal Quality Assurance System**

**2.2.1. Assessment of the efficiency of the internal quality assurance system within the study field 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 field and the relevant study programmes.**

The functioning of a sustainable study programme that meets the objectives of the study field and study programme is ensured by systematically defining and implementing quality assurance procedures, including continuous monitoring and analysis of the implementation of the study programme and the use of measurements for the prompt implementation of preventive and improvement measures. The provision of management levels involved in the quality assurance of the study programme allows the programmes to be implemented in a predefined form according to predefined procedures, reacting promptly to possible changes in the situation, with quality-related decisions being taken collectively or according to the division of competences. An important methodological tool for quality assurance is the Quality Management System Manual of the University of Latvia, which identifies in detail the practice of the University of Latvia in ESG implementation.

The following activities are the most relevant for the implementation of quality improvement

measures within the internal quality assurance system:

The internal quality management of the study field is ensured in accordance with the quality assurance mechanism and procedures established at the University (see Chapter 1). The management of the study field involves students, teaching staff, directors of study programmes, employers' representatives and graduates.

The programmes of the study field regularly update the content of the study courses. During the reporting period, the Academic Development Project (2018) was developed to implement the student-centred approach, within the framework of which the study courses were updated, specifying the course outcomes and particularizing knowledge, skills and competences, as well as explaining in more detail the requirements for obtaining the final assessment. The updating of the courses was accompanied by a detailed mapping of the programme outcomes.

In order to improve the study opportunities for potential ERASMUS exchange students, it was decided to prepare for part of the MSP "Chemistry" courses materials in English, which was also implemented within the Academic Project (2017). A total of 10 course materials were prepared (*Organic Synthesis I, II and III, Stereochemistry, Modern Analytical Methods, Spectrometric analysis methods, Physical Chemistry, Solid State Ionics, Methods of Electrochemical Analysis, Chemical toxicology*). Unfortunately, during the reporting period, lectures in English were not delivered, because the number of ERASMUS students was insufficient to form a group (at least 5 students), but the prepared materials were positively evaluated and used also by the students who study the programme in Latvian.

To ensure the quality of the study process, regular surveys of students on the quality of the study course are conducted at the end of each semester. At the end of the last academic year before receiving their diplomas, students complete a questionnaire evaluating various aspects of the study process. The results of the surveys are compiled and evaluated in order to make improvements in the respective programme and study courses. At the same time, continuous feedback is also provided with employers, both through surveys and by assessing students' achievements at the end of the defence session of students' final theses. This is possible because some of the final theses are developed in employers' institutions and employers are involved as committee members and reviewers in the evaluation of final theses. This also allows to assess the quality of students' knowledge, to keep abreast of developments in the labour market and to assess the necessary improvements.

Results of the surveys and the recommendations of employers and students are discussed annually with both lecturers and students, analysed at the Study Field Council and summarised in the Self-Evaluation Report of the Study Field. Thus, they serve as a basis for improving the quality of the study programme. Regular reports, changes and accreditation self-assessments of the Study Field are evaluated by the Study Field Council and the Chemistry Faculty Council, the UL SP QAC, including independent experts from the academic staff of the University, who evaluate the programmes of the Study Field and make recommendations for its further improvement before its approval by the University Senate.

One of the problems in the chemistry study programme that is being addressed is the high drop-out rate, especially in the bachelor programme, which averages 50%. During the reporting period, various measures have been taken to reduce the drop-out rate through continuous consultation with students and assessment of the situation in discussions with the academic staff, as well as by following the quality improvement recommendations of the University in this area. In 2014, the system of support of mentors (senior students) was introduced, and since 2015 a mentor (lecturer) has been working to support first-year students. Mentors can receive expert advice on working with students. The tutor and the programme director are still the ones who follow the attendance of first-

year students, communicate with those who "start to miss classes", advise and help them to solve both learning and everyday problems. However, as the activities of tutors and mentors did not bring any visible improvement, in 2020/2021 the so-called "study groups" were introduced in the BSP "Chemistry", and PhD students from the faculty were involved in supervising the laboratory work in the first year and following the work of the study groups. Unfortunately, in November 2020, due to the Covid -19 pandemic, remote learning started and the work of study groups was not fully implemented and it did not produce visible results in reducing the drop-out. In 2021/2022, the Study Field Council, discussing the possibilities of reducing the drop-out rate, approved the development of the course "*Introduction to Studies and Research*", which allows both to explain the details of the study work and, by meeting employers, to give an idea of the job opportunities for chemists. In parallel, the work of the "study groups" is continuing, so that some slight improvement has been observed in the 2021/2022 academic year.

In the reporting period, a lot of work has been invested in improving the communication and student information process through the Faculty's website and social networking sites such as Facebook; a person has been appointed responsible for the immediate placement of information on the relevant information channels. In view of the 2020-2022 pandemic situation, the importance of distance learning has increased, with its implementation on the MS TEAMS platform, which allows to ensure effective control of the quality of studies.

During the reporting period, several normative acts of the University of Latvia have been updated and the necessary procedures have been improved, student surveys have been improved, professional competence development of the academic staff has been ensured, which has allowed to increase the number of survey respondents and, consequently, the objectivity of results. The continuing of regular meetings with student representatives has increased the engagement of students in the functioning of the quality system and, according to student surveys, the overall satisfaction with the organisation, content and environment of studies has increased.

The established quality control system ensures the maintenance of continuous feedback for informing the stakeholders on the learning outcomes and competences achieved by students and graduates. Thus, the assessment of the effectiveness of the internal quality assurance system in the Study Field during the reporting period is generally positive.

**2.2.2. Analysis and assessment of the system and the procedures for the development and review of the study programmes by providing specific examples of the review of the study programmes, the aims, and regularity, as well as the stakeholders and their responsibilities. If, during the reporting period, new study programmes have been developed within the study field, describe the procedures of their development (including the process of the approval of study programmes).**

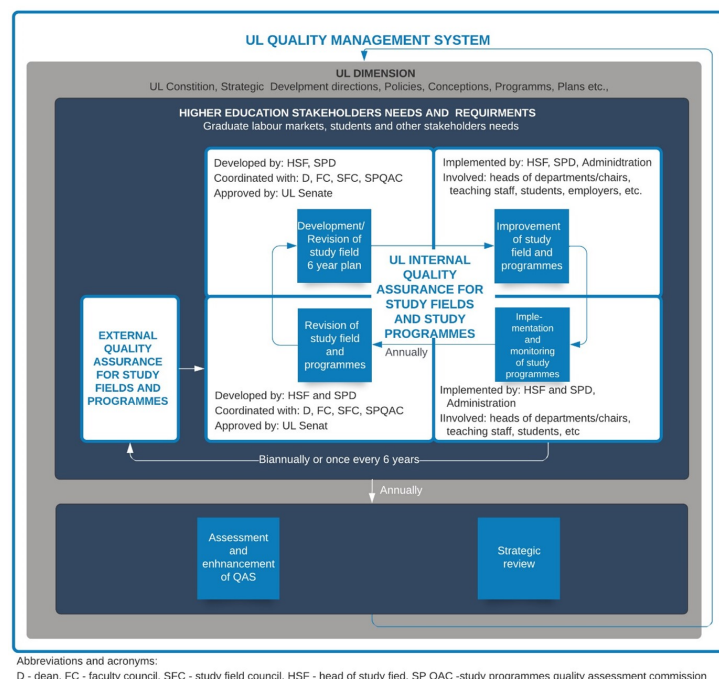
**Normative regulations, where the procedure and actions that should be followed during the creation and revision process of study programmes are stated in the:**

- [Regulations on University of Latvia Study and Continuing Education Programmes](#)
- [The UL Procedure for Preparation of Annual Study Field Reports](#) (available only in Latvian)

The quality of the field of study and its study programmes is managed through a Plan-do-check-act or Deming cycle, planning the development and improvement of the field of study over a six-year period, cascading its goals and objectives down to the level of each study programme and regularly

monitoring the requirements of stakeholders for effective planning, needs and proponents, in accordance with the UL Development Strategy, taking into account national and international sectoral policies and trends, as well as the impact of global environmental trends on the activities of the UL up to the level of study programmes.

**Within the framework of the quality assurance system** (see Fig. 5), the development of the study field and the interconnection of study programmes, the establishment of new study programmes, as well as the results of each existing study programme are planned, monitored, evaluated and reviewed, ensuring the involvement of all levels of the study field management in the quality assurance of studies, as well as representatives of key stakeholders. The review of study programmes is regulated by the procedure for preparation of the annual reports of the study fields of the University of Latvia (UL Order No. 1/255 of 13 July 2018).



*Fig. 5 Quality assurance system for the study fields implemented by the University of Latvia and the study programmes included in it*

The development of new study programmes is regulated by the Regulations of Study Programmes and Continuing Education Programmes of the University of Latvia (approved by the UL Senate Decision No. 102 of 24.04.2017), it is implemented in several stages, including coordination and evaluation at all levels of governance involved in the quality assurance of studies twice - by coordinating and approving the study programme concept, as well as coordinating and approving the study programme characteristics at the end of the process. For a detailed description of the development of the programme and the content of the concept, see the *Quality Management Handbook*, Chapter 3.1, Section II. (*The Quality Management Handbook* is available in the section *Other attachments*)

In the process of self-assessment and development of new study programmes, responsibilities are divided between the study programme directors, the head of the study field, the Study Field Council, the Faculty Council, the Academic Department and the Study Programme Quality Assessment Commission, as well as the Senate.

UL study field coordinators in cooperation with the directors of study programmes, prepare annual study field self-assessment reports (hereinafter - Self-assessment report). Self-assessment reports are approved by the Faculty Councils and submitted to the Academic Department. The Academic

Department checks self-assessment reports for compliance and submits the same to the SP QAC composed of all Vice-Rectors, the Chair of the UL Senate Academic Committee, the UL Students' Representative, the UL Alumni Club Representative, the UL Library Representative, the Quality Manager, the Internal Auditor, as well as representatives of the Academic Department and the Department of Study Services. The self-assessment reports reflect the implementation of the programmes, developments, newly introduced changes and evolution of the same as well as the assessment by stakeholders, both, in terms of student survey results and the assessment expressed by employers. In the process of self-assessment of study programmes, as well as development of a new study programme, the Academic Department also provides independent expertise, the implementation of substantiated proposals of which is considered at the SP QAC meeting. Accreditation self-assessment reports are prepared using the annual self-assessment results. The recommendations of the Accreditation and Licensing Evaluation Expert Group and the Study Quality Commission are evaluated by the Study Field Council, preparing a plan for the implementation of expert recommendations, which is agreed with the SP QAC. More information on the content of the self-assessment of study programmes and the process of ensuring external accreditation in Sections IX and X of Chapter 3.1 of the *UL Quality Management Handbook*.

During the reporting period, no new study programmes were developed in the study field "Chemistry, chemical technologies and biotechnology". Self-evaluation reports of study programmes are prepared every year. During the accreditation period, minor changes have been made to the BSP "Chemistry". For example, in order to better prepare students for the preparation of the Bachelor's theses and to introduce them to the research work of a chemist, a study course "*Research project in Chemistry*" was created in the compulsory part of the programme in 2014, which includes learning all components of a scientific paper: literature analysis, conducting experimental work, analysis of results, etc. The decision was taken after the discussion with employers and supervisors, assessing the progress and quality of the final work. The course partly fulfils the function of an academic internship, as contracts are concluded with the institutions where the students work. Due to the requirements set by the UL Students and UL Administration, the first year of the Bachelor programme in the autumn semester of 2015 emphasised the acquisition of English starting it in the first semester (the course "*English for Chemists I*" 2CP), thus providing all students with foreign language studies. In accordance with the Regulations on the State Standard of Academic Education (Cabinet Regulation No. 240 of 13.06.2014), the course in environmental protection "*Sustainable Development of the Environment*" 2CP was included in the Bachelor programme, reducing the biology and physics courses by 1CP each. The reduction was possible due to partial overlapping with other courses. In accordance with these regulations, the study course "*Civil Protection*" has been included in the compulsory part of the 3rd semester starting with the academic year 2016/2017 in the amount of 1CP. From the academic year 2023/2024, the corresponding course in both the Bachelor and Master programmes will be "*Environment Protection*" 1CP, which meets the requirements and is offered to all programmes of the UL.

Changes to the MSP "Chemistry" were made immediately after accreditation (in 2013), following expert recommendations and consultation with employers, graduates and students. Firstly, in order to avoid overlapping with study courses of the BSP, the content of the courses was analysed and the credits of some courses were reallocated, e.g. in the course "*Methods of Electrochemical Analysis*" the number of credits was reduced from 6CP to 4CP, while in the course "*Sample Preparation in Analytical chemistry*" the amount was increased from 2CP to 4CP. The course "*Water and Food Analysis*" was split into two separate courses: "*Analyses of Waters*" and "*Analysis of Foods*". All changes made to the programme were thoroughly evaluated and reviewed both by the Study Field Council and approved by the Council of the Faculty of Chemistry. The closure of two sub-branches "Food Chemistry" and "Didactics of Chemistry" in 2021 can also be considered as a

significant change, as there were no students in these sub-branches and these sub-branches are no longer chemistry sub-branches according to the Cabinet Regulations No.49 "Regulations on Latvian Scientific Branches and Sub-branches" (23.01.2018) and cannot be continued in doctoral studies in the field of chemistry. As the various changes made in the programme, cumulatively over almost 10 years, approached 20%, the changes to the Master's programme were submitted to the Academic Information Centre (AIC) for review in accordance with the quality control regulations. The changes were approved by the AIC Study Quality Committee, Decision "On changes in the study field and programme" No. 2021/16-I (13.10.2021).

The introduction of all changes in both programmes is evaluated in discussions with students, lecturers, employers, and approved by the Study Field Council, the Council of the Faculty of Chemistry, the Study Programme Quality Assessment Commission and the UL Senate.

The system of updating and reviewing study programmes and activities is aimed at involving all stakeholders and ensuring the highest possible quality of the study process.

**2.2.3. 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 field and the relevant study programmes are communicated by providing the respective examples.**

UL, in keeping with the principles of democracy and equality, and in line with *the UL Quality Assurance Policy*, in all stages of the study process, from admissions to final examinations, ensure the participation of applicants and students in the evaluation of the UL study process. In matters relating to the admission procedure, UL applicants have the right to lodge complaints with the Chairman of the Admission Board.

The right of UL applicants to lodge complaints regarding irregularities in the admission procedure are governed by the *Terms of Admission at University of Latvia* (the UL Senate decision No 2-3/68 of 31.05.2021), specifying the procedures for the lodging, processing, and appeal of the complaint.

However, to improve the quality of studies, students have the right to submit proposals and complaints concerning the study process and quality, the quality of material supply, duty fulfilment of the UL employees, service culture and cooperation, as well as dishonest or unethical actions from the UL employees.

To ensure the quality of the study process, in 2022 the UL reworked *the Procedure for the Submission and Resolution of Students' Proposals* and of 2002 and replaced it with *the Order of Submitting and Examining Proposals and Complaints of the Students* (the UL Order No 1-4/501 of 28.09.2022.) (hereinafter – the Procedure). This Procedure defines the form in which students, individually or in a group, can submit proposals and complaints, as well as its registration and reviewing order. Proposals and complaints can be submitted to faculty deans or vice rectors (in case they concern the deans work or if the submission may unfavourably influence the future of studies). The Procedure stipulates that replies to **students** about their proposals and complaints are to be submitted within the deadline set in *the Law on Submissions*. It should be noted that this Procedure states that faculty deans and vice rectors submit the report on received proposals and

complaints, as well as the decisions made regarding them in the previous academic year, to the UL Quality Manager by the end of each academic year. The UL Quality Manager assesses those reports, analyses tendencies, and prepares report to the Management of the UL. The established process demonstrates the internal control mechanism and cyclic monitoring of submission of complaints, decision making, respect to students' rights and interests, which is essential in ensuring acceptable functioning of this system as well as its possible improvement.

*The Procedure for the Organisation of Study Course Examinations at the University of Latvia* (the UL Senate Decision No 211 of 29.06.2015) has been developed and implemented for the comprehensive evaluation of UL study processes, where the right of students to file complaints regarding the procedures for study course interim assessments and study course final examinations, and the procedures for resolution of these complaints have been determined. The complaint is submitted by the student to the member of teaching staff who has evaluated the study course final examination within five working days from the moment the grade is inputted in the ULIS (on condition that the student has requested a justification for the assessment from the academic staff prior to submitting the complaint). The lecturer must review the application within 5 working days. If the lecturer considers that the student's application is not substantiated, they may submit the application to the respective head of structural unit for consideration and decision.

As regards the evaluation of graduation examinations, *Regulation on graduation examinations at the University of Latvia* (the UL Senate Decision No 183 of 27.12.2011), which stipulates that the students are entitled to appeal if the dean has not given them permission to take the graduation examinations or to appeal against the graduation examination procedure. The student receives the decision of the appeal commission, and can submit a complaint to the rector.

The UL also has an Academic Court of Arbitration, whose regulations provide for the opportunity to apply to this collegial institution for any study-related issues, including control over adherence to the principles of assessment.

The students have the right to appeal against the UL order on the exmatriculation in conformity with the *University of Latvia state budget subsidized study place competition (rotation) procedure* (the UL Senate Decision No 381 of 24.05.2010). In its turn, *the Study Fee Relief Procedure* (the UL Order No 1/89 of April 14, 2009) provides students with an opportunity to appeal against decisions on granting or refusing tuition fee discounts within one month from notification issued to the student by submitting a written application addressed to the Rector of the UL, to be considered by the Rector within one month.

Whereas *the Procedure for Granting an Academic Leave of Absence in the University of Latvia* (the UL Senate Decision No 178 of 01.12.2008) provides for the right to appeal against the decision of the dean refusing to grant a student the academic leave of absence. Also, *the Procedures for the Initiation of Studies in Subsequent Study Stages at the University of Latvia* (the UL Order No 1/128 of 08.06.2009) provides for the right to appeal within a specified period against the decisions made by the dean.

In compliance with the rights of students also outside the study process, for those students who use the UL student hotels, *the Internal Regulations of the Dormitories of the University of Latvia* (the UL Order No 1/171 of 30.06.2009) define the rights and obligations of students, including the right to submit complaints about problems in student hotels. These issues are addressed by the superior of a student hotel.

Every student has the right not only to use the right provided by *The Academic Ethics Codex of the University of Latvia* (the UL Senate Decision No 2-3/46 of 26.04.2021) to address the Academic Ethics Committee of the UL about possible ethical violations, but also to submit proposals for



improvement of the Code and its implementation to the Academic Ethics Committee of the UL.

The proposals and complaints are registered with the departments or commissions where they are submitted, as well as outcomes of the enquiry taken and respective resolutions.

At the normative level, *the Regulations on Visiting Students from the Latvian Higher Education Institutions* (the UL Order No 1/17, 25.01.2006) have defined the principle that visiting students also have the same rights and obligations as students at the UL, which means that the system of submission and consideration of complaints and proposals is applicable to these students.

It follows from the above that the centralised segment of the UL complaint and proposal submission and review system covers all the components of every student study life as it applies to enrolment at the UL as well as the full-cycle studies, final examinations, etc.

During the reporting period, no student complaints were received regarding the programmes represented in the Study Field, and no appeals were lodged regarding the marking of final theses.

During the reporting period, no any student complaints or written proposals were received regarding the programmes represented in the Study Field, and no appeals were lodged regarding the marking of final theses.

The faculty always pays attention to the opinions of students. Until now, written submissions have not been received, so all problems and proposal that appear in discussions with students are resolved through discussions with the student group, student self-government and/or lecturers. Usually, these are various organizational problems (about harmonizing the time table, about making video recordings of lectures, about the planning of seminar lessons and tests, etc.) Answers are given verbally or via e-mail. If necessary, the program director or administration follows up for the successful implementation of solutions.

**2.2.4. Provide information on the mechanism for collecting the statistical data, as developed by the higher education institution/ college. Specify the type of data to be collected, the regularity of collection, and the way the information is used to improve the study field. Describe the mechanism for obtaining and providing feedback, including with regard to the work with the students, graduates, and employers.**

To control, analyse and forecast the dynamics of the number of students, the UL collects data:

- characterizing the number of applicants and matriculated students and their profile, such as secondary education institution, year of institution graduation, assessment obtained in secondary education examinations, age, gender, previous higher education and the assessment obtained in such examinations;
- number of students, broken down by faculties, study programmes, study levels, study years, forms and types of studies, source of financing for studies, status of studies - ex-matriculated on the grounds of academic non-compliance, ex-matriculated on the grounds of financial non-compliance, ex-matriculated on the grounds of completion of studies, on academic leave.

In order to control the progress of students' studies and the implementation of the programme, the UL collects data on:

- intermediate assessment and final assessment of students' study courses, broken down by type of examination, final results of final examinations, weighted average mark; data are

collected once a semester;

- completion of the study programme, in accordance with the requirements set for the acquisition of the programme, broken down by study semesters, parts of the programme (obligatory part, restricted elective part, free elective part and others, according to the structure of the programme); data are collected once a semester;
- students' academic failures in credit points, by semesters, parts of the programme, study courses; data are collected once a semester;
- fulfilment of the tuition fee schedule provided for in the student agreement, broken down by study programmes and semesters.

In order to obtain information for planning and efficient use of study resources, the following statistical information is collected in connection with study programmes:

- financing of study places, broken down by state-funded, UL-funded and student-funded study places;
- the number of student scholarship recipients and the number of studies and student loans;

In order to prevent violations of the principles of academic integrity in the UL students' final theses and promotion papers, the UL ensures automatic examination of all submitted final theses and doctoral theses by using the unified computerized plagiarism control system, making a mutual comparison with the final theses of the University and other higher education institutions accumulated in the System.

Anti-plagiarism tools have been successfully used since 2014 in the programmes of the study field "Chemistry, chemical technology and biotechnology". No plagiarism cases have been detected in eight years.

In order to evaluate the satisfaction of students, graduates and employers with the study quality and its results, as well as to implement the necessary improvement measures, the UL organizes and compiles data from the following surveys:

- a survey on study courses and work of teaching staff;
- a survey at the start of studies;
- a survey of first-year students on study experience;
- a survey of final-year students on study experience;
- a survey of students, who discontinue studies;
- graduate survey;
- employers survey.

**A survey on study courses and work of teaching staff** is implemented in the ULIS every semester and is for all students (including internship study courses). With this survey the UL can learn the students' opinion on the content of relevant study courses in the specific semester and provides assessment of the teaching staff's work. The information obtained through this survey helps to improve the study process, eliminating imperfections and improve the study quality.

**A survey at the start of studies** takes place in the ULIS once per academic year. With this survey the motivation of students in choosing the university and study programme; sources of obtaining information about studies at the UL are ascertained, as well as the assessment of application and registration process is obtained. This survey helps the UL to build communication with potential students in the coming years, and to improve the admission process.

**A survey of first-year students on study experience** takes place in the ULIS one per academic year to learn students' opinion on different study aspects and on what support is necessary when starting studies. Thus, the information is obtained for improvement of study environment and

promotion of student adaptation.

**A survey of final-year students on study experience** takes place once per academic year. With this survey the assessment of potential graduates on further development of the study programme, improvement of study process, quality and study environment is ascertained.

To ascertain main reasons for study discontinuation and to promote the decrease of student dropout rate, **a survey of students, who discontinue studies** is conducted. The survey is conducted in the ULIS throughout the academic year.

The aim of **the graduate survey** is to collect information about the professional activity and further course of life of graduates, as well as to ascertain the opinion of graduates on the acquired education in the UL.

The aim of **the employers survey** is to find out the opinion of employers on the knowledge, skills and competence acquired by the graduates of the UL correspondence with the requirements of the labour market, as well as to obtain proposals for the improvement of the study quality. Surveys at their discretion are organised by programme directors using prepared surveys by the Academic Department.

Most of the regular surveys—survey on study courses and work of teaching staff, a survey at the start of studies, and surveys on study experience—results are gathered in two ways: (1) The summary of survey results for each study programme is generated separately, automatically by the ULIS; (2) The summary of surveys (except the survey on study courses and work of teaching staff) results on the UL as a total and on faculties is prepared by the Academic Department after the conclusion of the survey process, and they are published on the *My Portal*. The summary of a survey of students, who discontinue studies, results is prepared by the Academic Department, and they are published on the *My Portal*. However, the summary of graduate survey and employers survey results is organised at their discretion by study programme directors.

Survey results published on the *My Portal* are available to every student and employee of the UL with the username and password assigned to them. However, accessibility of the summary of survey results on the ULIS is different for various user groups. Moreover, similarly as students' grades some of the survey results, for example, assessment of study courses and work of teaching staff, is restricted access information.

Surveys on study courses and work of the teaching staff are fully available to each respective member of teaching staff about their own implemented study course; to programme directors – about teaching staff and heads of teaching staff departments (head of department or subdepartment, head of study field, vice-dean, and dean), as well as the UL SC and student self-governments of faculties.

The rest of surveys—a survey at the start of studies and surveys on student experience—summaries of results about their own study programme are available to students and programme director; on study programmes attached to the position – head of department or subdepartment, head of study field, vice-dean, and dean. Summaries of survey results on their own faculty are fully available to student self-governments of faculties, and on all study programmes to the UL SC.

Each year the head of the study field in cooperation with the study programme directors prepares a report on the operation of the study field and the programmes therein during the academic year. In the preparation of the report, statistical data is collected and analysed, and the obtained information is used for the evaluation and improvement of the study field. The report includes the following data, which are collected and analysed annually:

- number of students in programmes, showing the total number, number matriculated in the

first academic year, number of graduates, dropout rate, separately identifying different forms, types and languages of study;

- outcoming and incoming mobility of students, their participation in exchange programmes;
- composition of the teaching staff, indicating the position, number of academic staff with a doctoral degree, mobility of teaching staff;
- the ratio of students to teaching staff;
- the number of employers in the sector involved in the implementation of the programme;
- summary and analysis of the results of a survey of students about the courses and the programme.

Student evaluations and comments in surveys about the chemistry study programme and specific courses are an important source of information for improving the quality of the programme and courses. Since the academic year 2016/2017, **course surveys** have been completed by all students 2 times a year before registering for the next semester. The data is therefore complete and shows the quality of the courses and allows the quality of studies to be monitored. In the BSP "Chemistry" and MSP "Chemistry", all course evaluations received in the surveys below 5 (scale 1-7) are specifically analysed. The programme director will first discuss the views of the lecturer and students in order to assess the exact reasons for the low scores. A more detailed analysis of these courses has shown that the reasons are mainly related to the assessment of achievements, the untimely explanation of requirements, the organisation of laboratory work, etc. In general, solving mutual communication problems and adding the required information to e-courses reduces student dissatisfaction. The results of surveys are usually also evaluated by the Study Field Council, and sometimes students' comments also show various shortcomings. After the causes have been identified, further work is carried out to address the shortcomings. So far, the assessment in all courses has improved for the following year. For example, in 2016, the MSP "Chemistry" course "*Modern Analytical Methods*" had a score of 4.43. After discussions with the academic staff and students, the topics were sequenced and the lecturers' requirements were also aligned, so that the students' assessment of this course improved significantly in 2017 (6.0). Student comments initiated the improvement of laboratory works in the course "*Methods of Electrochemical Analysis*". The average grades of the courses are summarised in Annex 8 "Results of student, graduate and employer surveys". The Development plan for the study field foresees to continue improving the quality of study courses and to aim at eliminating low scores..

Student **surveys filled by students of the final year** are regularly analysed. The surveys describe students' satisfaction with the study process and its organisation in general. It is an important feedback that shows the quality of the programme. According to the surveys, some students have already entered the labour market at this point, so they evaluate the programme from the perspective of their possibilities. This allows to monitor the quality of the programme and to handle both organisational and content issues. Student comments are also important and are usually carefully considered. For example, in preparation of programmes for accreditation students recommendations to increase the offer of elective courses are taken into account in both the study plans of the Master's and Bachelor's study programmes.

**Graduate surveys** are carried out periodically. The graduates' opinion is essential for the improvement of study programmes. In this year's survey, graduates have identified important courses and areas of study where the programme should be strengthened. For example, the graduate survey showed that it is necessary to extend the study course "*Methods of Data Analysis in Chemistry*", that chromatographic methods are particularly important in the labour market, that basic knowledge of production technological processes is needed, etc. As the number of respondents to the surveys is rather small, graduate interviews are also practised to find out their opinions. These are usually organised to find out the employability, as well as to inform about

opportunities to study for a PhD or to offer job-improvement opportunities, etc.

**The employer surveys** help to identify the relevance of graduates' qualifications to changing labour market requirements, as well as to find out the knowledge and skills that need to be developed during the study process. Employers' suggestions were taken into account in the improvement of both study programmes, including study courses the content and skills of which are relevant to both scientific work and industry. For example, new courses have been created for the BSP "Chemistry" in line with employers' recommendations: "*Quality Assurance in the Laboratory*", "*Chemistry Technology*", the "*Research project in chemistry*" has been increased from 2CP to 4CP. On the recommendation of employers, the programme has also introduced a social humanities elective. The MSP "Chemistry" has expanded the sub-direction "*Organic and Biomolecular Chemistry*" and created new elective courses "*Chemical Biology*", "*Molecular Computer Modelling*", "*Biomolecular Structure*", "*Electrochemical Synthesis*" and "*Sustainable Chemical Processes*".

Overall, the statistical data collection mechanism set up by the University of Latvia ensures systematic data collection. The results of the various surveys provide feedback to students, graduates and employers. Overall, the information obtained serves the improvement of the study process.

#### **ANNEX 8. "Results of student, graduate and employer surveys"**

#### **2.2.5. Specify the websites (e.g., the homepage) on which the information on the study field 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 (State Education Information System (VIIS), E-platform).**

The target audience of the UL website <https://www.lu.lv/en/> (hereinafter referred to as the website) is the UL prospective and existing students, employees, cooperation partners, scientists and the general public.

The site is intended for access to and storage of public information, providing its visitors with an opportunity to familiarise themselves with the UL's activities as reflected in the digital environment on the internet.

The site consists of the following sections:

- ROTATING NEWS - important information of the University of Latvia through the visual identity of the University of Latvia, which has certain parameters and strengthens the image of the University and promotes its visibility in the digital environment.
- NEWS AND EVENTS - News and events at the University. Information prepared by LU departments and the Department of Communication and Innovation.
- DISCOVER UL - Information about studies, extracurricular activities, science.
- STUDIES - with subdivisions -
  - College study programmes,
  - Bachelor's study programmes,
  - Master's study programmes,
  - Doctoral study programmes,
  - Residency.

The information is prepared and posted on the website by the Communications Department in cooperation with the Academic Department and the Study Services Department.

The STUDIES section in Latvian provides information on programme goals, objectives, study outcomes, programme volume and duration, programme study language, information on job opportunities after graduation, as well as programme study plans. If you have any questions, please contact us for further information. This section also publishes study-relevant information under the heading STUDY PROCESS - Academic calendar, Lecture timetable, Tutorials, Key documents and forms, Information on mobility at higher education institutions, Recognition of experience/education, Lifelong learning opportunities as well as references to UL e-learning environment and LUIS information system.

The section contains information about the University of Latvia Libraries offer, Career Centre information. Student Council activities.

The two subsections STUDENT LIFE and EXTRACURRICULAR ACTIVITIES inform both existing and potential students about hostels, meals, parking and bicycle parking, mentor support, and information for people with disabilities. There is a wide range of information on how to enrich one's extra-curricular life with sport, culture.

The ADMISSION section contains information for school pupils, prospective and existing students. In this section, the pupils can get acquainted with the events and creative competitions organized by the respective faculty, the participation wherein and successful performance can give additional admission points. The prospective students may get introduced to the information on all levels of programmes, admission requirements, credit and scholarship information, as well as opportunities for the recommencement of studies on the site. The prospective students will be able to familiarize themselves with the most frequently asked questions and answers, information on Career Centre activities, preparatory courses and classes for school pupils.

Other Sections - Science, Cooperation, About Us. They provide more information about UL activities in research, projects, conferences, cooperation partners, normative acts, strategy.

The website [www.lu.lv/par-mums/dokumenti/pasnovertejuma-zinojumi/](http://www.lu.lv/par-mums/dokumenti/pasnovertejuma-zinojumi/) (in Latvian) contains annual self-assessment reports of study fields.

The websites of the structural units (faculties) prepare information on the programmes offered by the respective faculty and on the scientific activities of the faculty. Content blocks are exactly the same as the ones on the UL official site, but more specific information is posted directly about the respective faculty activities.

The faculty website can be reached from the UL website via the faculty reference.

The website <https://www.kf.lu.lv/en/> ADMISSION at the Faculty of Chemistry provides specific information for students, including information for pupils and teachers about the Young Chemists' School. The STUDIES section contains information for students on studying, counselling, offers on studying abroad; on scholarships, professional development courses for the academic staff, etc. The RESEARCH section contains comprehensive information on doctoral schools, research projects and programmes, defended doctoral theses, UL conferences and other conferences and lists of publications. The COOPERATION section contains information on universities abroad. ABOUT US presents information about the chairs of the faculty, the Student Council, the traditions of the faculty, as well as information for students and graduates about various job vacancies.

If the text to be posted on the site is submitted in a language other than English, a translation of the text into Latvian or a short summary is to be attached.

The heads of the UL departments are responsible for the preparation, correctness and updating of the information within the competence of the departments they manage. The content administrators of the structural units' websites are responsible for maintaining the website, posting the updated information and updating it regularly. For a given faculty, the person responsible for content placement is the marketing or public relations specialist or coordinator who administers the existing website, or an employee who has completed a short TYPO 3 content placement course in ITD management.

## **2.3. Resources and Provision of the Study Field**

**2.3.1. Provide information on the system developed by the higher education institution/ college for determining and redistribution of the financial resources required for the implementation of the study field and the relevant study programmes. Provide data on the available funding for the scientific research and/or artistic creation activities, its sources and its use for the development of the study field.**

The system of the University of Latvia for financing the study field and the corresponding study programs is based on the "*Law on Higher Education Institutions*", Cabinet Regulations No. 994 of 12.12. 2006 "*Procedures for Financing Higher Education Institutions and Colleges from the State Budget*", the Cabinet Regulation No. 376 of 21.06.2022 "*Procedures for Calculating and Distributing the State Budget Target Grant for Teachers' Salaries in General Education Institutions of Local Governments and General Secondary Education Institutions of State Universities*".

For the successful implementation of study fields, the University of Latvia must ensure sufficient financial resources for the entire study process, including the remuneration of the teaching staff, the library and other resources related to the implementation of studies, as well as the development of the study programme. The main costs related to the implementation of the study process are the remuneration of the teaching staff and the costs related to the organization of the study process.

**The remuneration of the teaching staff includes:**

- Costs of contact hours (e.g. lectures, seminars, practical and laboratory work);
- Independent work management, consulting and exam costs;
- Costs of methodical work (preparation for lessons, preparation of new courses, etc.);
- Student work management and evaluation costs, including reviewing;
- Internship management and organization costs;
- Costs of scientific work of the teaching staff to ensure the development of new study materials;

With the UL Rectors Order the norms of the formation of the remuneration of the teaching staff are determined in the *Planning and Accounting Regulations for Academic Personnel's Workload* (the UL Order No 1/469 of 07.12.2016). Considering the specifics of studies and available resources, the management of the faculties may set different regulations in coordination with the vice-rector of the respective field.

**Costs related to the organization of the study process:**

- General staff costs include the costs of study support staff remuneration, organization and

provision of faculty activities;

- Other costs are other direct costs related to the specific study programme, such as rent of external services, premises, additional equipment, transport, etc.;
- Infrastructure costs - costs of premises, including utilities, repairs and maintenance;
- The costs of property and services include the material and methodological provision of the study programme, including technical equipment, visual materials, professional development (experience exchange trips, training), etc.;
- Indirect costs include the costs of the University's overall operational support (IT, finance, staff, marketing, etc.) and investment in development.

In order to estimate the amount of funds required for financial provision, the UL calculates the prime cost of each study programme according to the methodology developed by the UL, which takes into account all the costs of providing the study process described above and information on the specific study programme plan, involved teaching staff, planned number of students, etc., thus ensuring the reliability of the forecasts.

### **Financing of studies at the UL - sources of financing**

To provide the necessary funds for the conduct of studies, the UL uses (1) the state budget subsidy (taking into account the base funding, programme level and field of study) from the Ministry of Education and Science and (2) tuition fees.

Tuition fees at the University of Latvia are determined taking into account:

- the prime cost of the study place, taking into account all the costs of the study process;
- tuition fees for similar programs at other universities;
- the interest of potential paid students in the study program;
- the estimated financing of the study place from the state budget;
- the opinion of the UL Student Council;

Tuition fees are set at the end of each year for the next academic year to ensure timely availability of information. The student's fee does not change during the studies, unless the fees vary from year to year in the programs, but even then they are all determined at the beginning of the studies.

Income from lifelong learning or other services, as well as accumulated unit funds, may also be used for curriculum development (development of new courses, improvement of existing courses, methodological support and other curricular aspects). If necessary, financial support can be obtained from the UL Study Quality Improvement Fund, where a sum is set aside annually in the UL budget to address various faculty issues, including the development of new study programmes and the development of existing study programmes.

Indirectly, research funding sources for academic staff are also channelled to the development of study programmes, e.g. for research activities, participation in international projects, publication of scientific articles, preparation of international project applications, organisation of scientific events at the UL, implementation of research development projects and fulfilment of long-term commitments, etc. By participating in these activities, academic staff increase their professional and research competence, often also involving students, which has a positive impact on the quality of the study process.

The scientific activities of the Faculty of Chemistry are financed from several sources: the base and performance funding granted by the UL as a scientific institution, contracted research, projects funded by the Latvian Council of Science, ERDF projects, as well as from the Faculty's own income and from the state subsidy. The base and performance funding is allocated to the UL in accordance with the Cabinet Regulation No.1316 of 12.11.2013 "Procedures for the calculating and allocating



the base funding for scientific institutions", the amount of funding for each structural unit of the UL is determined by the internal normative acts of the UL. According to the Regulations on "Approval of the Procedure for Support of the Development of Scientific Activity", the scientific staff can receive financial support from the centralised co-financing funds of the University for: participation in international conferences and seminars, publication of scientific articles, preparation of international project applications, organisation of scientific events at the University of Latvia. By participating in the above mentioned events, the academic staff increase their professional and research competence, often involving also students, which positively affects the quality of the study process.

Research funding also contributes indirectly to the development of the study field, through the purchase of laboratory supplies and chemicals, subscriptions to databases and the maintenance and repair of scientific equipment. These materials and services are used both for the development of students' research projects and final theses and for updating study materials.

Each year, the Faculty's financial resources are planned to include funds for study, work and official travel. These funds are used to pay for students' and staff members' travel to participate in international conferences.

Funding for student self-government is also essential; in accordance with Article 53 of the Law on Higher Education, it is not less than one two-hundredth of the annual budget of the higher education institution. The student self-government is financed from the central funds of the University according to the Law on Higher Education, while the faculty provides the self-government with the necessary premises (infrastructure).

For data on the available funding for a specific study programme, see section 3.3.3 of the BSP "Chemistry" and MSP "Chemistry".

### **Financing of studies at the UL - reallocation of funding received**

All income received from the state budget and tuition fees, as well as from other sources used for financing the study process, after prior deduction of indirect expenses for centralised expenses in accordance with the current redistribution procedure, shall be allocated by the UL for use by the faculties.

Faculties manage their own funding within the current year's budget. The Dean of the Faculty and the Executive Director are responsible for the rational use of financial resources and for operational financial management.

Actual returns are recorded at the faculty level, without separating results for each programme or field of study. At the same time, the management of the faculty monitors the outcomes of the study process, the dynamics of the number of students and the factors influencing it, the balance of the cost of a particular programme with the state budget subsidy and tuition fees and, if necessary, makes the necessary adjustments in the organisation of the study process to ensure the long-term viability and development of the study field of the faculty.

### **2.3.2. Provide information on the infrastructure and the material and technical provisions required for the implementation of the study field and the relevant study programmes. Specify whether the required provision is available to the higher education institution/college, available to the students, and the teaching staff.**

The necessary infrastructure and facilities are available for the implementation of the programmes of the study field "Chemistry, chemical technologies and biotechnology".

Procurement procedures are organised in accordance with the Public Procurement Law and the rules established by the UL. The purchased equipment and apparatus are available and used both in student teaching laboratories and for the research work of students and faculty members. The stock of the UL Library is regularly updated with the latest teaching and scientific literature. The facilities of the Faculty of Chemistry are located in Riga, Jelgavas iela 1, on the 6th floor of the House of Nature and in the basement. The total area of the Faculty of Chemistry is 1900 square metres, of which 1220 square metres are used for teaching and research laboratories. Each laboratory is equipped according to the requirements of the respective sub-branch of chemistry. The laboratories are equipped with modern chemically resistant laboratory tables, fireproof solvent storage cabinets, compressed gas cylinder storage cabinets; ventilation is provided by a system equipped with local ventilation units on laboratory tables and fume cupboards (Waldner, Germany). The fume cupboards are fitted with a gas supply system.

The House of Nature, which the faculty of Chemistry uses, offers modern lecture rooms and seminar rooms of 1990 sqm, including a 300-seat amphitheatre-style auditorium. All lecture rooms are equipped with electronically controlled multimedia projectors, screens and laptops. The larger lecture theatres are equipped with easily transformable lecture tables that can be folded and moved as needed. Several lecture rooms are equipped with interactive whiteboards. WiFi is available throughout the building.

The teaching and scientific materials and facilities of the Faculty of Chemistry consists of materials, teaching aids and scientific equipment purchased with state budget funds, EU funding for infrastructure improvement and development and the funding of the Latvian Council of Science.

The student teaching laboratories are equipped with modern teaching equipment, including analytical balances, rotary evaporators, pH meters, titrators TitraLab880 and Karl Fisher titrator, UNB500 thermostats, Shimadzu- UV-2700 spectrometer and ATR frontier FTIR -spectrometer, air analysers (ozone analyser, NOx analyser, aerosol particle analyser), various gas and liquid chromatographs and AutoLab potentiostats, etc.

Students, in their laboratory work and especially in research projects, graduation theses), use the entire research infrastructure of the Faculty of Chemistry, including a high-performance liquid chromatograph/mass spectrometer with TOF detector, gas chromatograph/ mass spectrometer, electrothermal atomic absorption spectrometer AAnalyst 600, inductively coupled plasma triple quadrupole mass spectrometer ICP-QQQ, differential scanning calorimeter, nuclear magnetic resonance spectrometer Ultrashield 300, isotope ratio element analyser, powder X-ray diffractometers D8Advanced and D8Discover, thermogravimeter TG/DTA600, luminescence spectrometer Aminco Bowman AB-2 etc.

Students also have access to computer resources (Gaussian 09 and Gaussian 16, (open source codes), data analysis software (MathWorks MatLAB, Wolfram Mathematica, SPSS), crystal structure database CSD and powder diffraction file database ICDD PDF-2CSD and PDF-2 databases. For a total list of equipment available to students and the teaching staff, see Annex 13 "Summary of quantitative data on scientific and applied research activities in the reporting period".

The academic centre of the University of Latvia also hosts other faculties of natural and life sciences and research institutes of the University, such as the Faculty of Biology, the Institute of Chemical Physics, etc., which means that there is also cooperation in the use of other equipment in scientific and teaching work.

In general, the funding and material technical facilities of the study field lag behind those of the

leading European universities, but they are sufficient to ensure a quality study process and to achieve the objectives of the study field. The Development plan for the study field sets out a number of tasks to improve this provision.

**ANNEX 13.** "Summary of quantitative data on scientific and applied research activities in the reporting period

**2.3.3. 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 field 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 field, 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 possibilities for the subscription to the databases.**

### ***General description of the UL Library***

The Library of the University of Latvia is included in the Library Register of the Ministry of Culture (BLB1000) and accredited as a library of national significance until 2027. (accreditation certificate No 22C of the Ministry of Culture).

### ***Access to UL Library information resources and services, opening hours***

The basic principle of the library is the availability of its services to every user.

The eight sectoral libraries offer all the services facilitating independent studies in accordance with *the UL Library Terms of Use* (the UL Rector's Order No 1-4/9 of 7 January 2021).

The opening hours of sectoral libraries are conveniently adapted to user's needs. The libraries are open from 9am to 8pm on weekdays – with some of them open from 9am to 6pm – and from 9am to 5pm on Saturdays. The Natural Sciences Library and the Library of the House of Science are open 7 days a week, 24 hours a day. Three of the sectoral libraries are open for visitors throughout the year, including summer.

In the Natural Sciences Library, the staff of the University of Latvia has the opportunity to use: free access to the collection, self-service facility for home delivery of books, renewal and check-out, computers, mobile phone charging. In the House of Science Library, the following facilities are available to UL staff 24 hours a day: the open-access collection, two self-service machines for home delivery, renewal and check-out of books, and a self-service wall for the use of laptops. The UL Library is the first in the Baltic States to provide such a facility and service. The self-service facility is equipped with 36 laptops. UL staff can check out the laptops at any time of the day and use them for 6 hours, not only in the library area, but in the whole building, using student or employee ID cards. All laptops are equipped with licensed software that students need for independent work: Wolfram Mathematica, MathWorks, MatLab, Autodesk Inventor, wxMacMolPlt, etc.

The Natural Sciences Library, which houses the Chemistry collection, is open 24 hours a day, 7 days a week at students' convenience. The collection is open access. The Natural Sciences Library is housed in the House of Nature of the Academic Centre of the University of Latvia (Jelgavas iela 1),

with a total area of 662.80 m<sup>2</sup>.

The Library has more than 100 workstations, including 20 computer workstations.

### **Free basic services and paid services**

The UL Library provides free basic services and paid services in accordance with *the Library of the UL Paid Services and Price List* (the UL Rector's Order No 1-4/387 of 10.08.2021).

More information on the UL Library website <https://www.biblioteka.lu.lv/en/> – section *Services*.

### **User training**

The Library of the UL actively works with its target audiences – students at all programme levels, academic, research and general staff – to promote information literacy and to provide in-depth knowledge and skills at working with electronic resources. More information on the UL Library website <https://www.biblioteka.lu.lv/en/> – section *Studies*.

### **Library collection, collection replenishment procedure**

The UL Library compiles the collection in accordance with the fields of studies and academic work of the UL and the requirements of its study programmes for all levels of the UL studies – bachelor's, master's, doctoral, as well as for scientific research. The priority in replenishing the collection is the purchase of e-resources.

New acquisitions for the collection (acquisition of books, subscriptions for databases and periodicals) are conducted in accordance with the UL centralised funding, which is approved annually by a UL order.

In 2022, 1.8 million items of information resources are available to library users. According to the study and research infrastructure of the University, the Library's collection is housed in 8 branch libraries and the Repository.

### **Literature available in the library for the implementation of the study field**

In the period from 1 January 2013 to 4 February 2022 (*date of data collection*), the total number of new titles added to the UL Library collection was 617 in the field of chemistry (see Table 7), of which 305 titles are available in the Natural Sciences Library (see Table 8). The print collection includes books, serials, periodicals, PhD theses and abstracts in Latvian, English, German and Russian.

Table 7

#### *Literature available in the Library of UL for the implementation of the study direction*

Printed publications added to the UL Library 01.01.2013 – 04.02.2022				
Number of printed publications (titles)		Distribution of publications per languages		
Books	Other publications	Latvian	English	Other languages*
532	85	204	385	28

Total: **617** titles **1735** copies

\*Mainly in German and Russian.

Table 8.

#### *Literature available in the Natural Sciences Library of UL for the implementation of the study*

Printed publications added to the Natural Sciences Library of UL 01.01.2013 – 04.02.2022

Number of printed publications (titles)		Distribution of publications per languages		
Books	Other publications	Latvian	English	Other languages
261	44	80	207	18

Total: **305** titles **1035** copies

\* Mainly in German and Russian.

Recent literature in the field published in the last five years - the collection of the UL Library comprises 210 titles, 142 of which are available in the Library of Natural Sciences.

### ***The level of digitization of the collection***

In cooperation with the UL Department of Information Technologies, the UL Library ensures the free online access to the e-resources repository of UL <https://dspace.lu.lv/dspace/?locale-attribute=en>. For the convenience of users, a mobile version of the repository is also offered. The Library offers digitalised publications, which are subject of prohibition of copyright for use online, on-site in the reading rooms of sectoral libraries.

Currently, the e-resource repository contains more than 5712 publications in the field of study "Chemistry, chemical technologies and biotechnology".

### ***E- resources***

According to the UL strategic plan, the UL Library increases the share of e-resources and develops remote access to e-resources.

By modernizing the availability of electronic resources, the latest technology web service Primo Discovery and SFX has been introduced in the UL Library.

In 2021, the UL provides access to 42 e-resource platforms (e-books platforms, e-journals databases and individual subscribed e-journals, reference resources and tools, mixed-format databases). In total there are 17 477 full-text e-journals (including the individual subscribed e-journal titles), 205 306 e-books, almost 5 million full texts and abstracts of doctoral and master's theses from around the world available through subscriptions. The UL also provides links to 174 credible open-access databases with multi-format materials.

Some of available platforms (both e-book platforms - *VLeBooks*, *ProQuest Ebook Central*, and e-journal databases - *Cambridge Journals Online* (archive available until 31.12.2018), *Emerald eJournals Premier* (archive available until 22.04.2020.), *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* and separately purchased e-journals, and *Lursoft Newspaper Library NEWS.LV*, reference resources - *LETA online news*, *LETA Archive* and *Nozare.lv*, *Letonika*, tools - *SAGE Research Methods*, *Passport*, *Orbis*, *Overleaf Commons*, *MarketLine*, mixed-format databases - *ClinicalKey*, *Culturethèque*, *European Pharmacopoeia*, *LVS Latvian Standards Online Reading Room*, *OECD iLibrary*, *ProQuest Dissertations & Theses Global*, *ScienceDirect*, *Scopus*, *UpToDate*, *Web of Science Core Collection*).

Every year, the UL Library offers an average of 110 new electronic resources. In total, as of 04.02.2022 the UL Library has acquired 1555 e-books, ~ 211 355 e-books are available in the

subscribed *ProQuest Ebook Academic Complete* collection.

Information about the e-resources is available on the UL Library webpage <https://www.biblioteka.lu.lv/en/> sections *E-resources from A to Z* and *E-resources by discipline*, as well as on *Mans portāls* section *Datubāzes*.

The UL provides remote access to the subscribed e-resources (databases, e-book platforms) outside the UL network by logging in with a ULIS username and password

A significant increase in individual usability is observed for foreign multidisciplinary databases *ProQuest E-book Central Academic Complete Collection* (+ 56.26%), *SAGE Journals* (+ 20.96%), *Sage Research Methods* (+ 12.77%), *EBSCO Central & Eastern European Academic Source* (+ 64.53%), while there is also some decrease observed, e.g., the foreign databases *Oxford Journals Online* (- 16.22%), *Taylor & Francis Social Science & Humanities Library* (- 8.96%), as well as the citation databases *Scopus* (- 15.84%) and *Web of Science* (- 36.32%). The use of the *Physical Review Journals* database, subscribed to by the Faculty of Physics, Mathematics and Optomology, decreased by 36.79% in 2021, while the use of the *Overleaf* tool, co-sponsored also the faculties of natural sciences, including the Faculty of Chemistry, in 2021 shows the importance of its accessibility for the members of the UL. In the context of the information support of the Study Field "Chemistry", the variety of e-resources subscribed to by the UL and the possibilities of remote access have increased in the period from 2016 to 2022.

The UL Library regularly provides trial access to various databases, with an average of 10-15 trial accesses per year.

Information on e-resources is available on the UL Library's website [E-resources from A to Z](#) and [E-resources by discipline](#), as well as in sections on *My portal* under *Databases*.

The UL offers the possibility to use subscribed electronic information resources (databases, e-book platforms) outside the UL computer network by logging in with a LUIS username and password, in some cases - with personal profile access data created within the range of UL IP addresses.

As of 04.02.2022, four individually subscribed e-journals are available in the collection of the UL Library. These e-journals contain materials relevant to the study field "Chemistry, chemical technologies and biotechnology": e-journal *Nature* subscribed by the UL Library, e-journals *The Physics Teacher* and *Magnetohydrodynamics* individually subscribed by FFMO, and e-journal *The Journal of Chemical Education* individually subscribed by the Faculty of Chemistry.

### ***Subscribed e-resources in science branches, including materials for the SF "Chemistry, chemical technologies and biotechnology"***

**Overleaf Commons** is an online LaTeX author collaboration tool suitable for people working in biology, chemistry, earth sciences, computer science and mathematics.

**Physical Review Journals** - provides access to journals published by the *American Physical Society (APS)* in the field of physics.

### ***Subscribed multidisciplinary e-resources that include materials for the SF "Chemistry, chemical technologies and biotechnology"***

**Cambridge Journals Online** - *Cambridge University Press* multi-disciplinary e-journal full-text database offering searchable information in over 300 scholarly journals, as well as related online resources. The database provides full texts in fields such as chemistry, biology, ecology, geology, medicine, etc. *The e-resource archive is available until 31.12.2018.*

**EBSCO Central & Eastern European Academic Source** - offers full-texts of more than 400

journals in chemistry, mathematics, biology, computer science, education, economics, politics, medicine, law, and other fields relevant to the Central and Eastern European region.

**Latvian Standards Online Reading Room** - a collection of documents from the Latvian National Standards Institution. Access to the Latvian Standards Online Reading Room in the UL Library is provided to more than 44 000 full-text Latvian standards documents in electronic format (national, adapted European (EN) and international (ISO, IEC) standards and their historical versions without ICS group restriction). The collection of standards is updated and supplemented with pre-publications, new versions, translations, their amendments and corrections.

**Nature** - one of the world's leading electronic journals in the field, published by *Springer Nature*. The latest issues of the journal with full-text articles and archives for the period 2017-2021 are available through the UL subscription.

**OECD iLibrary** - a full-text database of books, articles, reports and statistics published by the Organisation for Economic Co-operation and Development.

**Oxford Journals Online** - a collection providing access to over 350 authoritative and leading *Oxford University Press* journals, published in partnership with some of the world's leading scientific organisations. The database includes full-text journals with high citation indexes in a wide range of disciplines - physics, optometry, chemistry, data science, computer science, biology, mathematics, life sciences, physical sciences, humanities and social sciences, etc.

**ProQuest Dissertations & Theses Global** - the world's largest database of dissertations and master's theses - contains more than five million theses in a wide range of fields: natural and medical sciences, humanities and social sciences.

**ProQuest Ebook Central Academic Complete Collection** - *ProQuest* collection of e-books available on the *ProQuest Ebook Central* platform. It contains approximately 211 355 e-books from leading publishers in all fields, including many university presses.

**SAGE Journals** - full-text journal database of SAGE Publishing featuring articles from more than 1100 journals. The database covers a wide range of sciences, including materials science, statistics, data science, biology, bioengineering, computer science, mathematics and more.

**ScienceDirect** - *Elsevier* Publishing database for the natural and technical sciences, life sciences and medicine, as well as the humanities and social sciences. The database contains information on several thousand journals and books published by Elsevier. Around 2650 full-text journals, mostly from 2002 up to the latest issue, are available in the UL Library, as well as more than 350 e-books.

**Scopus** - Elsevier's multidisciplinary bibliographic and citation information database for scientific publications, contains records for more than 21 000 journals, 86 000 e-books and 6.8 million conference proceedings, as well as 27 million patents. The database covers fields such as materials science, physics, chemistry, biology, computer science, mathematics, etc.

**SpringerLink Contemporary Journals** - full-text journal database of the company *Springer Nature* offering access to more than 6 million articles from over 3400 journals, covering natural sciences and social sciences.

**Web of Science** - the database contains the most important scientific information on more than 12 000 journals, offering bibliographic and citation information, abstracts and other information. The fields covered include physics, mathematics, chemistry, materials science, biology, computer science, optometry, medicine, natural sciences, and the social sciences and humanities.

**Wiley Online Library E-Journals Full Collection** - more than 8 million full-text articles are available in over 1600 peer-reviewed multidisciplinary journals, including chemistry, mathematics,

physics, biology, computer science, data science, and more.

***E-books purchased by the Library of the University of Latvia in the SF "Chemistry, chemical technologies and biotechnology"***

**VLeBOOKS** - e-book platform, where 233 e-books purchased by the UL Library from the world's leading publishing houses, which include materials for the study field (e.g. *Wiley-Blackwell*, *CRC Press*, *Academic Press*, *Elsevier*, etc.), 62 of them published in the period from 2013 to 2019, are available.

**ProQuest Ebook Central Academic Complete Collection** - a collection subscribed to the *ProQuest eBook Central e-book platform*, with a total of **12 123** subscriptions to titles relevant for the SF "Chemistry, chemical technologies and biotechnology", of which **1894** were published between 2016 and 2021. There are also **45** separately purchased eBooks for the SF from world-leading publishers (e.g. *John Wiley & Sons*, *Taylor & Francis Group*, *Springer International*, *Royal Society of Chemistry*, etc.), **10** of which were published between 2016 and 2021.

***Open access resources that include materials for the SF "Chemistry, chemical technologies and biotechnology"***

*ArXiv.org*, *BMC (BioMedCentral)*, *BioOne Complete*, *BioRxiv*, *Bookyards*, *Bookboon*, *ChemSpider*, *Cogent OA*, *Cognitive Science Society's Journal Archive*, *Cogprints*, *Digital Library of Information Science and Technology (DLIST)*, *Directory of Open Access Books (DOAB)*, *Directory of Open Access Journals (DOAJ)*, *EBSCO e-book Open Access Collection*, *EBSCO Open Dissertations*, *Encyclopedia for Life*, *EuDML*, *F1000 Research*, *GitHub*, *Google Scholar*, *HighWire Press*, *Indawi Publishing*, *Journals for Free*, *LearnChemistry*, *Library Publishing Media*, *LR Centrālās Statistikas Pārvaldes datubāze*, *MDPI*, *OAPEN*, *Open Access Research Database (OARD)*, *Periodika.lv*, *PLOS – Public Library of Science*, *PubChem*, *Science of Synthesis*, *Science Books Online*, *ScienceOpen*, *SPIE. Digital Library*, *Springer Open*, *SwMATH*, *Wiley Open Science*, *Wolfram MathWorld*, *WorldWideScience.org*, *ZbMATH Open*.

**The library collection in general corresponds to the implementation of studies and the development of research, as its stocks are supplemented every year with the latest information resources in accordance with the information needs of the academic staff and students.**

**2.3.4. Provide a description and assessment of information and communication technology solutions used in the study process (e.g., MOODLE). If the study programmes within the study field are implemented in distance learning, the tools specially adapted for this form of study must also be indicated.**

Nowadays, information and communication technology (hereinafter – ICT) solutions provides excellent opportunities for the development of the educational process. It allows to implement new projects and introduce new systems so that the study process would be as successful as possible. The use of ICT in the educational process is one of the ways how to increase learning motivation.

The Department of Information Technology of the UL provides the UL students and employees with an application package *Microsoft* (henceforth – MS) *Office 365*, a cloud technological solution. *Office 365* provides students and employees with the best tools for modern study work, for example, *Outlook*, *Forms*, *OneNote*, *Sway*, and a package of *Office* programmes containing *Word*, *Excel*, and



*PowerPoint.*

In addition to *MS Office 365*, students and employees of the UL are provided with software such as *SPSS*, *Question Pro*, *Autodesk*, *MathWorks MatLAB*, *Esri ArcGis*, etc.

One of the *Office 365* online applications, *MS Teams*, is used to provide remote learning and distance learning programmes. This online application ensures both online lectures and recording of lectures, as well as online communication with students.

In addition to *MS Teams* programme for the online study process, the UL offers its students and employees an information system *BigBlueButton* (hereinafter – BBB system), which is an open-source web online videoconferencing system. BBB ensures the organisation of the University's online events for the UL personnel, including students and event attendees. It can also be used as an integrated solution for e-study system (for only registered users in the course) and outside an e-study system, in which case one must connect to the UL online conference server in a web browser <https://bbb.lu.lv>.

Two e-study environments are available in the UL – [estudijas.lu.lv](http://estudijas.lu.lv) and [edu.lu.lv](http://edu.lu.lv). The e-study environment is to ensure the study process and management, while the e-education platform is developed for e-education projects, events, and courses as well as distance learning programmes.

The open-source e-study environment *Moodle*, a modular object-oriented dynamic learning environment, is used for both e-study environments. Now, it is not only methodically and pedagogically but also economically most effective e-study solution. Courses have been developed in the *Moodle* e-study environment, where the necessary study materials and activities for students are available. There the teaching staff can assess students and register study attendance.

For data storage in the study process, the UL provides *Office 365* cloud service *OneDrive* 1TB, which is available for students and employees. *OneDrive* is *Microsoft's* cloud service that connects with all user files. It allows to save and protect files, share them with other users and access them from any location on all devices.

For data transfer, the UL offers its students and employees a large-scale file transfer system – <https://store.lu.lv/>. This system allows to send files that cannot be sent over an e-mail due to the size, however it is not intended for a long-term file storage.

Three computer rooms in the House of Nature, which are also used by students from other faculties, also provide access to internet resources. By connecting their laptop anywhere to the University's wireless network, students can use all information technology services available on the University's networks. All study courses have e-learning courses in Moodle environment; e-learning courses have a study calendar, study materials, mainly in Latvian and English, tests and assessment tools, as well as other tools available on the Moodle platform. The *MS Teams* environment is used for distance learning in situations when this is necessary, and in some cases, when guest lecturers are present, the *ZOOM* and *PPP* platforms are also used. These platforms allow both lecturers and students to present their work, conduct and listen to theoretical classes, seminars, send messages and exchange electronic documents.

Information communication technological solutions are systematically improved in accordance with their development trends and the needs of the study process.

### **2.3.5. 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.**

## Normative acts that regulate the process of teaching staff recruitment and/or employment:

- [\*Regulatory Enactments on Academic and Administrative Positions at the University of Latvia\*](#) (available only in Latvian)
- *Regulations of the UL Professors Council* ((*Latvijas Universitātes profesoru padomes nolikums*) available in section *Other attachments*, available only in Latvian)
- *Procedures for the Recruitment of Unelected Teaching and Research Staff at the University of Latvia* (available in section *Other attachments*)

There are three teaching groups at the UL: academic staff who hold their academic positions for a limited period of tenure on the basis of elections, acting academic staff and visiting academics, as well as hourly-paid staff.

In the case of elected academic positions, as well as the acting academic staff, the recruitment and selection are regulated by the *Regulatory enactments on academic and administrative positions at the University of Latvia*. According to the regulations, the following academic positions exist at the University of Latvia: professor, associate professor, assistant professor, senior researcher, lecturer, researcher, assistant, research assistant.

The decisions on the need for certain positions are made by the faculties. Competitions for elected academic positions are announced openly. Public calls for applications for the elected academic positions, including the function and terms of reference for the respective position, are published on the UL website <https://www.lu.lv/par-mums/vakances/> (available only in Latvian), internationally advertised vacancies: <https://www.lu.lv/en/about-us/vacancies/>, and also in National Scientific Activity Information System and State Employment Agency of the Republic of Latvia vacancy portal. Any person who conforms to the requirements specified by *the Law on Higher Education Institutions* may apply for the position

The applicants for academic positions must deliver an open lecture, which is evaluated by two reviewers, who issue their opinion on the quality of the lecture. The election procedure is carried out either by the decision-making body of the relevant unit (in the case of assistants, research assistants, researchers, senior researchers, lecturers and assistant professors - by the Faculty Council), or in the case of associate professors and professors by the relevant Professors' Council. Elections must take place within three months from the date of the call for applications. The personalia – docents, lecturers, assistants, senior researchers, researchers, and research assistants – are voted on by secret ballot. Professors and associate professors are voted openly (in accordance with the 05.11.2020 amendments of 2<sup>nd</sup> Paragraph of Section 33 (in force from 01.01.2021) of *the Law on Higher Education Institutions*). An applicant who has received more than half of the votes of the members present with the right to vote shall be considered elected. According to *the Law on Higher Education Institutions*, lecturers are elected for a term of 6 years. At the end of the term, the faculty decides on the need to announce a new competition. There are no restrictions on the term of office.

In accordance with the UL regulations, minimum requirements are set for all applicants for academic positions, i.e. knowledge of the official language in accordance with regulatory enactments, knowledge of foreign languages to the extent necessary for the performance of academic duties and continuous improvement of their academic and scientific qualifications. Other requirements differ across academic positions, for instance, to qualify for the position of Assistant Professor, the candidate has to have a doctoral degree, while the requirements for Associate Professors are more demanding, i.e. they must have considerable academic and pedagogical

experience, an extensive list of publications and experience in scientific research projects.

Terms of employment are prepared for all positions needed to deliver the field programmes before the elections. These include not only teaching and methodological work, but also the responsibility to carry out research work in the relevant research directions of the Faculty of Chemistry.

If the Senate chooses to decline the proposal from the department and not to publish vacancies, a visiting academic may be recruited; while if the respective department considers a member of hourly-paid staff to be more relevant to the development plans and needs of the faculty, the prospective employee concludes a contract for a specified period (usually for the duration of the study course). In such cases, the decisions relating to the candidates' recruitment and selection are taken by the structural units, i.e. faculties. In these cases, only the control to ensure that the remuneration set by the entity complies with internal and external rules and regulations is centralised.

The Rector of the University of Latvia concludes an employment agreement with the person elected for the entire term of office.

In accordance with the requirements of the University of Latvia and the State, the process of recruitment and employment of the teaching staff at the Faculty of Chemistry is fully open, the qualifications of applicants are evaluated several times and experts are involved; the decisions on election are taken by collegial bodies: the Council of Professors of Chemistry or the Council of the Faculty of Chemistry. This makes the overall process maximum transparent and allows for the selection of suitably qualified staff.

During the accreditation period since 2013, the teaching staff of the faculty has been renewed. This was due to the generational change of the teaching staff and the need to modernise the study field and improve the quality of study programmes. Since the previous accreditation, eleven lecturers from the Faculty of Chemistry are no longer involved in teaching the courses, while thirteen lecturers have been elected in a teaching position at the Faculty of Chemistry for the first time. Most of them started their academic career as hourly-paid lecturers, they have realised that they were attracted by working with students and have passed the competition for the vacant positions. During the reporting period, several members of the academic staff have achieved excellent research results, received positive student evaluations and improved their qualifications, and have therefore been elected to higher posts through open competition: for example, V. Bartkevičs, K.Jaudzems, D.Erts, E.Sūna – have been elected professors, G.Vaivars, V.Rudoviča, L.Orola, A.Bērziņš, and E.Pajuste – associate professors.

A total of 50 teaching staff have been recruited for the two study programmes prepared for the accreditation. 29 academic staff members work at the Faculty of Chemistry, all of whom are elected to academic positions. 13 lecturers are elected to academic positions at other faculties of the University of Latvia, 2 lecturers at other universities, and 6 specialists in the field are teaching courses as hourly-paid lecturers. (see Annex 9 "Basic information on the teaching staff involved in the implementation of the field of study").

The process of election and selection of lecturers is fully open, the qualifications of candidates are evaluated several times and experts are involved, decisions on election are made by collegial bodies, which makes the process as transparent as possible and allows selecting qualified specialists to successfully implement the objectives of the study field.

### **2.3.6. 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 qualifications (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.**

*The UL Strategy 2021-2027* emphasizes that the goal of the development and excellence-oriented personnel policy is to ensure the development, growth and renewal of academic and general personnel, to create a performance-based personnel management system, which will also include competitive and motivating personnel remuneration, to improve academic staff career development opportunities, to create a system for attracting local and foreign academic staff, as well as new talents, and to promote international mobility.

The professional development of the UL academic staff is organised in accordance with the Republic of Latvia Cabinet regulations No. 569 of 11. 09. 2018, *Regulations on the Necessary Academic and Professional Qualifications of Pedagogues and Professional Competence Development Procedures*, where paragraph 16 states: "Educators of higher education and colleges shall, by the end of the term of their election, undertake a vocational development programme on innovation in the higher education system, or the higher education didactics, or the management of educational work at 160 academic hours (including at least 60 contact hours). Professional development may include international mobility and participation in conferences and seminars relevant to the purpose of the professional development, as evidenced by submitted documents", as well as the Cabinet of Ministers' Regulation No 129 of 25.02.2021 *the Procedures for Evaluating the Scientific and Teaching Qualifications or Results of Artistic Creation Work of an Applicant for the Position of Professor or Associate Professor and of a Professor or Associate Professor Holding the Position*.

The qualification requirements and tasks of the academic staff of the UL are included in *the Regulations on Academic and Administrative Positions at the University of Latvia* (the UL Senate Decision No 2-3/11 of 31.01.2022), while the quality/performance of the academic staff of the UL is evaluated in accordance with *the University of Latvia Academic Remuneration Regulations* (the Senate Decision No 14 of 30.05.2016) and *the University of Latvia Scientific Personnel Remuneration Regulations* (the UL Senate Decision No of 27.01.2020).

The Academic Department of the UL and the Adult Pedagogical Education Centre of the Faculty of Education, Psychology and Art (FEPA) of the UL provide informative, consultative and methodological support to the UL academic staff in the field of the higher education didactics. The Adult Pedagogical Education Centre of the FEPA, UL, offers a professional development programme "Didactics of Higher Education: modern theories and practices", as well as continuing education programmes "Pedagogical aspects of the development of study programmes in higher education", "Professional development advising first-year students", etc.

As of 2018, the teaching staff of the study field have been particularly active, participating in several programmes of the project SAM 8.2.2.0/18/A/010 "Renewal and Competence Development of Academic Staff at the University of Latvia", (see Table 9).

On the completion of the continuing education programme "Methodology for the formulation and evaluation of the learning outcomes" (2015), the Head of the Study Field trained programme directors and academic staff, who are focused on updating their courses and mapping the

outcomes of their programmes and study courses. The latest approaches to the formulation and assessment of course outcomes were taught to programme directors at a seminar organised by the Academic Department in 2020.

In October 2021, study programme directors and the head of the Study Field were trained in the latest trends in the development of study programmes in the continuing education programme "Development and management of study programmes/directions", where the training was conducted by an international accreditation expert from Poland and representatives of the Latvian Higher Education Quality Agency.

The UL academic staff have the opportunity to advance their English language skills by completing the continuing education programme "Professional English Language Enhancement Course for Academic Staff" at the Centre for Applied Linguistics of the UL Faculty of Humanities. In the reporting period 16 lecturers of the study field (E.Pajuste, G.Vaivars, E.Sūna, A.Kinēns, A.Prikšāne, K.Parasiga-Parasiņa, V.Rudoviča, I.Ancāne, A.Bērziņš, V. Bartkevičs, I.Grante, I.Šteinberga, J.Logins, I.Klymenkovs, I.Reinholds, V.Rudovica) have completed the programme and obtained the certificate corresponding to their skills. More than half of them have obtained a certificate in English at C1 level.

Young lecturers and doctoral students from various UL PhD. programmes, each spring semester, are increasingly using the possibility to attend the continuing education programme "Introduction to teaching in higher education". This course is also included in the new Natural Sciences PhD programme and will be taken by virtually all PhD students in the future.

To promote collegial learning and identify good practices in teaching, the continuing education programme "Promoting collegial learning experience of the academic staff" (2018) has been developed within the framework of which the academic staff (J.Švirksts, L.Balcerbule, L.Orola, I.Nakurte) conducted peer observation of lectures, thus ensuring the exchange of pedagogical experience of the teaching staff. So far, before the election and re-election of lecturers, the lectures of the candidates are regularly observed, evaluated and discussed in the chair meetings. In December 2020, a seminar on experience exchange on the organisation of the distance learning process (Covid-19 restrictions) was held at the Faculty of Chemistry, where practically all lecturers participated.

The UL academic staff working with freshman students are a special target group for professional development and as such are offered a continuing education programme "Professional development advising first-year students". New lecturers (lecturer V.Valkovska, assistant professor I.Ancāne, doctoral student K.Šaršūns, etc.) are involved in the work with the first year students. Under the guidance of the didactics course deliverer, lecturer I.Gaile, these lecturers improved their skills in organising "student's learning groups" and used them already for the second year to support students and thus partially reduce the drop-out rate. Lecturer V.Valkovska has also completed the course programme "How to influence the 21st century student's perceptions and actions?" (2020). Lecturers in continuing education programmes particularly welcome the opportunity to model the study process, test new teaching methods and share experience with each other.

With the funding of the European Union in the period from 2018 to 2023, several study programmes for lecturers are being implemented:

1. Development of online learning and digitization of learning content (target group - academic staff);
2. Innovations to improve the quality of the learning process (target group - academic staff);
3. Academic integrity (target group - directors of study fields and study programs).

Most of the academic staff of the Study Field have participated in these programmes. During the reporting period, the teaching staff actively participated in various professional development courses, improving their knowledge and skills in university didactics, online learning development and digitalisation of the teaching content, for example, in the programmes "Learning e-environment Moodle", "Distance learning", "Subject-specific interactive solutions for lesson development", etc. (I.Ancāne, M.Bērtiņš, D.Erts, M.Feldmane, A.Osīte, E.Pajuste I.Reinfelds, G.Vaivars, A.Vīksna, G.Celma, L.Buša, A.Priķšāne, K.Parasiga-Parasiņa, J.Švirksts). The lecturers have also acquired competences in speech art, leadership, commercialisation and other individual development competences (A.Bērziņš, J.Logins, A.Kinēns, J.Jaudzems, G.Celma, K.Saršūns, E.Pajuste), which are important in the evaluation of scientific results, organisation of the study process and staff development. Some of the young researchers have completed the continuing education programme "Scientific Activity and Publication Skills" (V.Valkovska, J.Logins, A.Osīte, K.Saršūns, M.Bērtiņš). J.Logins, Dean of the Faculty of Chemistry, has completed the Academic Integrity Course.

Thanks to the support of the project "Renewal and Competence Development of Academic Staff at the University of Latvia", the lecturers of the Faculty of Chemistry have the opportunity to participate in internships for up to 6 months in major industrial companies for 200 hours. In 2019, associate professor L.Orola had the internship in the leading Latvian pharmaceutical company A/S Grindeks, and in 2020, associate professor Rudoviča did the internship at A/S Olainfarm. In the spring semester of 2022, assist.professor A.Osīte had the internship in the International consultancy company "Estonian, Latvian & Lithuanian Environment" (ELLE), Ltd., focusing on analytical solutions for environmental protection.

All programmes have been developed by analysing the professional development needs of academic staff in the context of higher education trends. As part of the deployment of the academic staff training system, the UL Academic Department conducted an electronic survey of the UL academic staff, which allowed to pool information on their ongoing professional development needs, as well as encouraged several Faculty members to express their readiness to participate in the development and offering of continuing education content to their peers in line with professional and didactic development needs.

On the implementation of each programme, a survey and an evaluation of the outcomes is conducted among the attendees of the programme. Participation in continuing education programmes is voluntary or else might be a recommendation issued by the leadership of the faculty. By and large, the UL faculties organise thematic seminars on topics relevant to the academic staff of the respective faculty. Thus, for example, in February 2022, a series of three lectures on occupational safety, the circulation of chemicals in the laboratory, and waste disposal was organised for the faculty staff, led by O. Kuzmina, lecturer of London Metropolitan University.

The professional development activities of the academic staff of the University of Latvia were included in the plan of measures for the development of the academic staff of the University of Latvia for 2018-2023.

In order to determine the professional development needs of the academic staff of the UL in the field of the pedagogical activity, the Department of Studies of the University of Latvia at the end of 2017, and the Programme for Development and Management Development of the University in the 1st quarter of 2020 and in the spring of 2021 conducted a survey of academic staff, including heads of study fields and study programme directors, the results of which were taken into account when developing a training plan for the development of academic staff competencies, including the project of the Operational Programme "Growth and Employment" 8. 2.2. within the framework of the 1st round "Renewal and Competence Development of Academic Staff at the University of Latvia", 2nd round - "Motivated, Modern and Competitive Academic Staff of the Study Field

"Education, Pedagogy and Sport" at the University of Latvia" and 3rd round "Strengthening the Capacity of the Doctoral Studies of the University of Latvia within the Framework of the New Doctoral Studies Model" in order to effectively plan and ensure the enhancement of the competences of academic staff. The following outcomes are to be achieved by December 2023:

- the system of attracting and selecting the academic staff of the University of Latvia has been improved;
- the average age of teaching staff has been reduced and the age structure is approaching the EU [average](#) (only in Latvian), with at least 1/3 of academic staff aged between 35 and 49;
- improved scientific performance;
- a model for the renewal and succession system of academic and scientific staff has been developed and implemented;
- a professional development system for the academic staff of the University of Latvia has been developed and implemented.

When planning the growth and development of the academic staff, the UL pays equal attention to the identification of the most capable students in the study programmes of the University of Latvia and to motivating them to get involved in academic work already during their studies (related to both teaching and research). In this context, the University of Latvia has developed requirements and selection criteria for attracting new doctoral students to the project operational programme "Growth and Employment" (objective of specific support "To strengthen the academic staff of higher education institutions in the fields of strategic specialization "):

1. A doctoral student studying in the last year of an accredited doctoral study programme, as well as a doctoral student who is a Latvian citizen studying in an accredited doctoral study programme outside Latvia, and a scientific degree candidate;
2. successfully acquired number of credit points required in the first two/three years of study/ or, for a doctoral degree candidate, successfully completed studies in DSP;
3. Participation in an international scientific conference with a presentation/report;
4. Publication of at least one scientific article in an international edition;
5. English language skills at least at C1 level;
6. successful passing of the doctoral exam in English;
7. Positive feedback from the supervisor of the doctoral thesis about the doctoral student as a potential lecturer;
8. leadership traits and interest in UL research and course delivery.

In Chemistry study programmes, staff reproduction has received special attention, as until 2017 the high average age of lecturers was regularly mentioned as one of the threats to the field in the SWOT analysis. An excellent example of how to ensure long-term development in the sub-direction of Physical Chemistry has been demonstrated by the former Head of the Chair of Physics, Professor A. Actiņš. He has nurtured a whole generation of young specialists, three of whom work at the Faculty of Chemistry: associate professor A. Bērziņš, associate professor L. Orola and researcher T. Rēķis. Professor V. Kaļķis (passed away in 2017) supervised the final theses and the PhD thesis and guided assistant professor I. Reinholds in the academic work. Under the guidance of professor A. Viksna, two strong young scientists have grown up - associate professor V. Rudoviča and assistant professor A. Osīte. Now, young colleagues M. Bērtiņš and L. Buša are actively involved in teaching analytical chemistry. In the sub-direction of organic chemistry, with the mentorship and extensive scientific contacts of professor A. Zicmanis (not teaching since 2020), researcher E. Baķis started his work at Imperial College in England in the ERASMUS exchange programme, where he subsequently developed and defended his PhD thesis in 2021 under the supervision of professor T. Walton. Now E. Baķis is back in the Chair as a leading researcher and continues his research on ionic liquids and is gradually engaging into teaching. Overall, the average age of lecturers of the Faculty of

Chemistry involved in the programmes is 43 years.

Targeting the growth and development of foreign academic staff, the University of Latvia has developed requirements and selection criteria for attracting foreign academic staff:

1. Persons who have been employed in an academic position in one of the accredited foreign universities during the previous five years;
2. A doctoral degree in the relevant field of science or a doctoral degree equivalent thereto;
3. Relevant scientific and academic work experience;
4. Ability to work in the e-learning environment;
5. Participation in at least three international conferences with a presentation/report;
6. Published monographs and scientific articles, including in indexed international editions;
7. Participation in or participation in research projects;
8. Excellent knowledge of foreign languages, especially English, skills to use them in studies and methodological work.

In 2019, professor A.Ramanavičius from Vilnius University worked in both Chemistry programmes with the support of the project 8.2.2.0/18/A/010 "Renewal and Competence Development of Academic Staff at the University of Latvia". The cooperation continues, but on a smaller scale. In the future, it is planned to look for opportunities to attract more foreign lecturers.

In the preparation of the self-evaluation report of the study field and working out programme development plans for the coming years, information on the promotion and qualification opportunities used by the lecturers engaged in the implementation of study programmes during the reporting period was collected, the results of which are summarised in Table 9.

Table 9

*Promoting the growth of teaching staff (assessment of didactic skills improvement and qualification improvement)\**

No.	Criteria / academic year	Teaching staff of the faculty of Chemistry, number of participants						
		2016	2017	2018	2019	2020	2021	2022
1.	Improving foreign language skills	0	0	0	2	2	8	4
2.	Professional development- hHigher education didactics (training)	0	3	2	1	1	5	0
3	Programmes for developing different individual competences	0	0	1	4	2	4	3
4	Professional development courses/programmes	2	6	3	5	1	1	10
5	Attendance at various summer schools	0	0	1	3	1	2	1
6	Membership in local professional organizations and boards	4	6	7	7	7	8	7
7	Participation in various international organizing committees	4	4	6	6	7	6	6



8	Participation in various international scientific editorial boards	4	4	5	5	5	6	5
9.	Organization of conferences	2	2	1	4	3	5	1

\*Data have been summarized starting from 2016, because these activities have not been precisely counted in 2013-2015.

During the reporting period and especially in the last two years, there has also been a threefold increase in participation in various professional development courses and training. Lecturers actively participate in scientific conferences, which increase their professional skills. Participation in summer schools and special professional courses is not regular and is used more by young teachers. All acquired knowledge and skills are an important factor in the realization of the goals of the development of the study field, for example, the improvement of the English language skills is essential in the internationalization of further activities.

More detailed information about staff activity is provided in the CVs of the teaching staff (See Annex 10 "Teaching staff Biographies ,Curriculum Vitae").

The systematically planned and offered qualification improvement opportunities for the teaching staff of the study field are essential for the implementation of the study process and the improvement of its quality.

### **2.3.7. Provide information on the number of the teaching staff members involved in the implementation of the relevant study programmes of the study field, as well as the analysis and assessment of the academic, administrative (if applicable) and research workload.**

Overall, the two programmes prepared for accreditation involve: 11 - Professors (9 - UL professors and 1 - RTU guest professor 1 - Vilnius University guest professor), 11 - UL associate professors (7 - Faculty of Chemistry, 1- Faculty of Physics, Mathematics and Optometry, 2 - Faculty of Biology and 1- Faculty of Geography and Earth Sciences), 9 - assistant professors(docents) (7 - Faculty of Chemistry, 1 - Faculty of Physics, Mathematics and Optometry, 1 - Faculty of Education, Psychology and Art) and 7 - lecturers (5 - Faculty of Chemistry, 1 - Faculty of Business, Management and Economics, and 1 - Faculty of Humanities). The programmes also involve 1 senior researcher and 4 researchers from the Faculty of Chemistry. 7 representatives of employers, specialists in the field, whose scientific work is closely related to the courses, participate asvisiting teachers (hourly-paid lecturers) in the implementation of study courses. In total, 50 teaching staff are involved in teaching courses. 82% of them are in elected positions at the UL, 39 of them have doctoral degrees, i.e. 78% of the total number, and the rest have master's degrees, which indicates the high qualification of specialists. The researchers involved in teaching the study courses (R.Klūga, M.Bērtiņš, T.Rēķis, E.Baķis) are PhD students of the Faculty of Chemistry or have just completed

their PhD studies. Some of them have also gained experience as teaching assistants in laboratories and are now well integrated into the study process.

The workload of all elected UL staff members consists of academic and scientific research work. Teaching work of lecturers includes reading lectures, work in laboratories and seminars, as well as preparation of methodological materials, management of final theses, assessment of student achievements, etc.) The average distribution of the total academic and research workload of the Faculty of Chemistry is 53% and 47%.

The number of teaching staff in the field of study have expanded compared to 2013. The range of elective courses has been increased in the programmes prepared for accreditation. The sub-direction in organic chemistry ("Organic and Biomolecular Chemistry") has been extended in the MSP "Chemistry". Thus, 4 lecturers from the Faculty of Biology (only 2 in 2013) have been included in the teaching staff of the programme. It should be noted that previously master's students could choose courses from other master's programmes up to 8CP, according to the research direction. The master's programme now has a free choice of 2CP, but the restricted elective part has been extended to include related courses in other sciences. It is planned to involve 4 young researchers from the Institute of Organic Chemistry and 4 guest lecturers, including two foreign specialists, in the implementation of the programme. In turn, the BSP "Chemistry" has been complemented by restricted elective courses in general skills and the recruitment of specialists in social sciences and humanities, respectively. The structure of the academic staff is thus optimal and reflects mutual integration with other study programmes of the University. The academic staff of the Faculty of Chemistry also provide basic courses in various fields of chemistry for students of the Faculty of Biology, Faculty of Geography and Earth Sciences, Faculty of Physics, Mathematics and Optometry and Faculty of Medicine (see Annex 10 "CVs of the teaching staff - Curriculum Vitae in Europass format").

Qualifications of the teaching staff involved in the programmes comply with Article 55 of the Law on Higher Education Institutions (see Annex 26B for BSP "Chemistry" teaching staff, Annex 26M for MSP "Chemistry" teaching staff "Confirmation that the staff comply with Article 55.1.3 (of the Law on Higher Education Institutions") for the development, submission for approval, implementation and take-over of the study programme in case of its liquidation, which has been achieved by involving not only highly qualified and internationally recognised experts in chemistry, but also in other fields. The compliance with the criteria of the Higher Education Council (HEC) for academic study programmes with fewer than 250 full-time students is assessed in the HEC decisions for each study programme (see. Annex 20B for the BSP "Chemistry" and Annex 20M for the MSP "Chemistry", "Conclusion of the Higher Education Council").

The knowledge of the state language of 48 academic staff complies with the Cabinet of Ministers' Regulation No. 733 of 7 July 2008 "Regulations on the extent of knowledge of the state language and the procedure for testing knowledge of the state language for the performance of professional and official duties, for obtaining a permanent residence permit and the status of permanent resident of the European Union and the state fee for testing knowledge of the state language" (see Annex 11 "Certificate of the state language knowledge of the academic staff"). It is also planned to attract 2 foreign specialists to teach study courses in English (this is in accordance with the regulations of the Higher Education Law on the permissible amount that no more than 20% of courses can be taught in a foreign language).

All academic staff members speak English. For the third year, the professional English language skills of academic staff to work in a study environment have been improved, and 16 lecturers have completed their English language knowledge and skills in courses during the reporting period at a level sufficient to enable them to conduct the study process in English. (see Annex 12 "Evidence of

the English language proficiency of the academic staff"). The participation of the academic staff in conferences and scientific articles in English confirm their good knowledge of English. During the reporting period, the academic staff have prepared study materials for Erasmus+ students and have taught laboratory works, individual lectures and seminars, as well as provided tutorials for exchange students (see Section 2.5.3).

In addition to academic work, all lecturers' workload includes scientific research work, which also incorporates an organisational component. The administration of the Faculty of Chemistry carefully monitors the balance between teaching and research and tries to attract the funding. Results of scientific work are one of the most important criteria for evaluating the quality of the work of the academic staff. The active involvement of the programme's staff in research is evidenced by the large number of publications in the most important databases and their participation in projects and conferences. For the scope of scientific work of the academic staff of the Faculty of Chemistry and its connection with the study programmes of the field, see further Annex 14 "List of publications of the teaching staff for the reporting period".

The academic qualification of the teaching staff of the study field and the competence and interdisciplinarity of the chemistry professionals engaged ensure the achievement of the learning outcomes of the study field.

**ANNEX 9.** "Basic information on the teaching staff involved in the implementation of the field of study"

**ANNEX 10.** "Teaching staff biographies - Curriculum Vitae"

**ANNEX 11.** "Certificate of the state language knowledge of the academic staff"

**ANNEX 12.** "Evidence of the English language proficiency of the academic staff"

**2.3.8. 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.).**

The students of the UL have access to academic support, career development support and psychological support.

*The aim of academic support* is to provide students with information and advice on study issues for the entire period of studies. Academic support includes the implementation of the first year of studies support programme, advice on the study process (content of study programme, choice of study courses, legal documents regulating the UL study process), information on tutorials, counselling and workshops on study skills (notetaking, reading for academic purposes, active listening, exam anxiety, time management, libraries and Internet resources).

Academic support in study matters is managed centrally by the UL Department of Study Services and the responsible persons with the respective faculties: director of the study programme, study advisor, trustee, mentor, coordinator, academic staff, and the UL Students' Council and Faculty Students' Councils. Advice on the use of library and Internet resources is provided by the UL

Library. The University of Latvia Library provides consultations on the use of the library and Internet resources. Table 10 displays examples of key tasks to be performed by student support units/ staff.

*Table 10.*

*Examples of key tasks to be performed by student support unit/staff*

<b>Structural unit/staff</b>	<b>Key responsibilities</b>
Student Council of the Faculty of Chemistry	Represents the interests of students of the Faculty of Chemistry, defends their rights by delegating representatives to the Faculty Council and the Study Field Council, which consider issues related to the study process. The Student Council organises cultural events and participates in the organisation of Faculty events.
Trustee	Informs students of the developments in the study process, provides individual support to those students who face difficulties entering academic environment of the UL and initiates adaptation and team-building measures.
Coordinator, study advisor	Provides study advice, assists in day-to-day issues related to the study process, files study records, advises on the Information System of the University of Latvia (LUIS).
Mentor	A senior student who helps freshman students adapt to the study environment and share their experience.
Student Council (SC)	The purpose of the SC is to represent UL students and to defend their rights and interests. The SC represents the students' interests in academic issues by electing student representatives to the decision-making bodies of the University of Latvia, considering issues related to the study process and its improvement.
Director of the study programme	Organises and manages the development of a study programme in accordance with the requirements of the specific scientific or economic sector, cooperates with employers and internship sites in matters of study content, evaluates and approves individual study modules and individual study plans, etc.
Study service department	Organises the admissions process, advises the staff and students on mobility programmes, study, social and cultural issues, advises and organises career coaching and consultancy. Organises adaptation measures for students provides training for trustees, mentors, organises cooperation with employers, etc.

*The aim of career development support* is to provide students with comprehensive support and

develop their lifelong skills to identify their interests, abilities, skills, experience, thus enabling them to make informed decisions as regards education and/or occupation, and ensuring that they can condition their future career, study and life paths. Career development support is provided by the Career Centre of the UL Study Services Department in collaboration with the respective faculties.

The Career Centre provides the following services to students:

- individual counselling for future studies and careers, setting up an individual career plan, providing support for the transition between different levels of education and from education to the labour market;
- workshops for career planning skills (“Career planning and development skills”, “My first job interview”, “Stress management”, etc.);
- Internet resource - Career Centre home page (information available in both Latvian and English) <https://www.karjera.lu.lv/> (available only in Latvian) and <https://www.karjera.lu.lv/en/> provides up-to-date information on career planning issues, occupational information and the labour market;
- the “E-career” electronic resource <https://e-karjera.lu.lv/> (available only in Latvian) which enables students to quickly find their internship opportunities and jobs by adding their CVs to a database and employers to recruit employees by listing information on job vacancies in the database.

Psychological support is provided by the Study Service Department. A psychologist-consultant provides psychological support to students in solving personal and study issues arising from studies (relationship issues, conflict resolution, and emotional difficulties). A psychologist provides individual counselling and telephone counselling.

Special events aimed at integrating domestic and international students are organised in cooperation with the ESN (Erasmus student network), thus introducing international students to Latvian culture and traditions and promoting international and domestic student interactions.

The assessment of infrastructure accessibility for persons with disabilities has been conducted in cooperation with Apeirons. The results obtained are considered both in the construction of the new infrastructure and in the provision of study programmes.

The International Relations Coordinator of the Faculty is responsible for the successful implementation of international exchange programmes (Erasmus, Erasmus+, etc.) and mobility processes; she works in close cooperation with the administration.

The Public Relations specialist maintains, updates and renews the content of the Faculty's website and social accounts. Information on all public events, conferences, seminars, cultural events, etc. is promptly added.

All students are provided with a minimum of two hours of consultations each week with the lecturer of each study course, to enable them to discuss any unclear issues in person. Students can also receive advice on any study-related issue and social life of students from the Faculty's Study secretary at the Study Information Centre of the House of Nature. The most common questions are how to re-register for study courses, get clarifications on course papers/projects, apply for course recognition, etc. The faculty provides photocopying services for students, while the library offers a possibility for students to scan the needed books and other materials. For independent work and research, students can use the reading room of the Sciences Library, where they can read scientific journals, articles, printed and e-books, etc., computer rooms, individual and group work study booths, as well as other facilities created for the needs of students.

## 2.4. Scientific Research and Artistic Creation

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

The aim of the study field "Chemistry, chemical technologies and biotechnology" is to prepare academically educated specialists in the field of chemistry at the bachelor's and master's level as required by the society and the specifics of the labour market, as well as to provide students with the opportunity to acquire theoretical knowledge, practical skills and participate in an innovative and internationally competitive research and production, by ensuring development of chemical science thereby promoting the growth of Latvia and its society.

To achieve the goals of the study field, teaching staff of the Faculty of Chemistry (FC) carry out scientific research and actively involve students from bachelor's and master's programs in this research. This report contains data only about the teaching staff of the study program elected at the Faculty of Chemistry (hereinafter referred to as the teaching staff of the FC) and their research in connection with the chemistry study programs. The scientific research of teaching staff and students of the FC is carried out in the chairs of the Faculty of Chemistry, as well as in other research institutions where, additionally to the work in FC, the academic staff works and the FC students are carrying out scientific research. Among these institutions are other structural units of the UL, such as the Institute of Chemical Physics (ICP), as well as other research institutions, such as the Latvian Institute of Organic Synthesis (LIOS), the Institute of Food safety, Animal Health and Environment "BIOR" (BIOR) and UL Institute of Solid State Physics (ISSP).

In the Scientific Institutions International Evaluation in 2019, the FC being evaluated as part of the Natural Sciences cluster of UL received 3 out of 5 points in the overall assessment, and 4 out of 5 points in the assessment of the quality of scientific research (which indicates a very good quality of scientific research and notable international cooperation).

Between 2013 and 2015, scientific research in FC was carried out in three main directions: a) development of organic synthesis methods using ionic liquids and developing new selective organic catalysts, b) research of crystal phases of active pharmaceutical ingredients, c) development of analytical methods for research of new materials and various object. "University of Latvia Research Program 2015-2020" developed in 2015 included program for research in UL in four directions, an institutional development plan, as well as a human resources development plan. According to this plan in the period from 2015 to 2020 the scientific research in FC was mostly carried out in two of these directions which are also in line with LU's future strategic plans 201-2027:

1. In the field of **chemistry and nanotechnologies (ChemNano)** within the framework of the project *Nano, Quantum Technologies, and innovative materials for economics*, in which FC teaching staff and students carried out research in subprojects:

- 1.1. *Elaboration of innovative functionalized or chemically modified materials and creating of new analytical methods* (mainly carried out by FC),

- 1.2. *Nanomaterials for applications in energy and sensors* (mainly carried out by ICP) and

- 1.3. *Innovative materials for energy* (mainly carried out by ICP), as well as

2. In the field of **medicine and life sciences (MedLS)** within the framework of the project *Research of biomarkers and natural substances for acute and chronic diseases' diagnostics and personalized treatment*, in which FC teaching staff and students carried out research in subprojects:

2.1. *Synthesis of natural products and their analysis,*

2.2. *Development of methodology for natural product synthesis,*

2.3. *Pharmacology of natural products and their synthetic analogues,* as well as thematically close research, which was not included in the project,

2.4. *Structure and interactions of therapeutic target proteins and biologically active substances.*

In addition to these two directions, the Faculty of Chemistry also conducts research in

3. **Development of innovative instrumental analytical methods (InAnMet)** for the quantification of inorganic compounds, chemical elements and organic substances in various objects. This research is essential for the implementation of other research directions in which it is necessary to carry out chemical analyses of various materials and samples. Within this direction of research teaching staff and students of the Faculty of Chemistry conduct research in:

3.1. *Development and application of analytical methods for combined research of a wide range of chemical and biological pollution,*

3.2. *Analytical research of the circulation of chemical elements in the environment.*

The quality and scope of research carried out at the FC is adequate to ensure the study process at all levels, including the doctoral study process, which until 2021 was carried out by the PhD Programme (DSP) in *Chemistry* at the FC. The quality of the implemented DSP is evidenced by 45 defended PhD theses (see Annex 13 "Summary of quantitative data on scientific and applied research activities in the reporting period.")

Quantitative data on the scientific activity of the teaching staff (scientific projects, scientific apparatus, doctoral theses"), whose research has been published in 3-5 scientific publications in *Scopus* and *WoS* indexed journals. In 2021, the University of Latvia implemented the consolidation of doctoral programmes, thus ensuring a unified, interdisciplinary approach to the training of new PhDs and fostering cooperation between scientific disciplines. The new consolidated DSP in *Natural Sciences* also includes PhD studies in Chemistry. Doctoral students will work in the research areas of the Faculty of Chemistry as before.

In accordance with the "[University of Latvia strategy 2021-2027](#)" a development plan for study direction has been developed, in which one of the main goals is to **ensure international recognition of the scientific research in the field of studies and study programs**. To achieve the goal, the work started in the previous planning period is continued, by focusing on achieving the highest-level scientific excellence, as well as promoting student-oriented studies. The list of scientific publications in the period from 2013 to 2021 is given in Appendix 14 "List of publications and patents for the reporting period". In this self-assessment report, a detailed analysis of scientific research in the period from 2016 to 2021 is presented, including part of the publications from 2022, according to the above-mentioned three research directions, by providing information on the attracted funding in scientific research projects and contract works.

1. In the direction of **Chemistry and nanotechnologies (ChemNano)** the research was carried out in accordance with the general topics of the UL project *Nano, Quantum Technologies, and innovative materials for economics* (implemented by various structural

units of the UL, the head of the whole project is *professor D. Erts*) in the following subprojects:

*1.1. Elaboration of innovative functionalized or chemically modified materials and creating of new analytical methods (supervisor assoc. prof. G. Vaivars).* In this direction various materials have been researched, including active pharmaceutical ingredients (investigation of structural aspects, crystal forms and structure-physicochemical property relationships of organic solids, mostly active pharmaceutical ingredients), hydroxyapatites (synthesis and development of analysis methods of modified apatite composite materials to ensure more successful integration of biomaterials into solid tissues), ionic liquids (as medium (solvents) and catalysts in the organic synthesis), polymer nanocomposite membranes (research of polymer nanocomposite membranes and possibilities for their use in alternative energy devices) and other materials. Additionally, analytical methods using ICP-MS/MS, FTIR and other analytical techniques have been developed. Within the framework of this project also potential applications of Latvian clay minerals have been studied.

These studies are mainly carried out in the chairs of FC in collaboration with such Latvian research institutions as ISSP, LIOS, Riga Stradiņš University, Riga Technical University (RTU), ICP, UL Institute of Atomic Physics and Spectroscopy (IAPS) as well as international research institutions Laboratoire de Chimie de l'ENS Lyon, University College London, Silesian University of Technology (STU) in Gliwice.

*1.2. Nanomaterials for applications in energy and sensors (supervisor prof. D. Erts).* In this direction methods for the synthesis of various types of nanostructures (nanowires, nanoplates, thin and ultrathin films) of topological insulators bismuth and antimony chalcogenides as well as carbon nanotubes containing heterostructures have been developed.

These materials, as well as environmentally friendly nanostructures of zinc, titanium, and copper oxides have been studied for applications in thermoelectric generators.

Nanostructured  $\text{Bi}_2\text{Se}_3$  and its heterostructures with carbon nanotubes have been studied as anode materials in lithium and sodium batteries. Selective ion diffusion in channels with nanometre diameters under the influence of a temperature gradient is being studied for the use of nanoporous materials, such as anodized aluminium oxide, in new types of batteries based on the conversion of heat into electricity. These studies are mainly carried out at ICP, in collaboration with the FC, other structural units of UL and Latvian research institutions such as RTU, ISSP, industrial partners Nano RayT, 3D Strong, as well as international research institutions Chalmers University of Technology, Sweden, University College Cork, Ireland etc.

*1.3. Innovative materials for energy (supervisor for part of the research assoc. prof. E. Pajuste).* In this direction mostly studies of radionuclides, their behaviour, separation methods and application in various sectors of the economy have been carried out.

These studies are mainly carried out at ICP, in collaboration with such Latvian research institutions as RTU, ISSP, industrial partners Baltic Scientific Instruments Ltd., as well as international research institutions European Organization for Nuclear Research (CERN), Switzerland, International Atomic Energy Agency, ITER, France, Max-Planck-Gesellschaft zur Forderung der Wissenschaften EV and Bundesamt fuer Strahlenschutz, Germany, and others.

2. In the direction of **Medicine and life sciences (MedLS)**, incl. research of organic synthesis, the research was carried out in accordance with the general topics of the UL project *Research of biomarkers and natural substances for acute and chronic diseases' diagnostics and personalized treatment* (implemented by various structural units of the UL, the head of the project *prof. U.Riekstiņa*) in the following subprojects:



*2.1. Synthesis of natural products and their analysis (supervisor prof. E. Sūna).* In this direction two topics can be identified: a) the development of simplified structural analogues of the cytotoxic natural substance diazonamide A as anticancer agents, by rationally simplifying the structure of the natural substance diazonamide A using classical medicinal chemistry methods. As a result of the research, a patent-free series of structural analogues was developed and a leading compound was nominated. As part of this research, large number of compounds was synthesized, their in-vivo cytotoxic activity was tested in cancer cell lines (in collaboration with Dr. I. Domračova and Dr. E. Liepiņš, LIOS), the functional activity of compounds in the microtubule dynamics test was determined (in collaboration with D. Zeļentsova, LIOS), the thermal effect of the binding of the most active substances and the RB3-TTL-tubulin complex was determined using the ITC method (in collaboration with D. Zeļentsova, LIOS) and binding was studied using the NMR method (in collaboration with prof. K. Jaudzems and D. Zeļentsova, LIOS), pharmacological mechanisms and *in-vitro* ADME properties of the most active compounds were studied (in collaboration with Dr. I. Domračova and Dr. E. Liepiņš, OSI). b) The total synthesis of natural substance pseudotabersonine was carried out by developing a stereodivergent synthesis method suitable for obtaining structural analogues of the natural substance. The total synthesis of the natural substance was carried out in cooperation with Prof. J.-F. Poisson (Universite Grenoble Alpes, DCM, F-38000 Grenoble, France).

*2.2. Development of methodology for natural product synthesis (supervisor prof. E. Sūna).* In this direction research is focused on the development of sustainable and environmentally friendly methods using organic substance catalysis and organic electrosynthesis:

1. in the direction of organic substance catalysis during the report period research was focused on the design of chiral Lewis base catalysts and their application in enantioselective synthesis. As known, the organic substance catalysis allows to obtain individual optical isomers of natural substances using cheap, stable, easily prepared, as well as non-toxic and environmentally friendly organic catalysts. The implementation of the research was partly funded by the USA pharmaceutical company *Pfizer Inc.*
2. in the direction of organic electrosynthesis, research was focused on the development of new electrochemical methods for obtaining synthetically valuable hypervalent halide compounds as well as heterocycles.

*2.3. Pharmacology of natural products and their synthetic analogues (supervisor Dr. I. Nakurte).* In this direction chromatographic analysis methods for characterization of various natural substances and bioanalytical samples and their qualitative and quantitative analysis have been developed. As a result of research, methods for studying the pharmacological properties of natural substances have been developed, which are offered for cooperation with pharmaceutical manufacturers for the development of commercial products. The studies were carried out in cooperation with other structural units of UL (Faculty of Medicine, Faculty of Biology (FB) and Faculty of Geography and Earth Sciences (FGES)).

*2.4. Structure and interactions of therapeutic target proteins and biologically active substances (supervisor prof. K. Jaudzems).* In this direction structure of target proteins and their interactions with potential medicinal substances have been studied. The research was mostly carried out as part of the development of antiinfection (antibacterial, Lyme borreliosis, antiviral) agents. As a result, potential antigens that could be used for the development of Lyme disease vaccines were investigated (in collaboration with prof. K. Tārs and Dr. K. Brangulis), and new drug compounds were developed, which in the future are planned to be improved up to drug candidates for the beginning of clinical trials. The research was carried out in collaboration with UL FB and Latvian research institutions such as LIOS, Latvian Biomedical Research and Study Centre, as well as international research institutions Central European Institute of Technology, Czech Republic, University of Padua, Italy, Lithuanian University of Health Sciences, Lithuania, Vilnius University,

Lithuania, Academia Sinica, Taiwan, etc.

The above-mentioned research in the field of medicine and life sciences form the basis for a science-based study process and have contributed to the improvement and development of the study programs. In the Master's study program, the sub-direction "Organic chemistry" has been expanded and renamed as "Organic and biomolecular chemistry" by including new study courses.

In the direction of **Development of innovative instrumental analytical methods (InAnMet)** (*supervisors prof. A. Vīksna and prof. V. Bartkevičs*) FC scientists are among the country's leading experts in the field of analytical chemistry. Researchers of the FC collaborate with various institutions, developing and applying analytical methods in the field of environmental, food and natural resources research. Particularly important role in these studies are the collaboration with "BIOR", as well as with the UL FGES, as the research done in collaboration with the latter corresponds to the research direction of the UL in the field of *Earth sciences, environmental science and environmental engineering*. In general, within the framework of this research direction, various problems are solved:

1. evaluation of the chemical composition (micro- and rare earth elements, polycyclic aromatic compounds) and microbiological control of washed seaweed samples, as well as evaluation of their potential use,
2. development of a fast, accurate and verified chemometric multidimensional model system, which includes several high-resolution analytical methods, and developed decision-making tool for checking the quality, origin and composition of honey,
3. study whether household waste (sewage treatment sludge) and bioenergy production by-products (wood ash and fermentation residues) can be used as a nutrient elements and basic soil fertilizer compensating for the buffer capacity of the soil,
4. study of the recovery potential of trace elements and rare earth elements from the fine waste fraction,
5. study of the influence of different fertilization regimes (biological, conventional) on the spread of light stable isotopes and various metallic elements in crops with the aim of applying these data in the future assessment of the origin of food products,
6. improvement of air and dust sampling methodologies in different degrees of pollution analysis in sampling environments (urban environment, working environment, indoor spaces in homes and offices), by analysing distribution of solid aerosol particle fractions, metallic elements and other pollutants,
7. sensitive and accurate instrumental methods for the determination of the content of organic pollutants in food and environmental objects have been developed.

In addition to the already mentioned collaboration, research in this direction is carried out in collaboration with other Latvian research institutions such as Latvian State Forest Research Institute "Silava", Latvian State Institute of Wood Chemistry, Latvian Institute of Aquatic Ecology, Institute of Agricultural Resources and Economics, The Institute of Horticulture and also with international research institutions such as Masaryk University in Brno (assoc. prof. V. Rudoviča, prof. A. Vīksna), University of Warsaw (prof. A. Vīksna), Jožef Stefan Institute in Ljubljana (assist. prof. A. Osīte) and the Estonian Environmental Research Centre in Tallinn (assist. prof. A. Osīte).

**Analyzing the future perspectives of scientific research** carried out in the directions of chemistry studies, the following key ideas and developments should be highlighted:

1) *in the direction of Chemistry and nanotechnologies*: a) development and continuation of the research of the connection between the crystal structure and properties of organic substances, by starting a research of molecules used in the material science (such as the fine-tuning of luminescence properties and the structures of metal-organic frameworks) b) further development of

ionic liquids and polymer composites, by increasing their conductivity and stability; c) development of new materials for lithium and sodium batteries, moving towards the creation of solid-state batteries (LiPo, NaPo); d) continuation of studies of routes for obtaining new hydroxyapatites, by paying special attention to the creation of coatings on various substrates e) synthesis of new nanostructured materials, studies of their properties and development of prospective applications in quantum, thermoelectric and sensor devices as well as in batteries; f) analysis of the effect of high-energy ions on lithium-containing ceramic materials which are planned to be used in nuclear fusion reactors for tritium generation; g) synthesis of new and innovative composite materials with improved sorption properties from renewable biological natural resources; h) participation in research coordinated by the European Organization for Nuclear Research CERN within the MEDICIS (radionuclide for medicine) and CMS (particle detectors) experiments; i) conduction of a study on the behaviour of tritium in reactor materials (ITER organization.)

2) *in the direction of Medicine and life sciences*: a) the development of structurally simplified analogues of the natural substance diazonamide A will be continued with the aim of creating anticancer agents with reduced systemic toxicity; b) the initiated research in the field of organic electro synthesis and in the development of organic catalysts will be continued and c) the initiated research in the determination of protein structure and study of interactions of potential medicinal substances will be continued.

3) *In the direction of Development of innovative instrumental analytical methods*: a) the development of methods for determining the distribution of inorganic compounds in various environmental objects, using laser ablation, isotope ratio mass spectrometry and inductively coupled plasma tandem mass spectrometry techniques available at the FC; b) studies of electrochemical properties of various materials and coatings using impedance spectrometry, voltammetry and other methods; c) studies of metabolites of organic compounds in food products with the high-resolution mass spectrometry method.

A list of scientific publications (indexed in *Scopus* or *WoS*) relevant to the research areas pursued by the academic staff and students of Faculty of Chemistry in the period 2016-2021 is available in Annex 14 "List of publications and patents of teaching staff for the reporting period". The number of publications, patents and conference abstracts in the three directions of research is summarised in Table 11. The summary includes data only for the elected academic staff of the Study Field at the Faculty of Chemistry.

Table 11.

*The number of scientific publications (Scopus or WoS), patents, and conference thesis in three scientific research directions*

Year	Scientific publications (Scopus or WoS)				Patents (Scopus or WoS)			Conference thesis			
Direction*	1	2	3	Total	1	2	Total	1	2	3	Total
2016	15	5	17	<b>37</b>	1	-	<b>1</b>	31	10	17	<b>58</b>
2017	23	5	19	<b>47</b>	-	2	<b>2</b>	47	16	11	<b>74</b>
2018	24	9	26	<b>59</b>	-	-	-	52	9	9	<b>70</b>
2019	28	5	19	<b>52</b>	-	2	<b>2</b>	57	15	29	<b>101</b>
2020	23	8	24	<b>55</b>	4	-	<b>4</b>	64	5	16	<b>85</b>

2021	26	10	22	<b>58</b>	-	2	<b>2</b>	76	11	32	<b>119</b>
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\*1 - ChemNano, 2 - MedLS, 3 -InAnMet

The most important publications in the 1st research direction:

1. Buks, J. Andzane, K. Smits, J. Zicans, J. Bitenieks, **A. Zarins, D. Erts**. Growth mechanisms and related thermoelectric properties of innovative hybrid networks fabricated by direct deposition of Bi<sub>2</sub>Se<sub>3</sub> and Sb<sub>2</sub>Te<sub>3</sub> on multiwalled carbon nanotubes, *Materials Today Energy*, 18, 100526 (2020), DOI: 10.1016/j.mtener.2020.100526
2. **Kons, A., Bērziņš, A., Actiņš, A., Rekis, T.**, Van Smaalen, S., Mishnev, A. Polymorphism of R-Encenicline Hydrochloride: Access to the Highest Number of Structurally Characterized Polymorphs Using Desolvation of Various Solvates. *Growth Des.* 2019, **19**, 4765-4773, 10.1021/acs.cgd.9b00648
3. **Pajuste, G.** Kizane, L. Avotina, **A.S. Teimane, K. Vonda**, A. Lescinskis. Novel method for determination of tritium depth profiles in metallic samples, *Nuclear Fusion*, 59 (2019) 106006.

The most important publications in the 2nd research direction:

1. **Sokolovs, I.**; Mohebbati, N.; Francke, R.; **Suna, E.** Electrochemical Generation of Hypervalent Bromine(III) Compounds, *Angew. Chem. Int. Ed.* 2021, 60, 15832-15837. DOI: 10.1002/anie.202104677
2. Dimanta, I., Kleperis, J., **Nakurte, I.**, Valucka, S., **Nikolajeva, V.**, Rutkovska, Z., Muiznieks, I. Metal hydride alloys for storing hydrogen produced by anaerobic bacterial fermentation. *International Journal of Hydrogen Energy* 2016, 41, 9394-9401, 10.1016/j.ijhydene.2016.04.064
3. Fridmanis, J., **Bobrovs, R.**, Brangulis, K., **Tārs, K., Jaudzems, K.** Structural and functional analysis of bba03, borrelia burgdorferi competitive advantage promoting outer surface lipoprotein. *Pathogens* 2020, 9, 826, 10.3390/pathogens9100826

The most important publications in the 3rd research direction:

1. **Perkons, I., Rusko, J.**, Zacs, D., **Bartkevics, V.** Rapid determination of pharmaceuticals in wastewater by direct infusion HRMS using target and suspect screening analysis. *Science of the Total Environment* 2021, 755, 142688, 10.1016/j.scitotenv.2020.142688
2. Shtangeeva, I., **Vīksna, A., Bērtiņš, M.**, Ryumin, A., **Grebnevs, V.** Variations in the concentrations of macro- and trace elements in two grasses and in the rhizosphere soil during a day. *Environmental Pollution* 2020, 262, 114265, 10.1016/j.envpol.2020.114265
3. Burlakovs, J., Jani, Y., Kriipsalu, M., Vincevica-Gaile, Z., Kaczala, F., **Celma, G.**, Ozola, R., Rozina, L., **Rudovica, V.**, Hogland, M., **Vīksna, A.**, Pehme, K.-M., Hogland, W., Klavins, M. On the way to 'zero waste' management: Recovery potential of elements, including rare earth elements, from fine fraction of waste. *Journal of Cleaner Production* 2018, 186, 81-90, 10.1016/j.jclepro.2018.03.102

The described research has been funded from various research funding sources. Some of the research has been carried out using UL base and performance science funding within the framework of the previously mentioned common UL projects, but a large part of the research was also funded by other scientific projects. The scientific projects, in the implementation of which the teaching staff and students of the Faculty of Studies of CF are involved, are summarized in Annex 13 " Summary of quantitative data on scientific and applied research activities in the reporting period". A summary of these projects, broken down by type of project funding and research focus for the period 2016-2021, is given in Table 12. Projects implemented by the UL and other research

institutions and carried out by the academic staff and students of the Faculty of Chemistry, are specified.

Table 12.

*The number of implemented scientific projects by funding source and research direction*

Direction	ChenNano		MedLS		InAnMet	Total
Funding source/ Organization implementing the project	UL	ISSP*	UL	LIOS*	UL	
Horizon 2020 and 7th Framework Programme	7	1		4	1	13
Other international projects	7			2	2	11
COST networks	1		1	1	3	6
ERDF or ESF	5			4	2	11
Latvian Council of Science FARP or grants	5		1	1	2	9
ERDF individual postdoc projects	3			3		6
National research program	2			1	5	8
Other national projects	1				1	2

\*ISSP –Institute of Solid State Physics, LIOS-Latvian Institute of Organic synthesis

The number of scientific projects implemented in each year, as well as the UL share of the funding (or the project implementer if implemented by ISSP or LIOS), by dividing the projects into national projects (funding from institutions in Latvia, mostly implemented independently or in collaboration with local partners) and international projects (at least part of the funding from institutions in foreign countries, implemented in collaboration with international partners) is given in Figure 6. We note that in the direction of medicine and life sciences most of the projects were implemented at LIOS where the research is carried out by FC teaching staff and in the implementation of all of the listed projects FC students and/or teaching staff have played an important role.

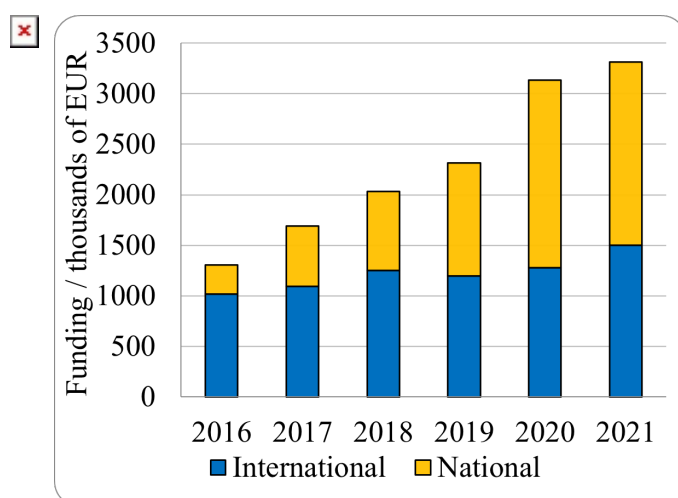


Figure 6. Summary of the number of implemented projects (on the left) and the share of funding by the implementing institution (on the right) in the respective year.

In addition to the scientific research carried out by implementation of scientific projects and

conducting research involving students of various study programs of the Faculty of Chemistry, the FC teaching staff also carry out contract research ordered by various research institutions, companies, and the public sector. Detailed information on cooperation partners in such contract research and the attracted funding from 2016 to 2021 is summarized in Annex 13 "Summary of quantitative data on scientific and applied research activities in the reporting period"

The collaboration partners for whom contract research and chemical analyses are carried out is broad and can be divided into several groups:

*1<sup>st</sup> group.* Other Latvian universities and research institutions, including, for example, RTU, LIOS, Latvian Institute of Aquatic Ecology, etc.

*2<sup>nd</sup> group.* Chemical and pharmaceutical industry companies, including, for example, JSC "Grindeks", JSC "Olainfarm", "Tenachem" Ltd., etc.

*3<sup>rd</sup> group.* Small and medium-sized companies and start-ups related to the chemical and pharmaceutical industry, including, for example, Alina Ltd., LabochemLV Ltd., Ardena Riga Ltd. (previously Syntagon Baltic Ltd.), etc.

*4<sup>th</sup> group.* Representatives of the public sector, which includes, for example, the Latvian National Armed Forces.

The analysis of the scientific research areas of the FC and the quantitative and qualitative indicators show that they are in compliance with the objectives and content of the study programmes of the study field and are in line with the level of contemporary science.

#### **2.4.2. 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.**

Most of the Compulsory (Part A) as well as the Restricted Elective (Part B) study courses in the **BSP "Chemistry"** are related to the scientific research carried out by FC. Based on the knowledge acquired in these courses, students gain an understanding of the basic fields of chemistry, chemistry subfields and their theoretical foundations, which are used in conducting every day research in chemistry and nanotechnology, medicine and life sciences, as well as in the development of instrumental analytical methods.

Study courses "*Introduction to Studies and Research*", "*Research Project in Chemistry*" and "*Bachelor's Thesis*" introduce students to research methods, approaches to data collection and analysis. In the last two of these courses students independently carry out scientific research work in the research fields related to the scientific research directions of FC: in organic synthesis, in the field of nanotechnology, in medical and life sciences, or in the direction of development of instrumental analytical methods. Some students carry out their scientific research works in scientific institutions and companies outside FC, but also in this case the research is thematically related to one of the research directions implemented by FC.

In the Restricted Elective (part B) courses, students are offered to acquire more detailed knowledge and skills in areas where research is also directly carried out and which forms the basis for further master's studies (see Table 13).

Table 13.

*Restricted elective study courses of BSP "Chemistry" related to the research areas implemented by FC*

Direction	Study courses	Connection to research
Physical chemistry	Energy Containment Chemistry, Nanochemistry, Introduction to Materials Science, Crystal Chemistry, Macromolecules, Mathematical Processing and Modelling in Chemistry	Provides an insight into the research directions implemented by the FC in the field of chemistry and nanotechnology, introduce students to the methods used in the research.
Organic and biomolecular chemistry	Heterocyclic Compounds, Preparation of Organic Compounds, Methods of Instrumental Analysis in Biology	Provides an insight into the research directions implemented by the FC in the field of medicine and life sciences, introduce students to the methods used in the research.
Analytical chemistry	Practical Analytical Chemistry, Principles of Food Chemistry, Quality Assurance in the Laboratory,	Provides an insight into the research directions implemented by the FC in the field of analytical method development, introduces to the methods used in research and the quality standards of analytical laboratories.

Study courses of **MSP "Chemistry"** are even more directly related to the areas in which the scientific research is carried out, because in the FC a science-based study process is implemented. All Compulsory Part A courses provide in-depth knowledge and skills in the most current research in the chemistry branches (analytical chemistry, physical chemistry and organic chemistry). "Research Project I", "Research Project II" and the Master's thesis provide students with the opportunity to carry out scientific research work mainly directly in the current topics of the scientific research done by the FC teaching staff.

In the Restricted Elective (Sub-direction courses B1) study courses knowledge and skills are acquired modern physical chemistry research methods, which are widely used by teaching staff in everyday research work (courses "X-ray Methods in Chemistry", "Chromatography", "Nuclear Magnetic Resonance Spectroscopy" and "Molecular Computer Modelling", "Physical Chemistry of Solid Materials" and "Advanced Surface and Colloidal Chemistry" etc.).

The results of scientific research are widely used in the organic chemistry and biomolecular chemistry subfield courses in both Bachelor's and Master's programs, for example, the catalysis of transition metals, the use of ionic liquids. In recent years, research in the field of electrochemical synthesis has become relevant, therefore a new elective course "Electrochemical synthesis" has been developed and offered. Today, interdisciplinary methods of chemical biology and structural analysis of biomolecules, which are included in the expanded sub-direction of organic and biomolecular chemistry, have become particularly relevant. Considering the experience of the present teaching staff and the opportunities to attract highly qualified specialists in the structural analysis of biomolecules and the studies of their interactions, as well as the use of this information in the development of vaccines or drug candidate substances, new courses such as "Chemical Biology", "Structure of Biomolecules" and "Molecular Computer Modelling" have been developed.

All the Restricted Elective (B1 and B2 part) courses of the MSP "Chemistry" in the sub direction of analytical chemistry provide an insight into research methods of modern analytical chemistry, which are widely used for conducting research work. Students are introduced to the most important methods of sample preparation (course "Sample Preparation in Analytical Chemistry"), the quantitative content of chemical elements in various environmental objects is quantified with

contemporary analytical instruments. Practical skills in working with various instrumental analysis methods are learned in the course "*Practical Applications of Advanced Elemental Analysis*".

Research results are systematically integrated in many study courses of both BSP "Chemistry" and MSP "Chemistry". For example, the BSP course "*Physical Chemistry I*" and the MSP course "*Physical Chemistry of Solid Materials*" use examples from research of pharmaceutical organic substances to demonstrate phase stability, transformations, and phase diagrams. In the MSP course "*X-ray methods in chemistry*" the results and examples obtained in research are used in the analysis of X-ray spectra, qualitative and quantitative phase analysis and crystal structure determination. The MSP courses "*Advanced Surface and Colloidal Chemistry*", "*Microscopy Methods*", "*Organic synthesis I, II and III*" use analytical and synthetic methods and research objects approved in research work. The content of the MSP "Chemistry" course "*Radiation Chemistry*" is in accordance with the research topic of the UL scientific group, by examining and using the obtained research results in this study course, for example, the evaluation of the radiation stability of various polymers. Also, the study courses "*Biomolecular Structure*" and "*Methods of Electrochemical Analysis*" are in accordance with the research topic. The last of the mentioned, for example, includes the results of the studies of electrochemical sensors and electrochemical properties of nanomaterials. The research results are most directly linked to the final thesis and research projects. Research topics of these works usually are chosen in accordance with the current research directions of the Faculty of Chemistry.

**2.4.3. 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.**

In all areas of research carried out by the FC, much of the research is performed in collaboration with foreign universities and other scientific research institutions. This cooperation is carried out both through joint international research projects and through the publication of the results of joint research. A summary of the share of research publications published with international cooperation partners between 2016 and 2021 is given in Table 14.

Table 14.

*Share of research publications where the co-authors are the international cooperation partners in all three topical research direction of the FC*

Research direction	Total number of publications	Publications with international collaboration partners	Fraction / %
1. Chemistry and nanotechnologies	140	60	43
2. Medicine and life sciences, incl. organic synthesis	37	10	27
3. Development of innovative instrumental analytical methods	129	59	46



Along with the preparation and publication of joint scientific articles collaboration is also realized as joint implementation of international scientific projects (see Table 15). Individual or intergroup international collaboration implemented without mutual financial obligations, such as scientific mobility or exchange of experience, is also important. For detailed information on such projects see Annex 13. "Summary of quantitative data on scientific and applied research activities in the reporting period".

Table 15.

*Scientific projects jointly implemented with international collaboration partners for each of the three research directions.*

Year/direction*	Total number of research projects			Number of collaboration projects		
	1	2	3	1	2	3
2016	6	2	1	1	2	2
2017	6	3	3	1	2	2
2018	8	3	1		2	1
2019	7	3	1		1	2
2020	8	3	1			2
2021	8	4	1			2

\*1 - ChemNano, 2 - MedLS, 3 -InAnMet

The most important international projects:

- CanBioSe - Novel 1D photonic metal oxide nanostructures for early stage cancer detection. Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant. Coordinator UL, 01.2018.-06.2023., UL funding 423 000 EUR.
- The European Medical isotope programme: Production of high purity isotopes by mass separation PRISMAP. 05. 2021. – 04.2025. UL funding 110 750 EUR.
- Strengthening the Competence in Radiation Technologies and Safety for Biomedicine and Materials Science. Technical Cooperation Project with International Atomic Energy Agency. 01.2020. – 12.2022. UL funding 265 835,75 EUR.
- EU FP7 IMI "New Drugs for Bad Bugs" (ND4BB) program, ENABLE "European Gram-Negative Antibacterial Engine", EU 7th Framework Programme. 2014-2021. LIOS funding: 6 065 220 EUR. LIOS implemented project.
- Integrative structural biology of pathological tau protein, an appealing therapeutic target for Alzheimer's disease modifying drugs. Horizon 2020 project. 01.2020 – 06.2025. LIOS funding 128 800 EUR. LIOS implemented project.
- European Human Biomonitoring Initiative HBM4EU. Horizon 2020 project. 2017-2022. UL funding 49 260 EUR.
- Establishing of the scientific capacity for the management of pharmaceutical products residues in the environment of Latvia and Norway. Project funded by European Economic Area Financial Mechanism and the Norwegian Financial Mechanism. 2015-2017. UL funding 220 000 EUR.

The most important collaborations with scientific research groups and their supervisors are the following:

- a) Vilnius University, Lithuania, prof. A. Ramanavicius. This scientific collaboration started before 2016 and was implemented in the various projects, moreover. it resulted involvement of prof. Ramanavicius in the study process as a permanent visiting professor.
- b) University of Montpellier, France, Mikhael Bechelany. This scientific collaboration is realized as implementation of various joint scientific projects and as several mobility activities in which the skills and competences of PhD student of the FC were improved;
- c) ITER, for which contract research on the tritium diffusion processes and its accumulation in nuclear fusion equipment materials is being carried out by several teaching staff members and students of FC;
- d) CERN, several scientific projects are implemented in the research of particle physics and detector crystals and the development of radiopharmaceutical preparations, including a project developed in collaboration with the MEDICIS consortium.
- e) Rostock University and Leibniz Institute for Catalysis, Germany, R. Francke. The scientific collaboration started in 2016, 3 mobility activities were implemented (2 PhD students and 2 students) and resulted in several joint scientific publications;
- f) Johannes-Gutenberg-Universitat, Mainza, Germany, prof. S. Waldvogel, Scientific collaboration started in 2018, 2 mobility activities (1 FC PhD student, 1 student), one of the results of the collaboration is a joint scientific publication;
- g) Pfizer Inc., USA, D. Piotrowski. Scientific collaboration started in 2014, several joint research projects, 2 joint scientific publications. In organic synthesis.
- h) St.Petersburg State University, Dr. Irina Shtangeeva. This collaboration which was carried out as several mobility activities resulted in several joint high-level scientific publications in analytical chemistry;
- i) involvement in the European transdisciplinary networking platform for marine biotechnology, resulting in several joint scientific publications.

Several research activities are planned to start with new partners in the nearest future:

- a) collaboration with the *Université de Rouen Normandie* as the coordinator and other consortium partners from 18 countries, the COST action project *Bringing Experiment and Simulation Together in Crystal Structure Prediction* has been submitted;
- b) involvement in the COST action *Mechanochemistry for Sustainable Industry*;
- c) collaboration with Polish scientific institutions *Maria Curie-Skłodowska University* (Lublin) and *Centre of Molecular and Macromolecular Studies, Polish Academy of Sciences* (Łódź), has been initiated in the field of research of crystal structures of active pharmaceutical ingredients;
- d) implementation of the Horizon 2020 projects "*European Partnership in radiation protection and detection of ionising radiation*" and "*EUROFusion*" (starts in 2022);

Some additional individual and intergroup scientific mobility and experience exchange are presented see Annex 13 "Summary of quantitative data on scientific and applied research activities in the reporting period".

To promote the international scientific collaboration the teaching staff of the Faculty of Chemistry have participated in the organization of scientific conferences. The conferences organized between 2016 and 2021 are also presented in Annex13 "Summary of quantitative data on scientific and applied research activities in the reporting period".

The international scientific recognition of the teaching staff of FC is indicated by the invited presentations at international scientific conferences and the working in the editorial boards of scientific journals. The invited presentations at international scientific conferences between 2016 and 2021 are listed here: prof. E. Sūna – 2, prof. A.Vīksna – 2, prof. D.Erts – 2, assist. prof. A.Ošiņe – 1, assoc. prof. G.Vaivars – 1.

Participation of CF teaching staff in editorial boards of international journals from 2016 to 2021. Professor A. Zicmanis and professor D. Erts work regularly, periodically prof. Vīksna and Prof. Suna.

Both BSP "Chemistry" and MSP "Chemistry" benefit from international scientific cooperation and participation in international projects, because both of these programs are taught by lecturers involved in such cooperation and project implementation, thus increasing their knowledge and competence. The most important directions of research with international cooperation can be mentioned: nanomaterials for applications in energy and sensors (courses "*Nanochemistry*" BSP, "*Microscopy Methods*" MSP); innovative materials for energy ("*Energy Containment Chemistry*" BSP, "*Radiation Chemistry*" MSP); structure and interactions of therapeutic target proteins and biologically active substances ("*Nuclear Magnetic Resonance Spectroscopy*" MSP, "*Molecular Computer Modelling*" MSP, *Biomolecular Structure*, MSP); synthesis of natural products and their analysis, as well as development of methodology for natural product synthesis ("*Heterocyclic Compounds*" BSP, "*Electrochemical Synthesis*" MSP, *Chemistry of Natural Compounds* MSP, *Organic Synthesis III* MSP etc.); development of innovative instrumental analytical methods ("*Principles of Food Chemistry*" BSP, "*Methods of Electrochemical Analysis*" MSP, *Practical Applications of Advanced Elemental Analysis* MSP). Lecturers and students of both programs conduct research in the implementation of various projects.

**2.4.4. 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 field by providing examples.**

Conducting scientific research and publishing the results as well as supervising students' scientific work is an important part of the tasks included in the employment contract of the teaching staff. The amount of research work intended for the teaching staff depends on the development plan of the respective research direction and the distribution of the planned workload between academic and scientific research tasks for the respective lecturer. The amount and quality of the conducted research is regularly discussed and evaluated, and the preparation of project applications for research funding is encouraged (including a financial support from the UL). High-quality research results provide opportunities to attract additional scientific projects by therefore developing the respective research direction and allowing involvement of additional scientific staff, including FC students. At the UL level one of the mechanisms for stimulating research excellence is the science excellence support program, which provides material support for a publication in the Q1 category journal according to the *WoS* or *Scopus* database classification.

The number of scientific publications indexed in the *WoS* and *Scopus* databases of the FC teaching staff has gradually increased since the accreditation in 2013 (see Appendix 14. List of publications and patents of teaching staff for the reporting period".

A total of 306 scientific publications (where affiliation to the University of Latvia is indicated) have

been included in the *Scopus* database in the above-mentioned three scientific directions during the last six years (from 2016 to 2021). The number of scientific publications in the *Scopus* database over the years are shown in Figure 7. It can be seen that in the period from 2016 to 2018 the scientific productivity of FC researchers is growing, while in the further years it is stable and relatively even. The fraction of the scientific articles published with international co-authors is also represented, and the number of such articles is also stable and relatively even. The relatively large number of scientific articles in 2015 is due to the large number of active doctoral students. This is largely because for three years until the end of the 2015 notable additional funding was available for doctoral students within the framework of the ESF project.

Part II of Annex 14 " List of publications and patents of teaching staff for the reporting period" contains a list of the most valuable publications for all of the teaching staff members involved in this study direction.

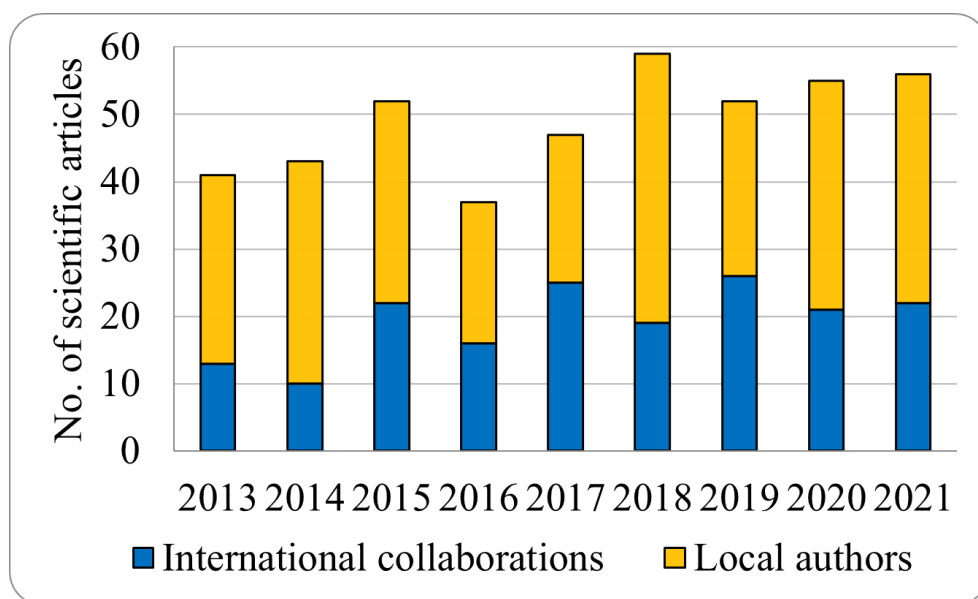


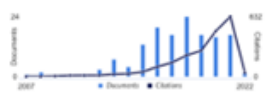





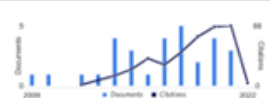
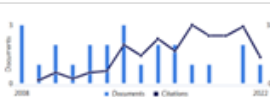



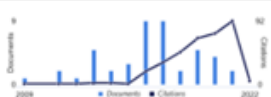
Figure 7. Number of scientific publications indexed in the *Scopus* databases by the UL FC teaching staff and students in 2013 – 2021.

By analysing the scientific contribution of the teaching staff elected by the FC, it can be concluded that 86% of the teaching staff involved in the implementation of the study program are actively involved in research. The intensity of work is most often determined by the ability to update the research topics and attract funding. Almost half of the FC teaching staff (14) have a *Scopus* h-index of at least 10, which indicates on their significant contribution to the development of the chemical science. Table 16 summarizes information about the teaching staff of the FC having the highest scientific productivity. Most of the publication citation graphs show an increasing citation dynamic. In most cases this is because among the listed teaching staff there are many young scientists whose scientific activity is in a phase of an increasing quantity and quality of the scientific results.

Table 16.

*Indicators of the scientific performance of FC study direction teaching staff leading in the field of research (giving the total number of publications of the teaching staff which also includes publications that are not included in this report).*

Name, surname, position	Entries in <i>Scopus</i> database	h-index ( <i>Scopus</i> )	Dynamics of the number of publications (bars) and citations (line) on February 1, 2022 (starts with the 1 <sup>st</sup> indexed publication)
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Chair of Analytical Chemistry			
Vadims Bartkevičs, prof.	147	24	
Arturs Vīksna, prof.	86	16	
Vita Rudoviča, assoc. prof.	28	11	
Chair of Organic Chemistry			
Kristaps Jaudzems, prof.	64	21	
Edgars Sūna, prof.	48	18	
Chair of Physical Chemistry			
Andris Actiņš, prof.	49	11	
Agris Bērziņš, assoc. prof.	31	11	
Liāna Orola, assoc. prof.	24	11	
Elīna Pajuste, assoc. prof.	38	10	
Guntars Vaivars, assoc. prof.	65	16	
Chair of Inorganic Chemistry and Labour Protection			
Donāts Erts, prof.	140	30	
Ingars Reinholds, assist. prof.	46	11	

Scientific publications with a very large number of citations additionally indicate on the high scientific quality of the research done by the FC teaching staff. Among the scientific articles published since 2013, 10 teaching staff members are author of scientific articles with over than 50 citations, including 4 articles by D. Erts (in total author of 18 articles cited at least 50 times), 5 articles by E. Pajustes, 6 articles by K. Jaudzems, 5 by V. Bartkevičs (in total author of 6 articles cited at least 50 times), 2 - for E. Sūnas articles (in total author of 6 articles cited at least 50 times),

1 by L. Orola, 1 by A. Bērziņš, 1 by I. Reinholds and 1 by V. Rudoviča. Also, among the authors with articles published before 2013 with a large number of citations is G. Vaivars (the largest number of citations for one article: 290 citations). FC teaching staff members are authors of publications in such prestigious journals as *Advanced Materials* (2007, 2006, IF=30,849), *ACS Nano* (2019, IF=15,881), *Angewandte Chemie International Edition* (2021, IF=15,34), *Journal of the American Chemical Society* (2003, 2012, 2014 IF=15,419), *Nature Communications* (2017, IF=14,919), *Small* (2006, IF=13,2801), *Nano Letters* (2009, 2006, 2006, IF=11,189), *Biosensors & Bioelectronics* (2018, IF=10,618).

By expanding the interdisciplinarity of the study program additional experienced and excellent scientists and professors are involved as lecturers in the study programs prepared for the accreditation: prof. L. Skuja (h-index=37), prof. K. Tārs (h-index =28), assoc. prof. A. Linē (h-index=24), assoc. prof. A. Šarakovskis (h-index=13) as well as excellent foreign visiting prof. A. Ramanavičius (h-index= 38) and Dr. E. Parisini (h-index=33).

It can also be noted that within the framework of the science excellence support program introduced at the University of Latvia the material support for a publication in the Q1 category journal (according to the *WoS* or *Scopus* database classification) has been awarded to the FC teaching staff members D. Erts, E. Sūna, A. Bērziņš, T. Rēkis, I. Reinhold, E. Pajuste and K. Jaudzems.

The FC teaching staff members participate in the implementation of scientific research projects at both international and national level, and these are described in the previous Sections 2.4.1 and 2.4.3. Most of the teaching staff highlighted in Table 16 as having the highest scientific productivity also have been supervisors of at least one scientific research project, while some supervise a large number of national and international projects. Detailed information about the projects is given in Annex 13 "Summary of quantitative data on scientific and applied research activities in the reporting period".

Among the FC teaching staff there are 14 Latvian Council of Science experts in mostly chemistry, but also in physics, material sciences, nanotechnology, biology, basic medical sciences and chemical engineering.

The scientific excellence of FC teaching staff is also indicated by the received awards, for example, prof. E. Sūna – Latvian Science Achievement by the Latvian Academy of Sciences for the research *Electrosynthesis solves a long-standing scientific challenge and opens the door to valuable chemical reagents* (2021); assist. prof. I. Nakurte – L'Oréal Baltic fellowship for Women in Science (2018); prof. D. Erts – Acknowledgement diploma from the Cabinet of Ministers of the Republic of Latvia (2018) and other.

**ANNEX 13.** "Summary of quantitative data on scientific and applied research activities in the reporting period"

**ANNEX 14.** "List of publications and patents of teaching staff for the reporting period"

**2.4.5. Specify how the involvement of the students in scientific research and/ or applied 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 field in scientific research and/ or applied research and/or artistic creation activities by giving examples of the opportunities offered to and used by the students.**

In the first semester of BSP "Chemistry" in the course "*Introduction to Studies and Research*" (1 CP) students are introduced to the conduction of the scientific research, the methods and techniques used in the research, as well as to the opportunities for involving in the scientific research carried out in the FC or related UL's and other scientific institutions. Part of the students start their scientific research works already when studying in the first year of the bachelor's study program, and the FC teaching staff encourage as many students as possible to start it. In the case of a student's interest, a research group where students have the opportunity to gradually get involved in conducting scientific research is provided. Not all the students involve in the scientific research during the first study year, because some students have difficulties in their studies or other circumstances, which result in later involvement in the scientific research. In general, such involvement of students in scientific research results that large part of the students of the Bachelor's program, and in further studies many of the students of the Master's program during their studies are also employed in scientific institutions, where they additionally learn the basics of scientific research. Among the institutions where the FC students are employed as the most notable UL ICP, ISSP, LIOS, BIOR as well as FC Chairs should be highlighted.

From the 5<sup>th</sup> semester in the BSP "Chemistry" and the 2<sup>nd</sup> semester in the MSP "Chemistry" the participation in scientific research is mandatory for all students, because among the Compulsory study courses "*Research Project in Chemistry*" in BSP and "*Research Project I*" and "*Research project II*" in MSP must be taken. In these study courses an individual scientific research work must be carried out (in either in one of the FC Chairs, another scientific institution or in a chemical production company) and the obtained research results must be processed, analysed, described, present and defended. The final theses of almost all the students are developed in scientific institutions under the supervision of scientists, or sometimes in chemical production companies or in cooperation with such companies.

In 2021, 39 final theses were defended at BSP "Chemistry". Most of the Bachelor's theses were developed at FC (17), but a large number of works were developed in other Latvian research institutions where students carry out scientific research and where FC teaching staff either work (in parallel to working in FC) or collaborate in the field of the research (ISSP – 7, LIOS – 6, ICP – 2, BIOR – 2, LSFRI Silava – 1 and Latvian Institute of Aquatic Ecology – 1). Also, some of the works were developed in the chemical and pharmaceutical industry or other chemistry related companies (JSC "Grindeks" – 1, JSC "Rīgas ūdens" – 1). Considering the institutions where these works were developed and the scientific research areas of the work supervisors, the research topics in general are related to the research carried out by the FC and described in the previous Sections.

Additionally, some of the authors of the Bachelor thesis at the time of the thesis defence already has publications in journals indexed in the *Scopus* database or they are authors of presentations in scientific conferences of different levels, mostly international.

By analysing the topics of the final thesis in the master's study program and the institution where these works have been developed it can be seen that during the period from 2016 to 2021 82-93% of the defended master's theses have been carried out in research directions in which the scientific research is carried out by the FC teaching staff. Students have developed these works in FC Chairs as well as other scientific institutions (see Figure 8). The rest of the works have been developed in Latvian chemical production companies (mainly pharmaceutical production companies), therefore the research is not directly related to the research directions of the FC, although in terms of the research methods used, there is still agreement with the research conducted by the FC.

The scientific excellence of the conducted research is evidenced by the fact that among these works, ~25-45% (of the total number of defended works) have been published as a scientific publication (or are part of a scientific publication) in *Scopus* or *WoS* indexed journals with the

student being a co-author or even the first author. Moreover, even if a publication based on the Master's thesis is not prepared, another ~10-23% of the authors of the Master's theses are still co-authors of scientific articles (about scientific research done before, in parallel, or after the Master's studies).

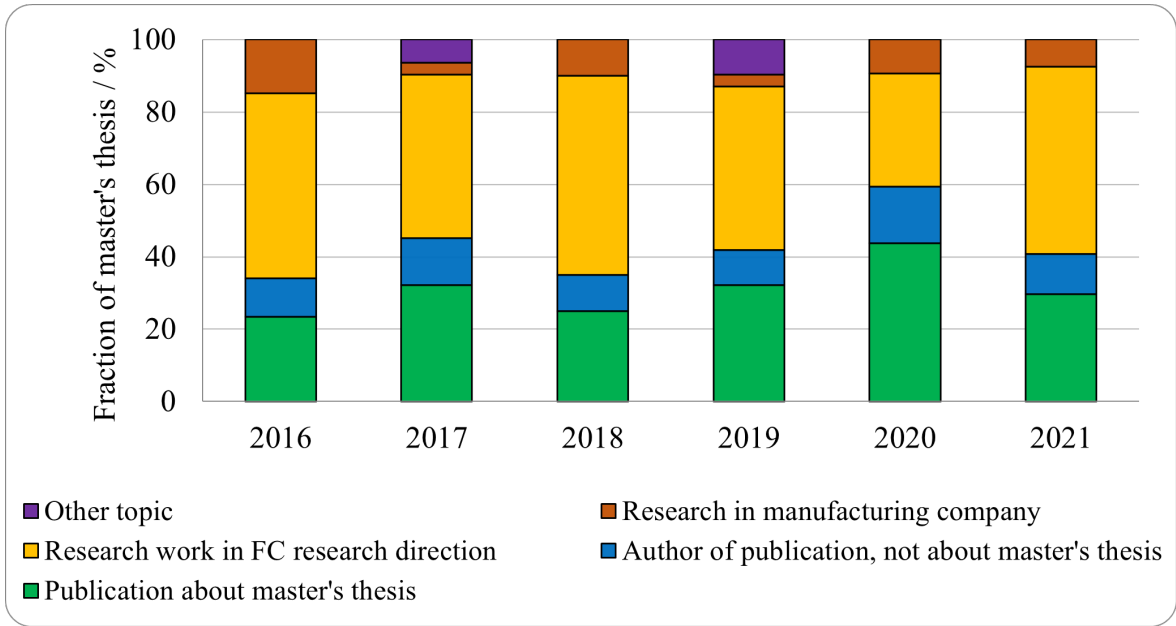


Figure 8. Distribution of master's theses defended at the FC by the agreement of the research direction to the research carried out by the FC and the involvement of the thesis's author in the preparation of scientific publications.

In general, students of both bachelor's and master's study programs who develop their works in scientific institutions are involved in the implementation of scientific research projects. Most of these are ERDF, Latvian Council of Science FARP, National research program, as well as less often international scientific projects. The FC students have been involved in implementation of the largest part of the scientific projects described in Section 2.4.1 of this report. Therefore, the FC students have developed their research projects and final theses within the framework of these projects.

Students' involvement in scientific research is also evidenced by their participation in scientific conferences. From 2013 to 2017, students participated in the scientific work competition-conference organized by the FC Students' Self-Government and currently students take part in student scientific work events organized by the Students' Council of the UL. During the whole report period between 2016 and 2021, students have regularly participated in the annual international scientific conference of the UL, both by independently presenting their own research and participating as co-authors of broader research teams. Students also systematically participate in other research theme related scientific conferences organized in the region (Latvia, Lithuania, Estonia). The number of abstracts for presentations at various scientific conferences organized in the region in which among the authors there are FC students are summarized in Table 17.

Table 17.

The number of abstracts for presentations at various scientific conferences organized in the region in which among the authors there are FC students.

Conference	Number of abstracts for which FC students are one of the authors						
	2016	2017	2018	2019	2020	2021	



UL International scientific conference	27	36	29	33	39	45
EcoBalt	14	-	9	-	-	27
RTU <i>Materials Science and Applied Chemistry</i>	5	7	5	5	9	3
Other international conferences	5	12	12	14	14	21

The importance and quality of the scientific research of the students of the FC has been recognized by awarding various scholarships awarded based on the scientific research carried out during the master's degree or doctoral degree studies. Since 2014 in total 14 chemistry students have received such scholarships.

In addition to the studies and basic research work, students have participated in summer schools or scientific seminars and courses to improve the quality of their scientific activities. These mostly were held in fields thematically related to the research directions carried out in the FC. Students regularly participate in the summer school in Lithuania *International Conference-School "Advanced Materials and Technologies"* as well as in unique events such as *Workshop "Introduction to Gaussian: Theory and Practice"* (2019, Germany), *Chromatography and mass spectrometry - interdisciplinary exchange of experience III* (Latvia Daugavpils) etc.

**2.4.6. Provide a brief description and assessment of the forms of innovation (for instance, product, process, marketing, and organisational innovation) generally used in the higher education institution, especially in study field subject to the assessment, by giving the respective examples and assessing their impact on the study process.**

In 2016 – 2021, innovations in areas such as marketing, infrastructure, teaching process and information technologies have been introduced in the implementation of the studies in FC.

- **Marketing.** Innovations in the marketing of the study programs have been introduced by the UL Department of Communication (in the previous period – the Department of Communication and Innovations). Close coordination of activities is observed in the study field to make the process more efficient; the study programs are advertised in cooperation with other Natural sciences study programs of the UL. The cooperation is enhanced by the fact that all the Natural sciences study programs are implemented in the Torņakalns academic centre of the UL. In addition, during this period FC now employ a public relations specialist.
- **Infrastructure.** The relocation of the FC to the newly established Torņakalns academic centre of the UL is the most important thing to highlight. This academic centre currently consists of House of Nature and House of Science (with location of all the faculties of Natural sciences and Medicine and health sciences in one place), and the construction of the House of letters is also currently taking place, thus ensuring the implementation of most of the study process of the UL in one place. Also, the UL is actively working to be able to also build additional infrastructure facilities characteristic to a modern university campus, including the House of Technologies (for a centre for technology development and transfer), the House of Sports, etc. Also, during this time investments in teaching and research infrastructure have been made by significantly modernizing both scientific and student laboratory equipment.

- **Teaching process.** Ensuring the learning process during the COVID-19 pandemic resulted in an active implementation of the remote studies and the improvement of learning materials, including the creation of video recordings of lectures. Overall, throughout the whole report period work was done on the implementation of a student-centered study process. During this time, UL has offered teaching staff the opportunity to improve their skills in English and in the use of various IT tools. UL continues to improve the possibilities of the study e-environment in the *Moodle* system, including efficiently connecting it with the *Microsoft Teams* platform allowing realization of remote studies.
- **Information technologies.** The UL Information System LUIS was improved. Among the other IT innovations are wide use of electronic documents and the use of e-signatures related to it, the above-mentioned innovations of the study e-environment, including linking it to the remote study implementation platform *MS Teams*. Important for the implementation of both scientific research and the study process is providing of selected software throughout commonly in the whole UL (from which in the field of chemistry *Microsoft Office 365*, *Gaussian 09* and *Gaussian 16*, *MathWorks MatLAB*, *Wolfram Mathematica*, *SPSS*, *Thomson Reuters EndNote* must be highlighted as the most important).
  - The implemented marketing and infrastructure innovations mostly are aimed to attract students, whereas the learning process and information technology innovations have raised the quality of studies and facilitated study work. In order to attract students and improve the quality of studies, implementation of new innovations is also planned in the future.

## 2.5. Cooperation and Internationalisation

**2.5.1. Provide the assessment as to how the cooperation with different institutions from Latvia (higher education institutions/ colleges, employers, employers' organisations, municipalities, non-governmental organisations, scientific institutes, etc.) within the study field contributes to the achievement of the aims and learning outcomes of the study field. Specify the criteria by which the cooperation partners for the study field 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 cooperation partners.**

The academic staff of the study programmes of the study field "Chemistry, chemical technologies and biotechnology" actively participate in various cooperation projects and organisations at both national and international levels.

One of the objectives of the Development plan of the study field is to guide staff towards excellence and collaboration in science, industry, society and teaching. FC is an important scientific research center with long traditions, cooperation with many partners (scientific institutes, companies and universities) has been established over a long period of time. Partners cooperation has developed, first of all, by solving common current scientific problems. Secondly, many cooperation partners are also employers, and cooperation takes place by systematically updating study programs in order to prepare qualified specialists for the labor market. Cooperation agreements are one of the mechanisms for attracting cooperation partners. Currently, 9 contracts have been concluded with cooperation partners for the development of students' final theses. Lecturers also cooperate with

various state institutions and associations, thus getting involved in the state solution of educational and scientific problems.

Scientific cooperation with other faculties and scientific institutes of the University of Latvia is carried out at all levels of the programmes, developing research projects and bachelor's and master's theses: the Faculty of Geography and Earth Sciences (V. Rudoviča, A. Vīksna), Faculty of Biology (I. Nakurte, K. Jaudzems, V. Valkovska), Faculty of Medicine (I. Nakurte, E. Sūna), Faculty of History and Philosophy (L. Orola, V. Valkovska, A. Vīksna, V. Rudoviča), Institute of Solid State Physics (G. Vaivars), Institute of Physical Chemistry (E. Pajuste, D. Erts, I. Reinholds), Institute of Atomic Spectroscopy (A. Vīksna, A. Actiņš).

Study programmes in the SF "Chemistry, chemical technologies and biotechnology" are also offered at Riga Technical University (RTU) and Daugavpils University (DU). Although the study programmes are different, various opportunities for cooperation are used. Cooperation between UL and RTU dates back to the last century. The Faculty of Chemistry of the UL has close cooperation with the Faculty of Materials Science and Applied Chemistry. For many years, there has been an agreement with RTU on the takeover of study programmes in case of liquidation, and this agreement has been renewed in 2022.

Mutual cooperation takes place in the work of the Council of Professors of Chemistry of both universities and also in the work of the Promotion Councils in the field of Chemistry. Cooperation also takes place in the area of Doctoral Schools, where different lectures and seminars are also attended by students of the Master's programme in Chemistry.

Together with RTU Faculty of Materials Science and Applied Chemistry and colleagues from Vilnius and Tartu Universities, EcoBalt conferences are also organised and held alternately in all three Baltic States (2014 in Riga, 2016 in Tartu, 2018 in Vilnius, 2021 - first online conference). FC is also collaborating with RTU in research on biomaterials, modified hydroxylapatites (A. Vīksna, A. Osīte).

Cooperation also takes place in the study process, for example, in the MSP "Chemistry", in the sub-direction "Organic and Biomolecular Chemistry" professors give lectures jointly in the study courses "*Organic Synthesis II*" (lectures by E. Sūna, UL) and "*Medicinal Chemistry*" (lectures by A. Jirgensons, RTU) to students of both universities. In the autumn semester of 2021 the lecture course "*Physical Organic Chemistry*" at RTU was delivered by assist. prof. A. Kinēns. From 2013 to 2017, professor D. Erts lectured in the course "*Nanotechnology*" (3 CP) in the RTU programme "Medical Engineering and Physics".

There is also cooperation with Daugavpils University. Associate professor J. Švirksts regularly gives guest lectures in the Bachelor's study programme of Chemistry at DU - several parts from the Inorganic and General Chemistry courses (in total ~ 20 hours), and professor A. Vīksna gives guest lectures in Analytical Chemistry to Master's students. From 2018, the UL academic staff also participate in the organisation of the DU Summer School of Chromatography "Chromatography Today". Both students and lecturers of the UL (I. Nakurte, G. Vaivars, A. Vīksna) were involved in the work of this Summer school.

At Riga Stradiņš University (RSU), assoc. prof. L. Orola lectures in physical chemistry, while researcher E. Baķis teaches general chemistry to foreign students at RSU.

The implementation of chemistry study programmes is carried out in close cooperation with employers, inviting representatives of employers - high-class specialists - as guest lecturers: Dr. J. Hmeļņickis and S. Šteinberga (Grindeks, JCS), Dr. O. Pugovičs and Dr. K. Pajuste (LOSI), Dr. G. Feldmane (State Forensic Expertise Bureau), I. Egerte (State Agency of Medicines), Dr. J. Purāns (ISSP), Dr. J. Klepe-ris (ISSP), P. Brangulis (State Fineness Bureau), J. Dipāne (Ministry of Environmental Protection and Regional Development), M. Neimanis (business accelerator "Buildit

Latvia"), A. Alksnis (Latvian Investment Development Agency), etc.

In cooperation with employers, current chemistry problems are solved and research projects and final theses are developed. Every year, students of Bachelor and Master programmes develop their final theses not only at the University of Latvia, but also at scientific institutes and companies: the Latvian Institute of Organic Synthesis, the Institute of Wood Chemistry, RTU, the BIOR Institute, as well as in cooperation with Grindeks, Olainfarm, Groglass Ltd. and other institutions. The final work is usually supervised by specialists from these institutions together with the academic staff of the faculty. Representatives of scientific institutes and industrial companies J. Rižikovs, U. Cābulis (IWC), V. Liepins (a/s "Bapeks"), J. Gulbis (a/s "Grindeks"), A. Plotniece (OSI), S. Šteinberga (a/s "Grindeks") also participate in thesis defence commissions and reviewing of master's and bachelor's theses. Such cooperation allows to assess not only the quality of students' work, but also the labour market requirements and development trends. When evaluating the final works, regular discussions with employers are held, which show the relevance of the programmes to the labour market demand and the students' ability to integrate into it.

Nine agreements are signed with industrial companies and institutes for cooperation in the development of research projects and theses. The academic staff and students of the study programme participate in joint research and applied projects, scientific conferences and seminars with employers.

Employers also support students granting them periodic scholarships. This is usually done through the UL Foundation. Our students have received scholarships from companies Valpro, Olainfarm, Mikrotīkls, etc.

The cooperation of the academic staff with various Latvian public and other professional organisations brings the latest developments in the field of chemistry to the study programmes. For example, assoc. prof. E.Pajuste is an expert of the Ministry of Environmental Protection and Regional Development Working Group "Radon Assessment and Radon Action Plan" (from 2017). Professor A.Viksna is the representative of the University of Latvia in the Metrology Council, Ministry of Economy (from 2019). Cooperation is also ongoing with the Latvian National Accreditation Bureau (LATAK) (experts A.Viksna, M.Bērtiņš)

The academic staff of the study programme were also active in the Latvian Young Scientists Association (E.Baķis, K.Jaudzems until 2021).

Among the academic staff involved in the study programmes there are also leading Latvian researchers, full members of the Latvian Academy of Sciences (LAS) (K.Jaudzems, D.Erts, E.Sūna, A.Zicmanis, K.Tārs (biology), A.Linē (biology), L.Skuja (physics) and honorary doctor of the Latvian Academy of Sciences A. Actiņš). The UL academic staff are also members of the Scientific Councils of the following scientific institutes: UL ICP (A.Viksna, D.Erts), OSI (E.Sūna, K.Jaudzems), LAS Council of Physics and Technical Sciences Division (D.Erts), LAS Council of Chemistry, Biology and Medical Sciences Division (K.Jaudzems).

The Faculty of Chemistry has extensive cooperation with Latvian municipalities, schools and the Ministry of Education and Science (MoES). The lecturers of the Faculty of Chemistry (J.Logins, J.Švirksts) are involved as experts in the MoES and other educational projects. The Faculty of Chemistry regularly organises professional development courses for chemistry teachers. In the organisation of the courses, cooperation takes place with both the MoES and the The Association of the Latvian Chemical and Pharmaceutical Industry (LAKIFA). LAKIFA is the leading professional association in the field, and meetings with its representatives are also held periodically about the preparation of bachelors and masters for the needs of the labour market.

Cooperation in the field of Chemistry didactics also took place with the Riga Academy of Pedagogy

and Education Management (until it joined the University of Latvia in 2017, D. Cēdere), now there is extensive cooperation with the Faculty of Education, Psychology and Art of the UL in training new chemistry teachers (J. Logins, J. Švirksts, I. Ancāne, A. Prikšāne, R. Klūga, I. Kļimenkovs).

Since 2013, the Faculty of Chemistry of UL has been organising the Young Chemists' School <http://www.kdc.lu.lv/skoleniem/> (only in Latvian), with up to 100 secondary pupils participating each year. The school's activities take place in Riga and in different regions: Rēzekne, Limbaži, Valmiera, Saldus, Dobele, Talsi, etc. Cooperation agreements with local municipalities are concluded every year. When the Covid-19 restrictions came into force, the Young Chemists' School classes for 2019/2020, 2021/2022 and 2021/2022 were held remotely, mainly for 12th grade learners. Cooperation with the public and pupils is also ensured through active participation in all UL events: the Night of Scientists, the Night of Museums, the Open Day, in the Student's Shoes, etc.

#### **ANNEX 15. "List of Cooperation Agreements"**

**2.5.2. Provide the assessment as to how the cooperation with different institutions from abroad (higher education institutions/ colleges, employers, employers' organisations, municipalities, non-governmental organisations, scientific institutes, etc.) within the study field contributes to the achievement of the aims and learning outcomes of the study field. Specify the criteria by which the cooperation partners suitable for the study field 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 cooperation partners.**

Cooperation with various foreign institutions in the study field is in line with the achievement of the development goals of the study field, the implementation of the relevant study programmes of the study field and related research. The selection of foreign partners is formed through cooperation in scientific projects, cooperation networks, etc. Partners are also selected by analyzing the content, structure, language of teaching, etc. of university study programmes, so that students can successfully go on exchange studies in both directions.. Thirdly, we also refer to cooperation offers of related universities. The main mechanism for building close regular cooperation is the conclusion of cooperation contracts.

FC of the UL participates in Erasmus+ and DAAD exchange programmes, as well as implements cooperation projects in the framework of bilateral agreements. The students of the study field are offered opportunities to participate in different exchange programmes and to study abroad for a semester or a year. Students can also take advantage of internship opportunities in study programmes of other foreign universities (mainly in the development of research projects). These cooperation projects allow both students and the academic staff to exchange experiences. The University of Latvia is actively involved in projects announced by the State Education Development Agency (SEDA) and in other international projects, such as the use of EEA/Norwegian Financial Mechanisms. International cooperation partners: universities and institutions are selected on the basis of their profile, the quality of their knowledge and experience in the field of chemistry, and the mutual interest of the parties.

The Faculty of Chemistry supports the Erasmus+ international cooperation mechanisms implemented by the UL in the mobility of students and staff between programmes and partner countries. In the field of Chemistry, 26 Erasmus+ cooperation agreements have been signed with universities in 12 European and EEA countries, as well as active cooperation has been initiated with

6 higher education institutions of the partner country (EU candidate country) Turkey. The Faculty of Chemistry also actively took part in the implementation of bilateral cooperation agreements with countries such as Kazakhstan, South Korea, Taiwan, South Africa, Bangladesh, etc.

According to the specifics of the study field, the Faculty of Chemistry has Erasmus+ agreements with Vilnius University, Tartu University, Kaunas University of Technology, Rostock University, Masaryk University, Aristotle University of Thessaloniki, etc. Regular exchanges of guest lecturers and students take place with these universities, especially universities of the Baltic region. There is also cooperation in the field of research - nanochemistry, organic synthesis, development of new analytical methods, etc., where the obtained results have been published in international journals. Both the implementation of research projects and student exchanges have also taken place in the framework of the Norwegian Financial Mechanism with the University of Oslo. Scientific cooperation with St. Petersburg University and Ljubljana Jozef Stefan Institute is also a part of the cooperation agreements. In post-doctoral projects, as well as Erasmus+ internships and mobility visits, young lecturers and PhD students of the Faculty of Chemistry cooperate with the University of Durham in the UK, several Poland Universities, etc. For more information on international scientific cooperation, see Chapter 2.3.3 "Characteristics and evaluation of international cooperation in scientific and applied research".

The participation of the academic staff in foreign and international professional organisations is also important for the development of the study field: the European Association of Crystallography (T.Rēķis from 2020), COST CA18238 Marine Biotechnologies (Ocean4biotech) national representative-vice-chair (V. Rudoviča, 2019), EU 6th and 7th Framework Programmes and Horizon 2020 NMPB Programme Committee (D.Erts, 2006-2020), Horizon Europe National Focal Point Expert on Fission (E.Pajuste, from 2021), Polish National Science Centre (expertise on scientific projects, A.Vīksna, from 2020), etc. As international experts of the Latvian National Accreditation Bureau (LNAB), professor A.Vīksna, researcher M.Bērtiņš participate in accreditation of chemistry laboratories in various countries (Azerbaijan, Ukraine, Uzbekistan, etc.)

Since 2004, the Faculty of Chemistry of the UL participates in ECTN (European Chemistry Thematic Network) activities and projects (A.Priķšāne, A.Vīksna, L.Buša etc.). UL Faculty of Chemistry is also a member of ECTNA (European Chemistry Thematic Network Association) association established by the network. The association unites more than 120 members (universities and institutes) from 30 European countries. Cooperation with this international organisation is very important in the evaluation of the quality of Bachelor's and Master's programmes. In 2012 BSP "Chemistry" gained the quality label "Chemistry Eurobachelor". The label was extended in 2017 and 2021. In 2012 and 2017, ECTNA experts visited UL to evaluate the content, outcomes, teaching methods, organization, etc. of our chemistry programs. In 2017, MSP "Chemistry" was awarded the quality label "Chemistry Euromaster". Now in parallel with this report, the applications for renewal of both quality labels have been prepared.

The academic staff of the Faculty of Chemistry have also participated in international projects related to the quality of the study process, for example, Erasmus+ project *Enhancing capacities in implementation of institutional quality assurance systems and typology using Bologna process principles*, (IQAT) (ZD2011/2709) (A. Priķulis, A. Priķšāne, J. Logins 2017-2018.), *Feasibility study for a European forum for Enhanced Collaboration in Teaching* (EFFECT) (ZD2016/20325 (A.Priķulis, J.Logins, A.Rusakova). From 2022, the lecturers of the FC are working in a joint project with Jagolinska University in Krakow, Poland, *Digital Support in Chemistry Teaching* (I.Logins, L.Buša). Participation in such projects is beneficial for the teaching staff of the programme, because by presenting their experience in the organisation of the study process, various aspects of the activity are compared and evaluated and experience is exchanged. Annex 16 "Statistics on mobility of the teaching staff" summarises data on the mobility of the teaching staff.

**2.5.3. Specify the system or mechanisms, which are used to attract the students and the teaching staff from abroad. Provide the assessment of the incoming and outgoing mobility of the teaching staff in the reporting period, the mobility dynamics, and the issues which the higher education institution/ college faces with regard to the mobility of the teaching staff.**

All possible measures are taken to ensure and organise the mobility of students and the teaching staff. First of all, the information on the concluded Erasmus+ agreements and other forms of cooperation is regularly updated on the website of the University of Latvia. Information is also available on the faculty notice board. Students for the exchange programmes are selected on the basis of three main criteria: study results, student motivation and foreign language proficiency. A total of 26 cooperation agreements have been concluded and are active for the 2021/2022 academic year.

Bachelor students are regularly informed in person about studying abroad: starting with the open day events, then at information events during their first year. Periodically, students meet participants from previous years' exchange programmes. After the sessions, bachelor students who have high academic performance, are also personally approached to explain the benefits and the possibilities of the exchange programmes. Master's students are approached individually already during the enrolment process and at the time of signing the contracts, when the choice of the sub-direction of the study field, students' interests, and their wishes and possibilities to study abroad are discussed, although in the last two years this has been done in a distance format. All Master degree students are informed, but as previous study results are already known on entry, some students are encouraged to start organising the exchange process for the second or third semester straight away.

The response was particularly strong in 2013/2014. , after which an average of 2 students in the Master's programme and 1 student in Bachelor's programme go on exchange each year or take up practice opportunities to develop their research project. See Annex 17 for data on outgoing students. Despite the impact of various external factors, the Covid -19 epidemic, political tensions in the world, etc., the overall outgoing student activity can be assessed as good, however, it has so far not really been possible to achieve a high level of student activity and competition for exchange vacancies.

The main reason that discourages our students from taking part in the Bachelor exchange programme is their foreign language skills, as most of the Bachelor programmes are in national languages and only some courses are offered in English. The most common obstacle to participation in exchange studies for Master's students is research work, as most students are involved in different research projects after graduating from the Bachelor programme and they do not want to lose their jobs. In some cases we have been in contact with the employers of these students and the results have been positive. One of the most popular exchange universities for Master's students is the Ruhr University in Bochum, Germany, because there, all study course,s are available in English. In the academic year 2015/2016, the amounts of ERASMUS scholarship decreased, which also, but not to a large extent, reduced students' interest in studying abroad.

Erasmus+ traineeships can be taken up independently of the signed contracts by matching students with a university or institute related to their field of study and research. During the reporting period, the internship opportunities were mainly used by PhD students of the Faculty of Chemistry (Erasmus+, DAAD). However, two Bachelor students (in University of Rostock, Goethe

University Frankfurt am Main) and four Master students (Imperial College London,, University of Cork, Ireland, J. Gutenberg University Mainz, Germany, Goethe University Frankfurt am Main) also participated in internships. Two Master students took advantage of the EEA/Norway Financial Mechanisms "Research and Scholarships" programme for internships by participating in research at the University of Oslo .

Chemistry students also gain international experience by participating in international conferences, Summer Schools and other student forums. For example, every year students participate in the conference - summer school in Palanga (Lithuania) "Advanced materials and technologies", where periodically lectures are also given by the teaching staff of the Faculty of Chemistry (G.Vaivars, E.Pajuste, D.Erts, etc.)

In academic year 2020/2021, the number of outgoing students has decreased, although the interest of students was high, but the Covid-19 restrictions disrupted most of the plans. We intend to continue to actively promote mobility opportunities and try to motivate students and assist them in selection of the exchange programmes.

Compared to the previous accreditation period, the number of **incoming foreign exchange students** in the programmes of study field has increased, but is still relatively small. (see Annex 17. "Statistics on the outgoing and incoming mobility of BSP "Chemistry" and MSP "Chemistry". The Faculty produces information materials and makes sure that students have access to information in English, where they can find out about the courses offered, application procedures and other issues of interest to foreign students. In order to improve the study opportunities for potential Erasmus+ exchange students, it was decided to prepare materials of 10 the MSP "Chemistry" study courses for teaching in English, which was also implemented within the Academic Project (2017).

However, the number of international exchange students has been 1-2 students per one study course, therefore laboratory practice and seminars in English are provided in joint groups, while lectures are replaced by tutorials, providing students with textbooks and teaching materials. This is also the experience of many of our partner universities, especially in Bachelor's programmes in Germany, France, Greece, etc.

At various times, some study courses within the scope of study programmes permitted by Latvian legislation have been taught in English. For example, from 2013 to 2016, two groups (Latvian and English) were formed in the study course *Chromatography* of the BSP. At that time there were more than 50 students in the course and also our students - those interested - and exchange students were given the opportunity to study one course in English. Students could choose to listen to the lectures in Latvian or English. Unfortunately after 2016 it was not possible to create a separate group with at least 10 students to teach courses in English.

Currently, 26 Erasmus+ cooperation agreements in the Chemistry field have been signed and the programmes are widely promoted, but student interest in exchange programmes is relatively low, with 2-3 incoming students each year choosing the BSP "Chemistry" as an Erasmus+ placement and there is no systematic influx of students in the MSP. However, chemistry courses are also chosen by exchange students from other faculties (most often the Faculties of Biology and Medicine, as well as the Faculty of Geography and Earth Sciences), so that cooperation with foreign students is more frequent in individual courses than in all courses of our programmes in the semester. For example, during the reporting period, eight incoming students from other faculties (Italy, Bulgaria, Germany, South Korea, Turkey) have chosen these the following courses offered by the FC - in the Bachelor programme: "*Organic Chemistry I*", "*Purification and Analysis of Organic Compounds*", "*Chromatography Methods*", "*Methods of Instrumental Analysis*", in Master's programme: "*Chemistry of Natural Compounds*", "*Chemical Toxicology*".



In line with the development plan of the programme, the BSP "Chemistry" will continue to advertise widely for exchange students. After analysing the offer of different Bachelor study programmes, tuition fees and possible student contingent, it is not currently planned to offer this study programme entirely for full-time studies in English, but to expand individual contacts with existing exchange partners in order to increase the number of student exchanges.

All in all, the interest of foreign students in the MSP "Chemistry" is twofold. Firstly, potential exchange students are mainly interested in research work and would be willing to study courses in English. The second group of students is interested in the possibility of studying the full Master's programme (up to about 10 students each year). Therefore, the Master's programme is planned to offer entirely in English, so that English groups can be formed and exchange students can freely join them. See more justification in the MSP "Chemistry" section 3.1.3.

When assessing the mobility of the teaching staff of the programmes of the Chemistry Study Field, it should be noted that since 2013 the **outgoing mobility of the staff** involved in the implementation of the study programmes of the Study Field has relatively increased and expanded. Since 2013, a mobility plan for the teaching staff has been in place, with at least one Erasmus+ Framework mobility visit for lectures or exchange of the experience planned each year.

As can be seen from the data collected in Annex 16 "Statistics on mobility of the teaching staff", young lecturers have become more active in recent years in order to gain experience abroad. Covid-19 constraints have somewhat reduced the opportunities for face-to-face exchanges, but there has been extensive experience of remote guest lectures, seminar discussions, group work and other teaching methods, which can be used effectively to attract guest lecturers (in both directions). Systematic exchange visits of the teaching staff are also planned for the coming years, using both face-to-face and remote working methods.

For the teaching staff, all mobility visits have been successful and the lecturers have gained significant experience. The only problem is the lecturers' lack of time, especially to find time for a week-long ERASMUS in-person visit.

During the reporting period, **many foreign guest lecturers** visited the FC to give lectures to students of different levels and programmes. Starting from the academic year 2013/2014, the Faculty hosted lecturers and researchers from 12 countries and 18 universities and institutes.

From 2012 to 2015, there was a systematic cooperation with professor Edvins Vedējs (University of Michigan), who lectured on elemental organic compounds (3CP) for 3 weeks each year to the students of the Master's programme of the UL and RTU. Later, this lecture series was taken over by prof. E. Sūna, lecturing to students of both universities. A systematic cooperation was established in academic years 2017/2018, 2019/2020 and 2021/2022 with M. Reinfelds, a graduate of the Master's programme of the University of Latvia, who, after obtaining his PhD from Goethe University in Germany, works at the University of Graz in Austria and researches photochemical organic synthesis methods.

In the sub-direction of analytical chemistry, a regular collaboration has been established since 2018 with Dr Irina Shtangeeva (St. Petersburg University), who works in the field of biogeochemistry and studies rare elements and contamination in soils.

Within the project No.8.2.2.0/18/A/010 "Renewal and Competence Development of Academic Staff at the University of Latvia", in the spring and autumn semesters of 2019 the Faculty of Chemistry hosted the visiting professor Arunas Ramanavičius from the Vilnius University. He taught several courses in the BSP: "Physical Chemistry II", "Nanotechnology", and in the MSP- the course "Methods of Electrochemical Analysis". After the end of the project, the cooperation with the professor in the field of electrochemical analyses is continued by organising remote lectures and joint seminars for

students of the University of Latvia and Vilnius University (6 hours) in 2021 and 2022. This cooperation is planned to continue in the next six years in the course "*Nanochemistry*" and "*Methods of Electrochemical Analysis*".

During the reporting period, many lectures were given by the teaching staff from our partner universities and researchers from Germany, Turkey, Norway and other countries on related research topics.

We have also invited many other experts from our partner universities for guest lectures and Erasmus+ exchanges. However, one of the problems is the lack of time. It is very difficult for an active lecturer to find time for a week-long visit. Thus, remote lectures offer more opportunities in this area. It is planned to make active use of them in the future.

**ANNEX 16.** "Statistical data on the incoming and outgoing mobility of teaching staff"

**ANNEX 17.** "Statistics on the outgoing and incoming mobility of BSP "Chemistry" and MSP "Chemistry"

## **2.6. Implementation of the Recommendations Received During the Previous Assessment Procedures**

**2.6.1. Assessment of the fulfilment of the plan regarding the implementation of the recommendations provided by the experts during the previous accreditation of the study field, 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 field and the relevant study programmes.**

The accreditation of the study field took place from 2011 to 2013. In 2011, the study programmes were evaluated by a group of experts headed by professor E. Butkus from the Vilnius University. The expert group suggested different recommendations for the improvement of the study process. They also basically form the recommendations that are attached to the Accreditation documents received in 2013. For a detailed description of the recommendations and the progress of their implementation, see Annex 18 "Report on the implementation of recommendations". The implementation of the recommendations started already in 2012. Firstly, the study courses were revised to eliminate the overlapping of courses of Master's and Bachelor's courses. The content analysis led to a reallocation of course credit points. At the same time, it was ensured that the changes were as close as possible to the set learning outcomes. For example, the number of credit points of courses *Methods of Electrochemical Analysis*, *Sample Preparation in Analytical Chemistry* and *Methods of Data Analysis in Chemistry* was changed. For example, in terms of the course content and outcomes, the course "*Methods of Electrochemical Analysis*" had a very wide range of laboratory work, in some aspects overlapping with the BSP "Chemistry". In turn, the course "*Sample Preparation in Analytical Chemistry*" is the cornerstone of analytical chemistry and was complemented by laboratory work up to 4CP. The revision of the courses also took into account the experts' suggestion that more seminars were needed in the Master programme.

Concerns about safety and infrastructure improvements were practically resolved with the move to new premises in the House of Nature of the Academic Centre.

Also important were the criticisms of the publications of the academic staff. To solve the problem,

the main task for all the academic staff was to improve the quality of scientific research, so that the results could be published in databases and cited in journals. This has been fully implemented in practice since 2013, as one of the main quality criteria for the work of the academic staff is the preparation of high-quality scientific publications. In addition, it also contributed to the activation of students' research work, and the number of credit points "*Research Project II*" was increased to 4 CP in the Master's study programme. Later in 2014, the study course "*Research Project in Chemistry*" (2CP) was created in the Bachelor's programme in order to promote more active involvement of students in research ( Now it has been increased to 4CP). The academic staff, in turn, are constantly improving the quality of their scientific outputs in order to maximise the publication of results in cited journals. Consequently, one of the main criteria for the work of the teaching staff is scientific publications and their quality.

A lot of effort was made to realize the recommendation on intensifying the international exchange of students and lecturers. The number of outgoing students and lecturers has increased, but it is still small, despite various mobility promotion measures. The reasons are various: the success of students, the busyness of master's students with studies and work, the language of study programmes, etc. Efforts to regularly attract incoming students to the Master's program have not been very successful. Therefore, special attention has been paid to these issues in the field development plan.

There were certain difficulties in implementing the recommendation related to high school chemistry and the implementation of master's theses in practice. In the previous period until 2013, the Master's study programme had an active sub-direction "*Chemistry didactics*", but as various circumstances changed, students' interest decreased and it was not possible to create a group in the field of chemistry didactics. In addition, in 2018, the regulations of the Cabinet of Ministers No. 49 "*Regulations on branches and sub-branches of Latvian science*" (28.01.2018) states that chemistry didactics is a sub-branch of pedagogy. Despite the lack of master's students, the lecturers of the faculty still continue to cooperate closely with the organizers of Latvian education reforms, mainly organizing continuing education courses for chemistry teachers (doc. J.Logins, assoc.prof. J.Švirksts, doc. I.Ancāne, lect. I.Gaile, etc.). For example, in 2022, the lecturers of the Faculty of Chemistry conducted 5 continuing education course sessions within the framework of the project "*Competence approach in the curriculum*" (School 2030) implemented by the National Centre for Education of Republic of Latvia. The lecturers of the faculty teach chemistry and chemistry didactics courses in the teacher's professional study programme "*Teacher*" (in the Faculty of Pedagogy, Psychology and Art of the UL.) Cooperation with Latvian chemistry teachers also takes place by organizing the classes of the "*School of Young Chemists*". Assoc prof. J.Švirksts is the head of the Latvian Chemistry Teachers Association. Therefore, lecturers of the Faculty of Chemistry continue to introduce various new chemistry teaching methods and approaches into the school programmes, to improve the quality of the teaching/learning process.

**Practically all recommendations have been implemented and have served to improve the quality of study programmes of the Study Field and to achieve the objectives of the programmes.**

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

During the reporting period various changes were gradually made in the description of the MSP "Chemistry" (**45441**) (see Table 4.4), which were submitted to the Academic Information Centre (AIC) and approved by the AIC Study Quality Commission, decision "On changes in the study field and programme" No.2021/16-I (13.10.2021). During the programme review process expert recommendations were received to improve the programme for accreditation. All the expert's and the Commission's comments and recommendations were very important and have been assessed in detail, discussed with students and employers both in the Working Group of the Study Field Accreditation and in the Study Field Council. They have been taken into account and incorporated into the study programmes prepared for accreditation. (See Annex 18 "Report on the implementation of recommendations").

## **ANNEX**

### **Annex 18.** "Report on the implementation of recommendations"

# Annexes

I - Information on the Higher Education Institution/ College		
Information on the implementation of the study field in the branches of the higher education institution/ college (if applicable)		
List of the governing regulatory enactments and regulations of the higher education institution/ college	Annex_1_List of the main internal normative acts and regulations of the University of Latvia.docx	1_pielikums_Saraksts ar galvenajiem augstskolas iekšējiem normatīvajiem aktiem un regulējumiem.docx
The management structure of the higher education institution/ college	2_Structure of the UL Governance.docx	2_Augstskolas parvaldības_struktūra.pdf
II - Description of the Study Field - 2.1. Management of the Study Field		
Plan for the development of the study field (if applicable)	3_Plan of development.docx	3_Studiju virziena attīstības plāns.docx
The management structure of the study field	4_Management structure of the study area.docx	4_Studiju virziena_ parvaldības_struktūra.docx
A document certifying that the higher education institution or college will provide students with opportunities to continue their education in another study programme or another higher education institution/ college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated.	5_A document certifying that the university provides students with the opportunity to continue their education a.docx	5_Dokuments, kas apliecina, ka augstskola studējošajiem nodrošina iespēju turpināt izglītības ieguvu citā augstskolā .edoc
A document certifying that the higher education institution or college guarantees compensation for losses to students if the study programme is not accredited or the study programme license is revoked due to actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme.	6_A document certifying that the university guarantees compensation for losses to students.docx	6_Dokuments_augstskola studējošiem garantē zaudējumu kompensāciju.docx
Standard sample of study agreement	7_standard_samples_study_contract.zip	7_Studiju līguma tipveida paraugs.zip
II - Description of the Study Field - 2.2. Efficiency of the Internal Quality Assurance System		
Analysis of the results of surveys of students, graduates and employers	8_Analysis of student, graduate and employer survey results.docx	8_Studējošo, absolventu un darba devēju aptauju rezultātu analīze.docx
II - Description of the Study Field - 2.3. Resources and Provision of the Study Field		
Basic information on the teaching staff involved in the implementation of the study field	9_LBasic information about the teaching staff.xlsx	9_LPamatinformācija par studiju virziena īstenošanā iesaistītajiem mācītājiem.xlsx
Biographies of the teaching staff members (Curriculum Vitae in Europass format)	10_Faculty biographies_CV.pdf	10_Mācītājspēku biogrāfijas_CV.pdf
A statement signed by the rector, director, head of the study programme or field that the knowledge of the state language of the teaching staff involved in the implementation of the study programmes within the study field complies with the regulations on the state language knowledge and state language proficiency test for professional and official duties.	11_ENG_valsts valodas_Apliecinājums_veidlapa_2022.edoc	11_LV_valsts valodas_Apliecinājums_veidlapa_2022.edoc
A statement of the higher education institution/ college on the respective foreign language skills of the teaching staff involved in the implementation of the study programme at least at B2 level according to the European Language Proficiency Assessment levels (level distribution is available on the website www.europass.lv, if the study programme or part thereof is implemented)	12_ENG_angļu valodas_Apliecinājums_veidlapa_2022.edoc	12_LV_angļu valodas_Apliecinājums_veidlapa_2022 .edoc
II - Description of the Study Field - 2.4. Scientific Research and Artistic Creation		
Summary of quantitative data on scientific and/ or applied research and / or artistic creation activities corresponding to the study field in the reporting period.	13_Summary of quantitative data on scientific and applied research activities in the reporting period.docx	13_Kvantitatīvo datu apkopojums par zinātniskās un lietiskās pētniecības aktivitātēm pārskata periodā.docx
List of the publications, patents, and artistic creations of the teaching staff over the reporting period.	14_List of publications and patents for the reporting period.docx	14_Mācītājspēku publikāciju un patentu saraksts par pārskata periodu .docx
II - Description of the Study Field - 2.5. Cooperation and Internationalisation		
List of cooperation agreements, including the agreements for providing internship	15_List of cooperation agreements with other institutions.docx	15_Sadarbības līgumu saraksts ar citām institūcijām.docx
Statistical data on the teaching staff and the students from abroad	19_Statistics on students during the review period.docx	19_Statistikas dati par ārvalstu studējošajiem un mācītājspēkiem.docx
Statistical data on the incoming and outgoing mobility of students (by specifying the study programmes)	17_Statistics on the outgoing and incoming mobility.docx	17_Statistikas dati par studējošo izejošo un ienākošo mobilitāti.docx
Statistical data on the incoming and outgoing mobility of the teaching staff	16_Statistical data on the incoming and outgoing mobility of teaching staff.docx	16_Statistikas dati par mācītājspēku ienākošo un izejošo mobilitāti.docx
II - Description of the Study Field - 2.6. Implementation of the Recommendations Received During the Previous Assessment Procedures		
Report on the implementation of the recommendations received both in the previous accreditation and in the licensing and/ or change assessment procedures and/ or the procedures for the inclusion of the study programme on the accreditation form of the study field.	18_Review of implementation of recommendations.docx	18_Rekomendāciju izpildes pārskats.docx
An application for the evaluation of the study field signed with a secure electronic signature	Submission for evaluation of study direction.docx	Iesniegums AIC studiju virziena "Ķīmija, ķīmijas tehnoloģijas un biotehnoloģija" novērtēšanai (A.Priekšane).edoc
III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme		
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)		
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period		
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with 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 or the requirements for professional qualification (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		
The curriculum of the study programme (for each type and form of the implementation of the study programme)		
Descriptions of the study courses/ modules		
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)		

## Other annexes

Name of document	Document
Kvalitātes vadības rokasgrāmata	Kvalitātes_vadibas_rokasgramata_14_10_2022.zip
Quality Management Handbook	Quality Management Handbook_14_10_2022.zip
Latvijas Universitātes profesoru padomes nolikums	Latvijas Universitātes profesoru padomes nolikums.doc
Kārtība par nevēlēto mācībspēku un zinātnieku pieņemšanu darba	Kartiba_par_neveleto_macibspeku_un_zinatnieku_pienemsanu_darba.doc
Procedures for the recruitment of unelected teaching and research staff at the UL	Procedures for the recruitment of unelected teaching and research staff at the UL.doc

# Chemistry (45441)

Study field	<i>Chemistry, Chemistry Technologies, and Biotechnology</i>
ProcedureStudyProgram.Name	<i>Chemistry</i>
Education classification code	<i>45441</i>
Type of the study programme	<i>Academic master study programme</i>
Name of the study programme director	<i>Kristaps</i>
Surname of the study programme director	<i>Jaudzems</i>
E-mail of the study programme director	<i>kristaps.jaudzems@lu.lv</i>
Title of the study programme director	<i>Dr. chem., profesors</i>
Phone of the study programme director	<i>+371 22073506</i>
Goal of the study programme	<i>Is to provide students with modern, in-depth theoretical knowledge, as well as practical and research skills in the main areas of chemistry and one selected sub-discipline. The programme prepares highly qualified specialists for employment as professionals in chemical industries, research or governmental organizations as well as for continuation of studies in the Doctoral programme.</i>
Tasks of the study programme	<ul style="list-style-type: none"> <li>● <i>to provide students with in-depth general knowledge and skills in the main areas of chemistry, and to provide understanding of the development of the chemical industry, as well as creative and innovative thinking;</i></li> <li>● <i>to provide in-depth knowledge, skills and competencies in one of chemistry sub-disciplines (analytical, physical or biomolecular and organic chemistry);</i></li> <li>● <i>to develop students' skills and abilities to carry out and organize research work in chemistry;</i></li> <li>● <i>to develop high professional ethics;</i></li> <li>● <i>to promote further development of soft skills (communication, presentation of results, etc.);</i></li> <li>● <i>to provide an understanding of the importance of international cooperation in scientific activities.</i></li> </ul>

Results of the study programme	<p><b>Knowledge</b></p> <ol style="list-style-type: none"> <li>1. demonstrate profound and extended knowledge and understanding in chemistry and its sub-disciplines: analytical, physical, or organic and biomolecular chemistry, including knowledge of the latest discoveries in chemistry.</li> <li>2. demonstrate knowledge and understanding that provides a basis for research in chemistry and its sub-disciplines, as well as at the interface of chemistry with other fields</li> </ol> <p><b>Skills</b></p> <ol style="list-style-type: none"> <li>3. independently apply chemical theory, methods, experimental and problem-solving skills to perform innovative research activities, or the professional functions of a highly qualified chemist in the field of chemistry or related fields</li> <li>4. argue and discuss complex or systemic aspects of chemistry problems in a reasoned manner with both specialists and non-specialists.</li> <li>5. is able to take responsibility for the results and analysis of the work in groups, to undertake entrepreneurial activities and innovations in chemistry and related sub-disciplines.</li> <li>6. is able to carry out work and research in chemistry or further studies in both traditional and complex, unpredictable conditions and, if necessary, to apply new approaches, to take independent care of the development of self-competencies and specialization in chemistry or related fields.</li> </ol> <p><b>Competence</b></p> <ol style="list-style-type: none"> <li>7. independently formulate and critically analyze and solve complex scientific and professional problems related to chemistry, in both qualitative and quantitative contexts, make and justify their decisions and, if necessary, to conduct additional research and analysis.</li> <li>8. integrate and apply chemistry knowledge and experimental skills, as well as to contribute to the creation of new scientific knowledge in chemistry and to the improvement and development of research or professional methods.</li> <li>9. demonstrate an understanding and ethical responsibility for the potential impact of scientific results or professional activities on the environment and society.</li> </ol>
Final examination upon the completion of the study programme	Master thesis

## 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)	<i>Bachelor's degree or second level professional higher education (or education equalled to it) in chemistry, chemical technology, material sciences, natural sciences, pharmacy and food technology</i>
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	<i>Master's degree of Natural Science in Chemistry</i>
Qualification to be obtained (in english)	-

### Places of implementation

Place name	City	Address
University of Latvia	RĪGA	RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050

### Full time studies - 2 years - english

Study type and form	<i>Full time studies</i>
Duration in full years	<i>2</i>
Duration in month	<i>0</i>
Language	<i>english</i>
Amount (CP)	<i>80</i>
Admission requirements (in English)	<i>Bachelor's degree or second level professional higher education (or education equalled to it) in chemistry, chemical technology, material sciences, natural sciences, pharmacy and food technology. Studies in English additionally require English language proficiency at least B2 level.</i>
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	<i>Master's degree of Natural Science in Chemistry</i>
Qualification to be obtained (in english)	-

### 3.1. Indicators Describing the Study Programme

**3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.**

Since the preparation of the previous accreditation report, the place of implementation of the study programme has changed. Now it is in the newly built UL House of Nature located at Jelgavas street 1 in Riga. There has been a change of director of the study programme. At the beginning of 2020, the previous director of the programme, Dr.chem., associate professor A.Priksāne, was replaced by Dr.chem., professor K.Jaudzems.

The MSP "Chemistry" was previously accredited in 2013. After the accreditation, changes were made immediately to follow the advice of experts, mainly in the scope of study courses, which are related to the overlap of study courses with BSP "Chemistry". Gradually, during the development of the master's programme, several new courses were created, other changes were made, all of which were submitted to the AIC Study Quality Commission (SQC) for evaluation (see Table 4.1). Initially, the programme had five elective sub-directions, but two of them were closed because there were no students and these two directions could not be linked directly to doctoral studies, as they no longer correspond to chemistry sub-disciplines in the classification of science branches. In the programme, the amount of compulsory study courses was also increased to 26 CP, in accordance with the regulations of the Cabinet of Ministers Regulations No. 240. "Regulations on the State Standard of Academic Education" (13.05. 2014). The changes made in the programme were submitted for evaluation, considering that the accreditation deadline was further extended in June 2021 until the end of 2023.

*Table 4.1.*

*Changes to the MSP "Chemistry", accepted by the SQC in October 2021*

Programme parameters	Accredited study programme (from 2013)	The improved study programme from 2021/2022 academic year	Justification
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Sub-directions of programme specialization	Analytical chemistry Physical chemistry Organic chemistry Chemistry didactics Food chemistry	Analytical chemistry Physical chemistry Organic chemistry	The number of sub-directions has been reduced, because there are no people who want to study in these directions, and Chemistry Didactics and Food Chemistry are no longer sub-disciplines of chemistry, according to the Cabinet of Ministers Regulations No. 49 "Regulations on Latvian Scientific Branches and Sub-branches" (23.01.2018).
The number of credits of the common compulsory part and of the compulsory and restricted elective parts of sub-directions	Common compulsory part: 20 CP (30 ECTS). Sub-direction compulsory part: 26 CP (39 ECTS).	Common compulsory part: 26 CP (39 ECTS). Sub-direction compulsory part: 24 CP (36 ECTS).	The number of credit points of the sections has been changed in the programme in accordance with the course implementation experience. (Minimum of 24 CP is determined by the Cabinet of Ministers Regulations No. 240)
Mutually agreed changes in the distribution of credit points for individual courses.	6 study courses	9 study courses, the total number of credit points and study results do not change significantly.	The changes were made taking into account the experience of the lecturers, the proposals of students and employers, and the instructions of the accreditation experts regarding the improvement of the master's study programme and to avoid overlap with the bachelor's study programme. At the same time, strictly following that the changes are in accordance with the set achievable results.
Inclusion of new courses in the optional part of the programme	No	12CP(18ECTS)	The inclusion of new courses is related to the need to modernize and improve the programme, taking into account the demand of the labor market.

The changes of MSP "Chemistry" were accepted in October 2021 (Decision of Study Quality Commission "On changes in the study field and programme" No. 2021 /16-I (13.10.2021).

Examining the submitted program changes (2021), the expert's recommendation was to continue updating the program and expand the scope of optional courses, to consider the possibilities of introducing a free choice (C) course block, etc. (see Annex 18. Review of implementation of recommendations). By updating and improving the program in the context of accreditation, a free Elective part (C) 2 CP is included in the programme, as well as the distribution of credits in the Compulsory part and Restricted elective parts is slightly changed. (see table 4.2.)

table 4.2.

*Changes of distribution of credit points in MSP "Chemistry"*

Parts of the programme	The volume of programme parts, CP(ECTS)			Changes in course distribution
	STA standard*	Study Plan from 2021/2022,	Study Plan from 2023/2024.,	
Compulsory part A (courses)	Not less than 24(36)	26(39)	24(36)	Course "Inorganic chemistry" 2CP(3ECTS) moved to restricted elective part
Master's Thesis s	20(30)	20(30)	20(30)	
Restricted elective part (B)	not defined	CP 34 (24+10)** ECTS 51(36+15)**	CP 34(22+12)** ECTS (51(33+18)**	Part B1-new courses 10CP(15ECTS) Part B2-new courses 20CP(30ECTS)
Elective part (C)	not defined	-	2(3)	
The total volume	80(120)	80(120)	80(120)	

\* Cabinet of Ministers Regulations No. 240 "Regulations on the State Standard of Academic Education" (13.05. 2014) and Law on Universities, Article 55.

\*\*Restricted elective part is divided into two parts: Sub-direction courses B1, and Courses for all sub-directions (B2)

As can be seen from the table 4.2. in the Restricted elective part, the offer of study courses has been significantly expanded. It deepens and broadens the possibilities of specialization in all sub-directions of the program: B1- new courses: "Molecular Computer Modeling"4CP, "Chemical Biology" 2CP, "Chemistry of Environmental Systems I"4CP; B2- new study courses: "Biomolecular Structure" 2CP, "Molecular Biology and Genetics" 4CP, "Radiochemistry and Introduction to Radio pharmacy"4CP, "Electrochemical Synthesis"2CP, "Sustainable Chemical Processes"2CP, "Synthesis, Processing and Applications of Modern Materials" 4CP, "Chemistry of Environmental Systems II" 2CP. The sub -direction Organic Chemistry has been seriously expanded and updated and it has been renamed the " Organic and Biomolecular Chemistry".

In the description of the programme (2013 and 2021), however, there was a note that students, in

coordination with the supervisor of their scientific work and the programme director, can choose 8 CP from another Master's study programme. In order to ensure the achievable results of the Master's program in chemistry, the choice has been specified. First of all, the Elective course (part C) 2CP has been created, which allows students to choose courses from various Master's study programs. In the frame of the Restricted elective part (for all sub-directions) (B2), students can choose offered study courses or course from the compulsory part of other sub-divisions (B1), or for conducting interdisciplinary research students can choose also 4 CP courses from other Natural Sciences Master's programs.

The aim and tasks of the study programme also have been updated. The results of the programme have been reassessed and updated, dividing knowledge, skills and competences separately. Updating the outcomes of the study courses and developing the teaching/learning methods, the scope of some study courses has been précised, see annex 23M. Planes of Master's study programme "Chemistry". Detailed description and justification of the program changes is given below in the section " Analysis of the content of the study programme".

The changes also apply to the teaching language of the study programme: in the previous period it was Latvian only, but from now on Latvian and English, this is very important for attracting foreign students both for full-time studies and also for exchange students. The Faculty of Chemistry of UL is ready to provide high-quality studies in English, which is confirmed by the fact that all lecturers have English skills at least B2 level and 50% have obtained a C1 level English language certificate. A large number of MSP "Chemistry" lecturers also regularly go on business trips abroad (to visits or to conferences) or have spent a significant part of their career abroad. As shown in chapter 2.4.4. "Characterisation and evaluation of the scientific and/or applied re-search and/or artistic creativity of academic staff in the field relevant to the field of study", the lecturers of MSP "Chemistry" have extensive scientific experience and are experienced in working in an international environment, which is very important for the high-quality implementation of the study programme in English for students from different countries.

In accordance with the expert recommendation of the 2021 evaluation of programme changes, the admission conditions have been revised, clarifying the requirements (Bachelor's degree or second level, professional higher education (or equivalent education) in chemistry, chemical technology, material sciences, natural sciences, pharmacy and food technology). *Studies in English additionally require English language proficiency at least B2 level.*

All changes in MSP "Chemistry" were made in close cooperation with employers and considering the opinion of graduates and students, as well as following the development trends of the chemistry programs in Europe.

**3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.**

MSP "Chemistry" (code 45441) has been developed and is being implemented at the UL FC as one of the stages of a full-cycle academic education in chemistry. The programme was accredited for 6

years on June 26, 2013, and later the accreditation was extended until June 30, 2023. In 2021, changes were made to the programme, which were evaluated and approved by the AIC.

The implementation of MSP "Chemistry" corresponds to the aim and tasks of the study direction "Chemistry, chemical technologies and biotechnology", as well as the development trends of the national economy and the needs of the labour market. According to the Cabinet of Ministers Regulations No. 322 "Regulations on Classification of Latvian Education" (13.06.2017), the programme code is determined by the level of education - higher (4), type - academic Master's education (5) and belonging to the group of educational programmes - chemistry (441). Its compliance with the study direction is determined by the affiliation of chemistry as a branch of science to the natural sciences, which is also confirmed by the obtainable Master's degree of natural sciences in chemistry. The name of the academic Master's study programme "Chemistry" and the degree to be obtained are interrelated. The aim and objectives of the programme, as well as the study results corresponding to Master's level chemistry studies, follow from them. The knowledge, skills and competences acquired within the study programme correspond to the 7th level of the Latvian Qualifications Framework (LKI), this is also confirmed by the attached study course mapping (see Annex 25M "Mapping learning outcomes of the Master's study programme "Chemistry"").

The programme is implemented in accordance with the Cabinet of Ministers Regulations No. 240 "Regulations on the State Standard of Academic Education" (13.05.2014) (see Annex 22M Compliance of the Master's study programme "Chemistry" with the State Education Standard). The duration of studies in the study programme is 2 years (4 semesters), during which all students of this programme must complete compulsory study courses (Part A 44 CP, including master's thesis), restricted elective study courses (Part B 34 CP) and free choice courses (Part C 2 CP). To be able to start studies in a Master's programme, students must have a Bachelor's degree or a second-level, professional higher education (or equivalent education) in chemistry, chemical technology, material sciences, natural sciences, pharmacy and food technology. Studies in English additionally require English language proficiency at least B2 level. In the case of BSP "Chemistry", the duration of studies is 3 years. Thus, the total duration of higher education for obtaining a Master's degree is 5 years, according to the Lisbon Convention (1997), the Bologna Declaration (1999), etc. international documents regulating higher education.

At the centre of the learning process of the programme is the student, the improvement of his learning process, the cultivation of each individual's personal abilities and the skill in evaluating the achieved learning results. The Law on Higher Education Institutions of the Republic of Latvia (1995/2021) stipulates that study results are "the set of knowledge, skills and competences obtained at the end of a study programme, study module or study course". The European Qualifications Framework (<https://www.nki-latvija.lv/en/lqf>) and the Latvian Qualifications Framework (<https://www.nki-latvija.lv/en/eqf>) documents. In formulating the results of the study programme, the requirements set by the European Chemistry Thematic Network Association (ECTNA) for the awarding of the "Chemistry Euromaster" quality mark for Chemistry Master's programmes are also taken into account (guidelines can be found at <http://ectn.eu/committees/label/labels/>). This quality label was awarded to our master's study programme in 2017 and it is planned to obtain it also for the now improved and updated programme.

Table 4.2.A

*Comparison with study programmes of other Latvian and foreign universities*

Name of University/college	University of Latvia (UL)	Daugavpils University (DU)	University of Oulu	University of Ljubljana
Name of the study programme	Chemistry	Chemistry	Chemistry	Chemistry
Duration of studies	2 years	2 years	2 years	2 years

Volume (CP and ECTS)	80 CP/120 ECTS	80 CP/120 ECTS	120 ECTS	120 ECTS
Comparison of study courses and their volume	Compulsory part 24 CP(36ECTS), compulsory part of sub-directions 22 CP(33ECTS), restricted elective courses 12 CP(18ECTS), free choice courses 2 CP (3ECTS)	Compulsory part 24 CP (36ECTS)	Compulsory incl. mandatory part of sub-directions 45 ECTS (including master's thesis and research project, restricted elective part 30 ECTS, free choice courses offered 23 ECTS	Compulsory part 50 ECTS, restricted elective part 20 ECTS, free choice courses 10 ECTS Master's thesis included
Study results	Knowledge, skills and competences related to chemistry	Knowledge, skills and competences related to chemistry	Knowledge, skills and competences related to chemistry	Knowledge, skills and competences related to chemistry
Final examination	Master's thesis 20 CP (30ECTS)	Master's thesis 20 CP (30ECTS)	Master's thesis 20 ECTS (before - Research Project 30 ECTS)	Master's thesis 40 ECTS
Internet address	<a href="https://www.lu.lv/en/studies/faculties/faculty-of-chemistry/graduate-studies/chemistry/">https://www.lu.lv/en/studies/faculties/faculty-of-chemistry/graduate-studies/chemistry/</a>	<a href="https://du.lv/en/studies/study-programmes/academic-master-study-programmes/chemistry/">https://du.lv/en/studies/study-programmes/academic-master-study-programmes/chemistry/</a>	<a href="https://opas.pepi.oulu.fi/en/programme/12945">https://opas.pepi.oulu.fi/en/programme/12945</a>	<a href="https://www.fkit.uni-lj.si/en/study/second-cycle-study-programmes/university-study-programme-of-chemistry-2021/2022/">https://www.fkit.uni-lj.si/en/study/second-cycle-study-programmes/university-study-programme-of-chemistry-2021/2022/</a> (Only in Slovenian)

Master's programmes in Chemistry from different countries can be divided into two groups: general, with a narrow specialization, and combined, where several specializations are integrated into one programme. DU and Ljubljana Master's programmes are general, with narrow specialization, but Oulu's is combined, just like the UL's Master's programme (see table 4.2.A). The number of specializations offered in Oulu is 5. The Oulu programme is the most similar to UL MSP "Chemistry" in terms of sub-directions (analytical, physical, organic, inorganic, applied chemistry), the distribution of courses and their volume. The main difference is that the language of implementation of the Oulu programme is only English, while the UL Master's programme will be implemented in Latvian and English. The volume of the Master's thesis is slightly different - in Oulu it is 20 ECTS, and in Ljubljana 40 ECTS, since its development takes place in both the 3rd and 4th semester. In general, the MSP "Chemistry" at the UL can be well compared with the Master's programmes in Chemistry at various foreign universities. This especially applies to programmes that have met the requirements for obtaining the ECTN quality mark "Chemistry Euromaster" (including the Oulu and Ljubljana chemistry Master's programmes).

The carried-out mapping confirms that the defined aim, tasks and study results of the study programme are interconnected with the results of the study courses. The knowledge and skills acquired by the students are sufficient for the graduates of the study programme to continue their studies in the field of doctoral studies.

**ANNEX 19M.** Sample of Master's programme "Chemistry" Diploma template and Diploma Supplement

**ANNEX 20M.** Conclusion of the Council of Higher Education on the Master's programme "Chemistry"

**ANNEX 22M.** Compliance of the Master's study programme "Chemistry" with the State Education Standard

### 3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

UL is one of the three institutions preparing chemistry specialists in the Republic of Latvia. Others are RTU and DU, which specialize in training chemical technology specialists and environmental chemistry specialists, respectively. Potential workplaces in Latvia have been identified and are as follows: chemical and pharmaceutical production companies (for example, joint-stock company "Grindeks", joint-stock company "Olainfarm"), scientific research institutions (e.g. Latvian Institute of Organic Synthesis, Latvian State Institute of Wood Chemistry, Latvian Institute of Aquatic Ecology, Institute of Food Safety, Animal Health and Environment "BIOR"), quality control and forensic laboratories, environmental protection services and educational institutions, as well as various companies (trade, consulting) related to chemistry and natural sciences. It is important to note that the programme prepares specialists capable of engaging in scientific research in the chemical industry and its sub-sectors, which is provided by science base (institutional) and performance funding, Latvian Council of Science funding, other research grants provided by Latvia

and the European Union, as well as contract research.

The compliance of MSP "Chemistry" with the demand of the labour market is also shown by the results of graduate surveys (see Annex 8. Results of students, graduates and employer surveys). The analysis of the results obtained in the 2021 graduate survey shows that 93.1% of the respondents have worked in the industry related to the study programme. 82.8% answered positively to the question about the connection between the job and the specialty studied at the UL FC. To the question about the relationship between employment and education 30 out of 31 respondents answered that the acquired education contributed to their employment. Summarizing the results of the graduate survey, it can be seen that the majority of MSP "Chemistry" graduates work in the chosen or a related specialty. Good results in the employment of graduates are also confirmed by the monitoring data of graduates of the Ministry of Education and Science of the Republic of Latvia. The data show that the demand for graduates of this study programme is relatively high, and the opportunities for graduates of this programme to find a job are extensive.

The need for specialists in the future is predicted in the 2020 report of the Ministry of Economy "Informative report on medium and long-term forecasts of the labor market", where it is noted that by 2027 the shortage of highly qualified specialists in STEM fields could increase to about 14 thousand specialists. This clearly shows the increasing importance of MSP "Chemistry" in Latvia's economic development.

The relevance of the programme is also shown by the results of employer surveys. Employers highly value the qualifications of the programme graduates. It is stated that the graduates have good theoretical knowledge, the practical preparation is good or can be improved (depending on whether the student practiced with the employer in parallel with his studies). Graduates' ability to learn new knowledge and skills is appreciated. Employers point out that there is a shortage of specialists in the industry and 75% of respondents note that they have faced difficulties in finding suitable specialists for the positions in the last 5 years.

MSP "Chemistry" will also be implemented in English in the future. This is justified by the fact that part of the employers in the chemical industry are international and/or exporting companies (for example JSC "Grindeks", JSC "Olainfarm", Ltd PharmIdeas), where one of the working languages is English. Likewise, work documentation (recordkeeping), especially in regulated industries such as pharmaceutical production, is done in English in these companies. On the other hand, scientific research institutions (for example, the Latvian Institute of Organic Synthesis, the Institute of Food Safety, Animal Health and Environment "BIOR") increasingly participate in international projects and carry out contract research commissioned by foreign cooperation partners. These employers require chemistry masters to have good knowledge of the English language, which also applies to knowledge of industry-specific terms. The programme is intended to accept foreign students who will be able to enter both the Latvian and European labor markets. In addition, some of the graduates of MSP "Chemistry" go abroad to continue their doctoral studies after completing their studies. Therefore, it is expected that the graduates of the MSP "Chemistry" implemented in English will have more opportunities to get a job in Latvia's international exporting companies and research institutions.

Master's study programmes in chemistry and related sciences, which are conducted in English, are currently offered at Vilnius University (Biochemistry, Nanomaterials Chemistry, Pharmaceutical Chemistry), Tartu University (Analytical Chemistry), Kaunas University of Technology (Applied Chemistry, Chemical Engineering). This indicates that similar programmes are in demand in both neighbouring countries. At the same time, UL MSP "Chemistry" offers to specialize in two sub-directions - organic and biomolecular chemistry and physical chemistry, which are not offered neither in Lithuania nor in Estonia, which could reduce direct competition with these universities in



attracting foreign students.

**3.1.4. 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 into different study forms, types, and languages.**

During the reporting period, the studies for students of MSP "Chemistry" mostly paid by state budget funds, only 2.7% of all students were fee-paying students. Studies were conducted in Latvian, with the exception of exchange students, for whom part of the lectures, practical, laboratory work and individual consultations were held in English. The total number of students during the reporting period has fluctuated from 58 to 95 students (see Annex 21M Student statistics in the Master's study programme "Chemistry"). In the last two years, the number of students of MSP "Chemistry" has decreased by approximately 20%. This could be due to the COVID-19 pandemic, which made it difficult for students to fully participate in classes, resulting in a large number of students dropping out. In addition, difficulties in developing a bachelor's thesis, etc. discouraged some from continuing their studies towards the master's degree (in 2020-2021, the number of graduates of the bachelor's programme was 10% less than in 2017-2019). During the reporting period, an average of 10 students were expelled each year. During the COVID-19 pandemic, there has been an increase in the number of students voluntarily withdrawing from their studies. The average dropout rate is around 25%. In individual discussions with students, it has been clarified that, in general, studies are content-wise satisfying, but it is difficult to combine them with work. In most cases, this is the main reason for stopping studies. The second reason mentioned is health problems, which is mentioned as a reason for stopping studies in recent years.

The data show that the number of matriculated (enrolled) students has slightly decreased in the last three years, however, the number of graduates decreased only in 2022, which was partially affected by the Covid-19 pandemic. There are also several reasons for the decrease in the number of matriculated students. First of all, it is determined by the low demographic indicators of the group of young people who have finished school, which have influenced the decrease in the number of students and graduates already in the bachelor's study programme. The data show that approximately 20% more students start their studies in the master's programme than the number of graduates in the bachelor's programme of the given year, which are mainly graduates of the Bachelor's programmes of the Faculty of Materials Science and Applied Chemistry of RTU.

*Table 4.3.*

*Number of students and graduates of MSP "Chemistry" from 2013-2023.*

LRI code	Title of study programme	Progr status	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
45441	21202 Chemistry (MSP)	A										
Number of students			103	110	95	80	80	89	78	61	58	64
Matriculated in the first year of study			50	57	39	36	46	46	35	30	31	35
Graduates			38	39	46	31	21	32	32	28	20	

**3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).**

## **3.2. The Content of Studies and Implementation Thereof**

**3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.**

MSP "Chemistry" has been developed respecting the interrelationship and order of study courses, which thus gives the opportunity to achieve the goal of the study programme as much as possible. In order to ensure this, nine elements of the set of knowledge, skills and competences obtained as a result of the study programme have been formulated. Observing the results to be achieved within the framework of the study programme, the study courses of the programme were renewed and new specific study courses were developed. In each study course, the results to be achieved are indicated, divided into three didactic levels: knowledge, skills and competence. The correlation of study programme aim and results with the results of individual study courses can be found in each study course description, which provides the course content, course plan, course learning requirements, literature to be used, achievable results and their evaluation (see Annex 24M Descriptions of courses of the Master's study programme "Chemistry" and Annex 25M Mapping learning outcomes of the BSP "Chemistry"). The study programme consists of the Compulsory part (Part A; 44 CP), which includes the Master's thesis (20 CP) and is common to all students, the restricted elective part (Part B; 34 CP), in which students choose one of three sub-directions (Analytical Chemistry, Physical chemistry or Organic and biomolecular chemistry) and elective parts (Part C; 2CP). The courses of the restricted elective part are divided into two parts - "Courses according to the sub-direction" (Part B1; 22 CP), which are considered the compulsory part of the sub-direction, and "Courses for all sub-directions" (Part B2; 12 CP).

.As already mentioned above, the implementation of the programme is always carried out in close cooperation with employers, as well as by regularly analyzing student survey data, listening to students' recommendations and taking into account good practice examples of foreign programmes. Various current needs and suggestions for the study process were clarified with employers at joint department meetings (in May and November 2021), as well as in surveys of employers and graduates (see Annex 8 Results of students, graduates and employer surveys) for

further development. In October 2021, the Accreditation Preparation Working Group was established to prepare the self-assessment report, which included lecturers, students, representatives of employers from companies and scientific institutes and a representative of the graduates of the programme. With everyone working together, a new Study Plan and the course structure of the restricted elective part have been prepared, which is planned to be implemented from academic year 2023/2024. This opens up opportunities for deeper specialization, wider choices and opportunities for interdisciplinarity in the sub-directions of the programme. (Annex 23M Plans of the Master's study programme "Chemistry" (Parts I and II).

**Compulsory part (Part A).** The compulsory part of MSP "Chemistry", which is common to all students, consists of a master's thesis of 20 CP and two course works of 6 CP in total, which guide students in a targeted and timely manner towards the selection of their research topic, the development of goals and tasks, and make them learn the necessary research skills. In order to ensure better preparation of the master's thesis, in the implementation of the programme, the acquisition of research skills is divided into several stages: 1) development and defence of course work I (2 CP) in the 2nd semester, 2) development and defence of course work II (4 CP) in the 3rd semester and 3 ) development and defence of the master's thesis in the 4th semester.

The rest of the compulsory part in the amount of 18 CP consists of 5 study courses. In the course "*Physical Chemistry*" (4CP), students get to know how to describe chemical systems and reactions using the computational chemistry approach. In the course "*Spectrometric analysis methods*" (4CP), students are provided with the knowledge of modern optical analysis methods and their practical application corresponding to the level of development of modern science. The course "*Organic Chemistry*" (4CP) is designed to gain an in-depth insight into the factors and laws that affect the equilibrium, rate and selectivity of organic reactions, into the study of reaction mechanisms, as well as to extended knowledge of quantum chemistry calculations acquired in the *Physical Chemistry* course. In the course "*Modern Analytical Methods*" (4 CP) students are introduced to the working principles of modern analytical methods and their use in the analysis of samples of organic and inorganic origin. On the other hand, in the course "*Innovation processes in chemistry*" (2CP), students are introduced to the ethics of scientific research, dissemination and communication of results to the public, chemical industry in Latvia, prospects for the development of the chemical industry, innovation, intellectual property protection, technology transfer and commercialization, business idea development and presentation.

The study course "*Inorganic chemistry*" (2CP) has been moved from the common compulsory part to the part of optional courses for all sub-directions (B2), because it is not relevant for all sub-directions. This follows from student surveys, as well as the expert's doubts about the usefulness of this course in the mandatory part of the programme in the discussions during the evaluation of changes to the programme in 2021. The mentioned changes do not significantly affect the overall study results, although the total amount has decreased to 24 CP. On the other hand, these changes slightly expand the choice of (2CP) study courses for students, thus providing the opportunity to acquire a wider range of knowledge, skills and competencies.

The study plan is designed in such a way that in the first 3 semesters students learn various consecutive study courses, while in the 4th semester the main attention is devoted to the development of the Master's thesis.

**Restricted elective part (Part B).** If, as a result of taking courses in the compulsory part, students can deepen their knowledge and demonstrate an understanding of the concepts, theories and relevant methodologies of the most important branches of modern chemistry and the main sub-branches, then taking the courses of the restricted elective part (B) allows them to acquire in-depth knowledge in one of the sub-disciplines of chemistry - analytical chemistry, organic and

biomolecular chemistry, and physical chemistry. When starting their studies, students immediately choose one of the sub-directions of the programme. See the distribution of restricted elective courses by sub-directions, see Annex 23M Plans of the Master's study programme "Chemistry", Part II. The courses of the restricted elective part are divided into two parts: sub-direction (B1) courses of the restricted elective part of the and optional courses for all sub-directions (B2), which complement the B1 part of the sub-direction to some extent, but can be chosen freely. Students have a wide range of choices, and instead of B2 part courses, they can also choose courses from the compulsory part courses (B1) of other sub-directions, if the student wants to specialize, for example, in physical-organic chemistry. In the course schedule, the study courses of part B1 are planned parallel for each sub-direction.

Since inception, the programme included the sub-direction "Organic Chemistry" and practically no changes were made in the previous period, however, the need for an interdisciplinary approach in solving various problems of organic synthesis has now come to the fore. Therefore, the sub-direction has been expanded and renamed to "Organic and biomolecular chemistry". This need to look at biomolecular mechanisms in parallel with the problems of organic synthesis was brought up in the discussions at the meeting of the Department of Organic Chemistry (June 2021) where 8 employers' representatives participated. As well as from employer surveys (see Appendix 8 "Results of student and graduate and employer surveys"), the conclusion follows that many graduates work in the field of design and/or synthesis of new potential medicinal substances, and it would be useful to expand students' knowledge in medicinal chemistry and in the field of biomolecular structure research. Therefore, in order to fully achieve the study results in the sub-direction, the content and scope of the existing courses have been updated, new optional courses have been created: "*Biomolecular structure*" (2CP), "*Chemical biology*" (4CP), "*Electrochemical synthesis*" (2CP). The volume of the study course "*Medical Chemistry*" has also been increased from 2CP to 4CP. This sub-direction is implemented in close cooperation with the Latvian Institute of Organic Synthesis and the Latvian Biomedical Research and Study Centre, also by inviting leading specialists in the field as course lecturers. Cooperation with RTU is also planned in this sub-direction, in joint teaching of two study courses for students of both universities. In the study course "*Organic synthesis II*" - joint lectures are given by professor E. Sūna and in the course "*Medicinal chemistry*" lectures are given by RTU prof. A. Jirgensons. By carefully analysing and evaluating the course survey results, all topics of study courses and all achievable results, changes of credit points were made in several B1 part study courses of this sub-direction: "*Organic synthesis I*" (8CP to 6CP) and "*Stereochemistry*" (4 CP to 6 CP), "*Organic synthesis II*" (6 CP to 4CP ).

In the "Analytical chemistry" sub-direction, the task of the programme is to prepare specialists capable of using modern analysis methods in various fields. The sub-direction was gradually updated during the development of the programme and the main changes were accepted in 2021. However, after evaluating the content of the courses together with employers and students, two changes have been made in the new study plan. The volume of the course "*Methods of Data Analysis in Chemistry*" has been expanded from 2CP to 4CP, based on the recommendations of employers that it is necessary to improve and learn more about statistical methods (various software) and their application for data processing and evaluation. As well as from the surveys of graduates, it can be seen that the answers to the question "Acquired skills in working with specific industry computer programmes" fall short of the maximum rating. This course is also relevant for students of the Physical Chemistry sub-direction.

In the survey, employers have also indicated the relevance of environmental problems and the need to expand knowledge about the applicability of instrumental methods for characterizing environmental objects, as well as to expand understanding of EU and Latvian legislative requirements regarding environmental quality and sustainability. Therefore, all study courses

related to environmental issues were evaluated: "*Analysis of Waters*" (2CP), "*Analysis of Air and Soils*" (2CP), "*Environmental chemistry*" (2CP) and "*Chemical toxicology*" (2CP), and consolidated into two in-depth courses: "*Chemistry of Environmental Systems I*" (4CP), which is included in the restricted elective part (B1), and "*Chemistry of Environmental Systems II*" (2CP), which is in part B2 of the restricted elective courses.

Also, the recommendations on chromatography course specified in the expert opinion of the 2021 programme changes evaluation have been taken into account. The expert's report states that overlap with the BSP "Chemistry" should be avoided in the course "*Chromatography*" (see Annex 18 Review of the implementation of recommendations). The content of both chromatography study courses was carefully analyzed and changes were made to prevent content overlap and to achieve the planned study results in both level programmes. As graduates and employers in surveys especially emphasize the importance of chromatography skills in the labor market, the BSP "Chemistry" course "*Chromatographic methods*" has been transferred to the compulsory part of the bachelor's programme, and the volume of its laboratory work has been increased. The master's course includes various theoretical aspects of chromatographic method development and advanced learning opportunities in the use of extended hardware. The names of the courses were not changed as the courses are actually complementary to each other. Learning of methods in chromatography is also highly supported by employers, especially in cooperation with the institute "BIOR", students have the opportunity to familiarize themselves with the most modern analysis methods.

In the "Physical Chemistry" sub-direction, following the recommendation of the employers, in 2022 the course "*Advanced Surface and Colloidal Chemistry*" (4CP) was moved from the optional B2 part to the compulsory B1 part of the restricted elective part of the sub-direction, because the use of these methods is growing rapidly. The course has been replaced by the course "*Methods of Electrochemical Analysis*" (4 CP), the use of which may be relevant only for part of the students of the sub-direction. The sub-direction has been supplemented with a new course "*Molecular modeling*" (2CP), which is very important for students of this sub-direction, because until now modeling elements were covered in various courses to a much smaller extent and young specialists often learned these methods independently.

Restricted elective study courses intended for all sub-directions (Part B2). In the opinion of the evaluation expert of the programme changes submitted in 2021, it is recommended to "expand the part B2 of restricted elective courses so that there are equal opportunities in all sub-directions". Also, in the comments of the last year's student surveys, there are suggestions to expand the offer of optional courses. Until now, there were relatively few choices in the direction of organic chemistry. In the newly created sub-direction "Organic and biomolecular chemistry", students have the opportunity to choose four new courses: "*Molecular computer modeling*" 2CP, "*Biomolecular structure*" 2CP, "*Electrochemical synthesis*" 2 CP. The study course "*Sustainable chemical processes*" 2CP was also created, where various approaches necessary for the development of environmentally friendly chemical processes are examined. The need for creating such a separate course was also brought up by the employers.

On the other hand, the number of students in the "Physical Chemistry" sub-direction was relatively small for many years, but in recent years, students increasingly choose this sub-direction and work in international projects at the Institute of Solid State Physics of the University of Latvia, and in the field of radiation chemistry - at the Institute of Chemical Physics of the University of Latvia. Radiation chemistry has a long tradition at the faculty, because until 2007 it was one of the sub-directions of this programme. For some time, the scope and activity had decreased, but now research in this field is expanding in the country, including in connection with the applications in medicine. That is why the programme also offers optional courses "*Radiation Chemistry*" 4CP and

In the previous study plans of the MSP "Chemistry" in the restricted elective part B2, students were given the opportunity to choose courses in the amount of up to 8CP from other study programmes in accordance with their chosen research direction, coordinating this choice with the programme director and the supervisor of scientific work. This option was rarely used by students, while annual surveys indicated that the programme had few optional courses. In order to preserve these interdisciplinary options, the new study plan now includes three study courses from other UL Master's study programmes, *"Modelling of Environmental Processes" 4CP*, *"Synthesis, Processing and Applications of Modern Materials" 4CP*, *"Molecular Biology and Genetics" 4CP*, respectively from Environmental Science, Physics and Biology Master's study programmes. They were chosen considering the students previous years' choices. The inclusion of the course *"Synthesis, Processing and Applications of Modern Materials" 4CP* in the programme has also been recommended by employers, particularly Institute of Solid State Physics.

However, for conducting interdisciplinary scientific research, if necessary, these courses can be replaced by another course of the natural sciences masters's programme up to 4 CP or by some course from compulsory part of other sub-divisions or creating an individual plan coordinated with the Study Field Council. Evaluation and coordination of course selection is necessary to ensure the achievement of the study results of the programme.

**Elective part (Part C).** Since students' interests are very diverse, a free choice part has also been created, which makes up 2CP. In the survey of graduates, a large dispersion was observed in the answers to the question whether the acquired education contributed to starting a business. This is explained by the fact that the programme does not have specific courses for acquiring business knowledge and skills, and most graduates work as employees in various companies and institutions. Taking this into account, the programme now includes a part of elective courses in the amount of 2 CP. Students will have the opportunity to choose various courses from other branches, including business, project management, etc.

Overall the content of study courses is designed according to the latest scientific trends in chemistry. **Computational chemistry and computer modelling** are playing an increasingly important role in chemical research as they can substitute time- and resource-consuming experiments in the laboratory. Students of the program learn and use these methods in solving problems both in the compulsory part courses *"Physical Chemistry" (4CP)*, *"Organic Chemistry" (4CP)* and in the restricted elective (Part B) courses *"Molecular Computer Modelling" (2CP)*, *"Biomolecular Structure" (2CP)*, *"Methods of Data Analysis in Chemistry" (4CP)*. Thanks to the development of technology, **the limits, and possibilities of various physico-chemical methods (including spectroscopic, analytical) are constantly being redefined.** In the compulsory part courses *"Spectrometric Analysis Methods" (4CP)*, *"Modern Analytical Methods" (4CP)* and restricted elective courses *"Chromatography" (4CP)*, *"Advanced Surface and Colloidal Chemistry" (4CP)*, *"Methods of Electrochemical analysis" (4CP)*, *"Nuclear Magnetic Resonance Spectroscopy" (2CP)*, *"X-ray Methods in Chemistry" (4CP)*, *"Bioanalytical and Pharmaceutical Analyses" (4CP)*, *"Microscopy Methods" (2CP)*, *"Practical Applications of Advanced Elemental Analysis" (2CP)* students gain insight about the possibilities and applications of these methods in solving the problems of modern science and innovative industry. **Science is nowadays becoming more and more interdisciplinary** and, following this trend, the restricted elective (B) part of the program includes several courses that provide knowledge on topics that lie on the border between two or more natural science disciplines, for example *"Chemical Biology" (4CP)*, *"Chemistry of Environmental Systems I" (4CP)*, *"Chemistry of Environmental Systems II" (2CP)*, *"Medical Chemistry" (4CP)*, *"Radiation Chemistry" (4CP)*, *"Radiochemistry and Introduction to Radiopharmacy" (2CP)*, *"Modelling of Environmental Processes" (4CP)*, *"Synthesis, Processing and*

*Applications of Modern Materials" (4CP), "Molecular Biology and Genetics" (4CP), "Forensic Chemistry" (4CP). One of the latest scientific trends is related to **sustainable (green) chemistry**, which would ensure consumption of less resources and avoid the use or creation of harmful substances. This scientific trend is reflected in the courses "Sustainable Chemical Processes" (2CP), "Electrochemical Synthesis" (2CP). The content of all courses is regularly (annually) reviewed and updated, following the development of science and technology. Following these trends is ensured by the significant involvement of the lecturers of the master's program courses in research projects and contractual works, as well as regular attendance at scientific conferences.*

The participation of students and lecturers in **exchange studies** plays a special role in the acquisition of student skills and experience. Student mobility data are given in Appendix 17 "Statistical data on student mobility", where it can be seen that on average every year two students of MSP "Chemistry" take courses in foreign universities (exception during the Covid-19 period). By transferring the study results, the common development trends of the content and methods of foreign study programmes can be seen. Students always positively evaluate the experience gained and the international nature of the study programmes.

During the reporting period, in order to increase the number of incoming international students, an academic project was implemented in 2017 and 10 study courses were prepared for teaching in English, and their lecture and seminar materials were placed in the e-study environment. Unfortunately, during the reporting period, lectures in English were practically not given, because the number of ERASMUS students was insufficient to create a group (at least 5 students), but the prepared materials were positively evaluated and used by students of the existing programme. Now, a full offer of MSP "Chemistry" courses in English has been prepared for accreditation, and it is believed that the wide choice of study courses will enable the implementation of the set goals and increase the number of foreign students in the programme and even more active inclusion in the common family of European chemistry programmes.

In general, the study courses included in the study programme and their teaching methodology are aimed at acquiring in-depth knowledge in various sub-branches of chemistry, as well as creating synergy with knowledge in other fields of science (e.g. biology, physics, environmental science), because today the job market requires specialists who use and know how to integrate fields into a unified whole and know how to solve problems using interdisciplinary, innovative approaches.

**ANNEX 23M.** Plans of Master's study programme "Chemistry"

**ANNEX 24M.** Descriptions of courses of the Master's study programme "Chemistry"

**ANNEX 25M.** Mapping learning outcomes of the MSP "Chemistry"

**3.2.2. In the 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. In the 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 (if applicable).**

The awarding of the Master of Science degree in Chemistry is based on the achievements and knowledge of the field of chemistry and its major sub-disciplines, which is acquired in the study courses of the programme. Emphasis is placed on the problems of sub-disciplines (analytical, organic and biomolecular, physical chemistry) in order to promote theoretical understanding and

learn the methodology of solving problem situations, thus developing the skills of research work and promoting the strengthening of the practical skills necessary in the labor market.

Lecturers with a doctorate degree in chemistry mainly participate in the implementation of MSP "Chemistry". Two researchers (doctoral students) with a master's degree in chemistry have been involved in managing the laboratory work of the study programme courses "Electrochemical analysis methods" and "Water analysis". The involvement of doctoral students in the teaching of study courses is evaluated positively from the point of view of accumulating academic experience and, in many cases, also from the reflection of a new methodology or theory, which they themselves use in their doctoral theses. Lecturers mainly conduct research in one of the sub-branches of chemistry.

The obtained scientific degrees and research areas prove the ability of the lecturers to provide students with study courses based on the latest achievements and knowledge of the scientific field, as well as the fact that the awarded Master of Science degree in chemistry is based on the achievements of the relevant scientific field.

**3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.**

During the study courses and examinations, both oral, written and combined study and assessment methods are used.

Studies employ a variety of knowledge acquisition and consolidation methods, such as introductory lectures, interactive lectures, consolidating lectures, and problem-oriented lectures. Practitioners and professionals from different institutions are invited to teach individual lectures in study courses (e.g. "Forensic chemistry", "Bioanalytical and pharmaceutical analyses", "Chemical biology", etc.) to promote the unity of theory and practice. Practical assignments, seminars, individual, pair and group work, discussions and project development, study tours to industry organizations are widely used. Employers are involved in the implementation and improvement of study courses (they are invited to conduct separate seminars, often the classes are organized as work experience visits, etc.). This allows for science-based studies, as almost all involved employers are scientists from UL and State research institutes. Thus, the study content also includes lectures and discussions on the latest scientific discoveries, experimental approaches and methods.

In order to promote the development of students' research competence, students in successive courses ("Course work I", "Course work II") have an opportunity to carry out research on the topics/issues of interest in the given field, thereby learning research methodology and the latest approaches.

To aid students in achieving learning outcomes - in acquiring and consolidating knowledge, skills and competence - the study process is dominated by student-centred methods. The study process is supported by methods that facilitate students' communication in the implementation of study



tasks, solving real-world problems, modelling situations In seminars, students present and analyze independent tasks, expand complex problem solving skills, presentation and discussion skills.

The physical environment of studies is also gradually changing: classrooms are easily transformable for group work, individual work, students can use digital technologies. Lecturers mainly use methods that encourage students' active participation, critical thinking and reflection. The e-learning environment is used in the study process and to promote independent studies. Each study course has an e-learning environment (Moodle) where students have access to lesson materials, task descriptions in addition to course-related learning materials, as well as study tasks (tests, forums, seminars, conferences, etc.). All interim and final assessment grades of the study courses are recorded, justified and made available to students in the e-learning environment.

In the implementation of the study programme, an individual approach to each student, which manifests itself in several aspects, is of great importance. First of all, students have the opportunity to consult individually with every teaching staff during certain consultation times. Secondly, cooperation with students and teachers is also provided by the possibilities of using e-learning environment. It is the responsibility of the teaching staff to regularly check their received electronic mails and respond to them. Thirdly, students are provided with free access to the faculty's general staff, study methodologists and management.

The student-centred approach is followed in updating the study programmes and the respective study courses, paying special attention to meaningful formulation of learning outcomes, thus promoting dialogue between lecturers and students on the content of studies, forms and methods of organization. Well-formulated learning outcomes, on the other hand, promote students' understanding and co-responsibility for their own learning, self-assessment, and understanding of the assessment they receive. During the study process, lecturers use methods, examination forms and assessment criteria that are appropriate to the study goal and planned learning outcomes.

Students receive support and feedback from the lecturers during the study process. Grading criteria for marking are made public in advance. The assessment gives students an opportunity to demonstrate the extent to which they have achieved the expected learning outcomes.

Following the principles of student-centred studies, student mobility (recognition of learning outcomes) is promoted, students engage in academic research and social activities initiated by the academic staff, thereby gaining significant experience through testing gained knowledge and skills in practice. By implementing internal quality assurance policies, study programmes are implemented to encourage students to actively participate in the improvement of the study process. There are procedures and regulations for submitting student proposals and complaints and reviewing student appeals. The results of student surveys are evaluated and taken into account for the improvement of the study process. Students are eager to express their proposals for the improvement of study programmes and processes in discussions with teaching staff and programme directors.

Students' independent or individual work is of great importance in studies. Students' independent work is organized individually (preparing for classes, preparing homework) and in small working groups (in seminar classes, group work, homework, presentations). Students must independently learn the mandatory literature indicated in the course description, as well as follow and read the latest publications related to the course topics, work with Internet resources, etc. study materials, reports and presentations must be prepared, etc. activities provided in the course description. In addition, during their studies, master's students can participate in the activities of UL doctoral schools, which provide the opportunity to participate in seminars and guest lectures on various topics. Students are also offered opportunities to get involved in research projects implemented at the faculty.

The study programme is oriented towards the improvement of students' knowledge, skills and competences in accordance with the development trends of chemical science, based on the knowledge and skills acquired in the Bachelor's programme. The methods chosen in the programme correspond to the didactic aspects of adult education, and they are based on developing critical thinking, solving problems and applying the acquired knowledge.

To achieve the results of the study programme, students are offered various methods: lectures, laboratory works, seminars, individual discussions or colloquiums, report presentations, group work, independent work, etc. The distance learning platform Microsoft TEAMS was also used for the last two academic years. The proportion and application of different methods is determined by the course lecturers, taking into account both the specifics of the study course and the students' previous knowledge and skills. In some courses (for example, "Physical Chemistry"), the Moodle environment is used not only for posting lecture materials, but also for testing knowledge. In order to provide students with the opportunity to achieve the planned results, special attention is paid to laboratory works, seminars, practical classes and the analysis of scientific literature and conducting scientific research. Research and problem solving methods are widely used in the laboratory works of the programme. Starting from the second semester, students are actively involved in research work in Faculty departments, UL scientific institutes and the largest scientific institutes of Latvia: Latvian Institute of Organic Synthesis, Institute "Bior", Latvian Institute of Wood Chemistry, etc. The results are summarized in two course theses and a master's thesis. Special attention is paid to ethical values: presentation of personally obtained results, citation of literature <https://www.lu.lv/en/studies/study-process/academic-integrity/> as well as for the use of chemicals in an environmentally friendly and reasonable manner. UL FC has developed methodological instructions specific to the chemical industry for the design of course works, bachelor's and master's theses. The instructions described in them are similar to those that should be followed when preparing scientific publications for international journals in the field of chemistry.

Assessment of study achievements takes place in accordance with the requirements of the Ministry of Education and Science of the Republic of Latvia and the University of Latvia: Procedure for organizing study course examinations at the University of Latvia (Senate decision No. 211 (29.06.2015)). Students' achievements are evaluated according to the study results at two levels: a) qualitative evaluation - (grade in a 10-point system); b) quantitative assessment - number of credit points. Experts of the industry are involved in the evaluation of the course and master's theses. Methodical instructions have been developed for the preparation, design and evaluation of course works and final theses at the UL FC, which include samples for drawing up work plans, interim reports of the works, as well as forms for reviews and evaluation guidelines (approved by the UL FC Council on 13.04.2022.).

For the implementation of the study program in English, it is planned to use the same methods that are used for the implementation of the program in Latvian. Accordingly, it is planned to prepare all study course materials in English and to involve lecturers with sufficient knowledge of English in conducting the lessons. At the same time, it is expected that in the first years of the study program implementation in English, there will be a smaller number of students, which means that it will be possible to implement an individual (personalized) approach to each student more successfully.

**3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign**

**students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).**

**3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).**

**3.2.6. 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 marks of the final theses.**

The Master's thesis must be developed in accordance with the UL regulations "Requirements for the development and defence of final theses (Bachelor's, Master's theses, diploma theses and qualification theses) (UL regulations No. 1/454 of 11.02.2020) and in accordance with the "Instructions" approved by the Council of the Faculty of Chemistry for the development, design and evaluation of course work and final theses" (approved at the 13.04.2022 meeting of the FC Council). The Master's thesis is evaluated by the Master's final examination commission, taking into account the recommendation included in the reviewer's review. Guidelines have been developed for evaluation, which describe the evaluation criteria for the defence of works. The overall assessment of the work is formed as the average of the assessment for B1 (Content and structure of work, 60% weight) and B2 (Défense of work, weight 40%) parts.

The selection of topics for master's theses is done individually, in consultation with the teaching staff of the faculty. Initially, the topic of the research work is selected in the 2nd semester in the study course "Course project I". Most of the students continue to develop the chosen topic in the 3rd semester course "Course project II", but some change the topic after realizing that the initially chosen topic does not interest them. When defending both course works, students receive instructions from the reviewer and the evaluation commission on continuing research, which purposefully leads to the achievement of the results of the master's thesis. The procedure for submitting and defending the Master's thesis is described in the above-mentioned UL regulations.

The Master's thesis must meet the basic requirements of the scientific work:

- there must be a scientific study in one of the sub-branches of chemical science;
- the result must be based on the data obtained in the experimental part of the work, on the materials of the relevant literature, other sources of information and personally conducted research;
- the course of the research should be logical, successive, the result generalizable and unambiguous;
- uniform terminology and standard abbreviations must be used throughout the master's thesis;
- the Master's thesis must be written in such a way that the opinions of the author of this thesis

- can be easily distinguished from the opinions of other authors;
- the presentation of the content must be precise, clear, logical, concrete;
- the Master's thesis must be written in the correct literary language of the country.

During the reporting period (2016-2021), graduates of the programme have developed a total of 190 master's theses in three main scientific directions of the Faculty of Chemistry and cooperation partners: 1) in the field of innovative materials and nanotechnology, 2) in the field of medicine and life sciences, which is very closely related to organic synthesis industry, 3) in the field of development of innovative instrumental analytical methods.

In the field of innovative materials and nanotechnologies, theses are mainly closely related to the area of physical chemistry. The most current topics of the final theses are related to the synthesis and properties of functional materials, the research of crystalline forms of pharmaceutical active substances, as well as the research of radiation effects in various materials, for example:

- Obtaining monolithic silica by the sol-gel method;
- Studies on the formation of solid solutions of various nitrobenzoic acid derivatives and their isomers;
- Accumulation of tritium in United European Thor tungsten materials.

In the field of medicine and life sciences, which is very closely related to the field of organic synthesis, it is most directly reflected in the works of students of the organic chemistry sub-direction. Topics in the development of new synthetic methodologies and the synthesis of biologically active substances for medical applications have gained attention, for example:

- Electrochemical production of  $\alpha,\beta$ -unsaturated esters from 2-(hydroxymethyl)furan derivatives;
- Synthesis of new resistance-free aminoglycoside antibiotics.

Most works have been developed in the field of development of innovative instrumental analytical methods. The theses in this topic were mainly developed by students of the analytical chemistry sub-direction. Final theses integrate modern analytical methods and at the same time promote the development and use of their application in various fields (pharmacy, environmental science, food product analysis). Examples of developed final theses topics:

- Creation and application of analytical methods for the characterization of newly developed thyrokinase inhibitors;
- Chemical pollution in children's toys sold in Latvia;
- Evaluation of the authenticity of honey from different flowers.

Looking at the topics of the final theses of the master's study programme and the places where the work was carried out, it can be seen that during the period 2016-2021, 82-93% of the defended master's theses were conducted in research directions, in which scientific research is also carried out by FC teaching staff, students developing these works both in FC departments, and in other related UL's and other scientific institutes (see Figure 8 in Chapter 2.4.5). The needs of the Latvian pharmaceutical industry also play an important role in choosing the topics of the final theses, as a significant number of students develop their work in pharmaceutical companies. Environmental problems of Latvia are also important, where the study of pollution and the impact of human activity play an important role. In the field of organic chemistry, the final theses are related to current topics in the world, as the works mostly take place within the framework of international research projects. On the other hand, in the fields of physical chemistry, the topics of works are determined both by the needs of the Latvian pharmaceutical industry and by world scientific trends in the context of international research projects.

In general, it can be concluded that the topics of the master's theses are in accordance with the name and content of the study programme, as well as the results of the research conducted by the students are relevant in the chemical industry. The results of the research and projects presented in the theses confirm the in-depth knowledge of the degree candidates in one of the fields of chemistry, the skills to independently obtain, summarize and interpret the results obtained in the work, which allows conducting research activities and developing a research project at a high professional level.

The topic and quality of the master's theses defended indicate the successful achievement of the study results. Evaluations of master's theses (Figs. 4.2 and 4.3) show that students are able to demonstrate high-level knowledge, skills and competence, in accordance with the requirements set for the master's thesis. The scientific excellence of the conducted research is evidenced by the fact that ~25-45% (depending on the year of study) of the works are later published as a scientific publication or part of it in one of Scopus or WoS indexed journals, with the student being a co-author or even the first author. The results of the students' work are evaluated by both programme lecturers and employers' representatives, who are part of the evaluation committee of the final thesis and participate in their review.

During the reporting period, in total, more than 90% of the developed and defended master's theses received a grade from 7 (good) to 10 (excellent) points. A very small number of master's theses received an assessment of less than 7 points. Evaluations of master's theses by individual study years are summarized in Figure 4.2. Data analysis shows that, in general, the quality of master's theses, which is already high enough, starting from 2017/2018. academic year, slightly increases: the proportion of Master's theses evaluated with 8 or more points has slightly increased. In the academic years 2019/2020 and 2020/2021, under the influence of COVID-19, the defense of master's theses took place remotely, and there were also various restrictions on the practical part of the master's theses. Data analysis shows that these difficulties have not reduced the quality of developed and defended master's theses.

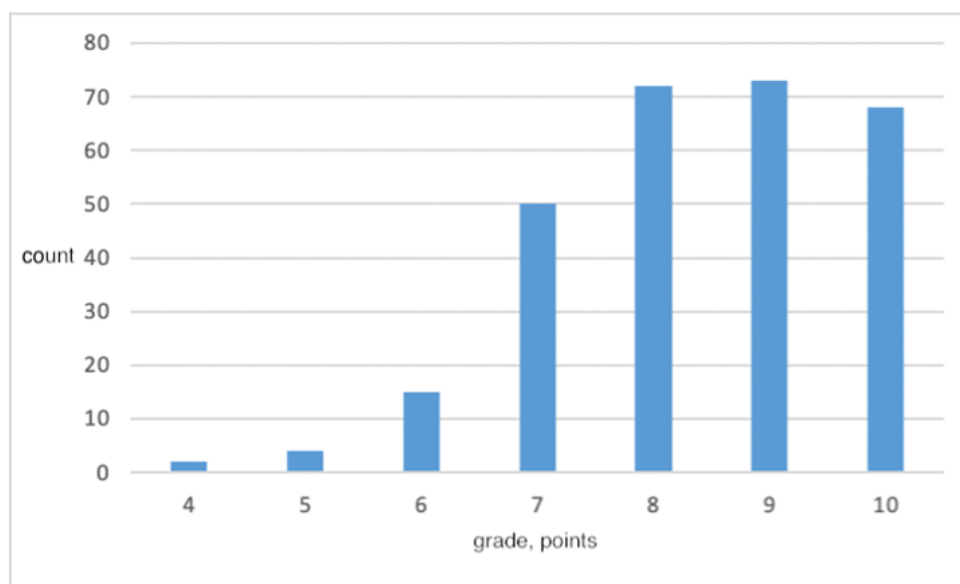


Figure 4.2. Grades for master's theses in the period 2016-2021.

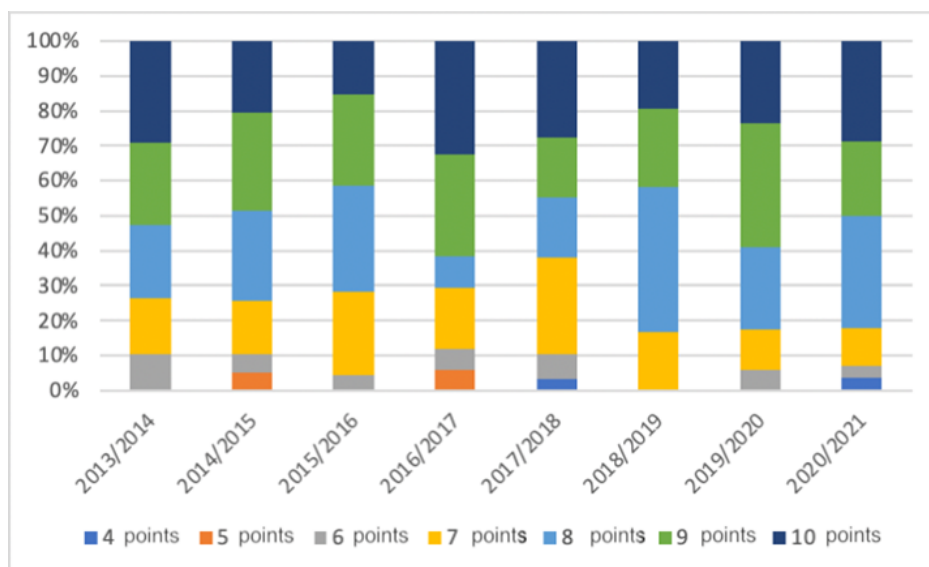


Figure 4.3. Grades for master's theses in the period from academic year 2013/2014 until 2020/2021.

In the survey about the final theses in 2021, the students' average assessment of the supervisor, acquired skills and work evaluation is high (5.9 to 6.2 points out of 7.0). The comments emphasize the availability, cooperation and support of supervisors. Students admit that the supervisors' sharing of experience and advice helped them to successfully develop their master's thesis.

### 3.3. Resources and Provision of the Study Programme

**3.3.1. 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.**

The University of Latvia has a modern material and technical base, which allows creating a high-quality modern learning environment. The premises and equipment of the UL have been significantly modernized in several laboratories, which open wide opportunities for scientific and educational work for the student. MSP "Chemistry" is implemented at the UL FC, which is located in the UL Academic Center, on the 6th floor and in the basement of the House of Nature. The total area of FC is 1,900 square meters, of which teaching and scientific laboratories occupy 1,220 square meters. All auditoriums and seminar rooms located in the House of Nature are available to students. They are equipped with projectors, most of them also with an electronic whiteboard. Student teaching laboratories are equipped with modern teaching equipment, including analytical balances, rotary evaporators, pH meters, titrators TitraLab880 and Karl Fisher titrator, thermostats UNB500, UV-VIS spektrometer Lambda 25 un FTIR spectrometer FT-IR Frontier, air analyzers (ozone analyzer, NOx analyzer, aerosol particle analyzer), as well as with AutoLab potentiostats.

Master's programme students use the scientific research infrastructure that is available at the Faculty of Chemistry for laboratory work and especially in research (course work, master's thesis),

including an HPLC-MS system with a TOF detector, a GC-MS system GCMS-QP2010 and quadrupole ISQ7000, an AAnalyst 600 electrothermal atomic absorptiometer AAnalyst 600, inductively coupled plasma triple quadrupole mass spectrometer ICP-QQQ, differential scanning calorimeter DSC25 (TA), nuclear magnetic resonance spectrometer Ultrashield 300, elemental analyzer of isotope ratios, powder X-ray diffractometers D8 Advanced, thermogravimeter TG/DTA600, fluorescence spectrometer Aminco Bowman AB-2, etc. (see Annex 13 "Summary of quantitative data on the scientific and applied research activities in the reporting period").

All other equipment which is in the Academic Center of the UL under the supervision of other faculties and institutes is also available for students to perform various interdisciplinary tasks. For the development of theses, depending on the work tasks, students can also use the technical resources of cooperation partners.

Students also have access to extensive literature resources of the UL Natural Sciences Library in Latvian, English, and other languages. The Natural Sciences Library and the adjacent Library of the House of Science are available 24 hours a day, 7 days a week, and also during the summer. More than 100 workplaces are available to users at the Natural Sciences Library, incl. 20 computer workplaces.

All study courses are provided with appropriate literature. More than 500 new books have been purchased in the last ten years (look 2.3.3. chapter, table 7 and 8.) Part of them are intended for the basic courses of the Bachelor's program, but at least half are relevant to the level of the Master's programme courses, as well as dedicated to interdisciplinary topics that can be used for scientific research. However, the Master's programme makes extensive use of scientific publications available in various databases.

In accordance with the UL strategic plan, the UL Library increases the proportion of e-resources and develops remote access to e-resources. By modernizing the availability of electronic resources, the latest technological web service Primo Discovery and SFX have been introduced in the UL Library.

In 2021 UL has subscription for a total of 37 e-resource platforms (both e-book platforms – VLeBooks, ProQuest Ebook Central, and e-journal databases). List of the subscribed multidisciplinary e-resources available to the UL, which include materials directly for use in the master's study programme:

Scopus, Web of Science, ScienceDirect, Cambridge Journals Online, EBSCO Academic Search Complete, Emerald eJournals Premier, JSTOR, LVS Latvian Standards Online Reading Room, Oxford Journals Online, ProQuest Dissertations & Theses Global, SAGE Journals Online, SAGE Research Methods - research methods library with more than 1000 books, SpringerLink Contemporary Journals, Taylor & Francis Social Science & Humanities Library. The full list of subscribed e-resources is available at <https://www.biblioteka.lu.lv/en/resources/subscribed-e-resources/> For the full list of available equipment and other aspects see Annex 13 "Summary of quantitative data on the scientific and applied research activities in the reporting period".

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

**3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).**

### Revenues of the programme

To ensure the necessary funds for the implementation of the MSP “Chemistry”, the University of Latvia uses:

- a state budget grant from the Ministry of Education and Science, which in the academic year 2022/2023 is set at EUR 4,646 for full-time studies;
- tuition fee, taking into account all the factors referred to in the section “Financial support”, which in the academic year 2022/2023 is set as follows:
- 2200 EUR per year for full-time studies;
- 2200 EUR for full-time international students (EU/EEA/Swiss citizens); other – 5406EUR per year.

Taking into account the above Latvian and planning international students, the total budget of the study programme is expected to be 417 thousand EUR, per year, the data are shown in Table 4.7.

Table 4.7.

*Number of students in the programme and annual income*

Type of study	LV state funded	LV for tuition fee	EU/EEA/Swiss citizens* for tuition fee	Others** for tuition fee	Total	State subsidy	For tuition fee LV and EU/EEA/Swiss citizens	Fee for citizens of other countries	Annual income
	number	number	number	number	number	EUR	EUR	EUR	EUR
FTS (Latvian)	65	0			65	4646	2 200		301987
FTS (English)			6	19	25		2 200	5406	115914
<b>Total</b>					<b>90</b>				<b>417892</b>

\* EU/EEA/Swiss citizens – European Union / European Economic Area / Swiss Confederation.

\*\* Others – outside of EU/EEA/Swiss Confederation.

### Programme costs

In order to estimate the amount of funds required for financial provision, the cost of study programmes at the University of Latvia is calculated according to the methodology developed by the University of Latvia, which takes into account the costs of providing the study process and information on the study programme plan, reliability of forecasts.



### a)The full-time study programme costs Latvian (FTS Latvian)

For calculations, the implementers of the MSP “Chemistry” use students data of the academic year 2022/2023 - 65 students 01.09.2022 and study plan/normative acts and structure of the involved academic staff. Based on the data total cost of the programme is 301 978 EUR per year. A more detailed percentage cost breakdown is shown in Table 4.8.

Table 4.8

*Percentage breakdown of costs in the study programme (in Latvian)*

<b>Expenditure item</b>	<b>% of total</b>
Teacher costs	42%
General staff.	5%
Other payments	1%
Infrastructure expenditure	14%
Property and services	12%
Indirect costs	26%
<b>TOTAL COST</b>	<b>100 %</b>

Figure 4.4 the prime cost of the study programme is visually represented by the red line (vertical axis) depending on the number of students (horizontal axis), indicated average weighted tuition fee (green line).

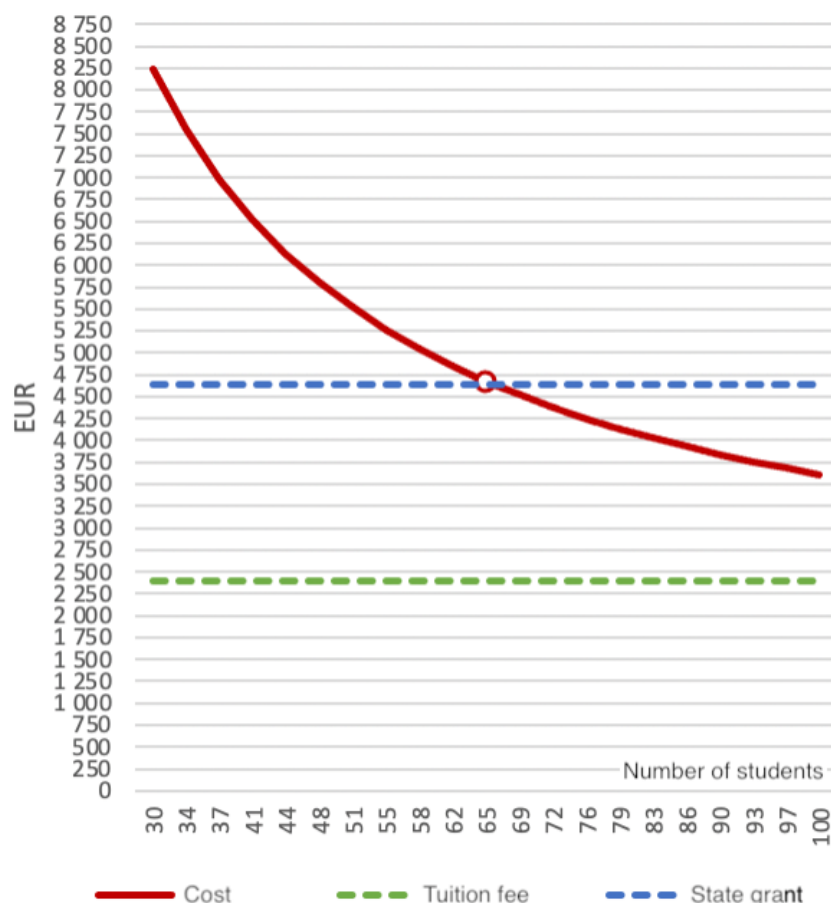


Figure 4.4. Prime cost per number of students or the MSP “Chemistry” (in Latvian)

Based on the calculation and students number 65, the prime cost of the program per student is 4631 EUR per year. It can be seen that for the programme to be profitable and provide students with a quality study process, the number of students in the programme (all courses combined) must be at least 65 (intersection of red (cost) and green (tuition) lines projected on the x-axis).

#### b) Programme costs for full time studies in English, (FTS English)

The developers of the programme plan that 25 students will study in the English language programme, students could be from different countries, respectively, and with different tuition fees (for example, 6 students from the EU/EEA/Swiss citizens (fee 2200 EUR) and 19 students from countries outside the EU/EEA/Swiss citizens – tuition fee 5406 EUR). With such a planned number of students, the estimated full-time cost per full-time student of the MSP “Chemistry” is 4631 EUR per year and the total cost of the programme is 115775 EUR per year. A more detailed percentage cost breakdown is shown in the table 4.9.

Table 4.9

Percentage breakdown of costs in the study programme (in English)

Expenditure item	% of total
Teacher costs	42%
General staff.	5%
Other payments	1%

Infrastructure expenditure	14%
Property and services	12%
Indirect costs	26%
<b>TOTAL COST</b>	<b>100 %</b>

In Figure 4. 5 the prime cost of the study programme is visually represented by the red line (vertical axis) depending on the number of students (horizontal axis), indicated average weighted tuition fee (green line).

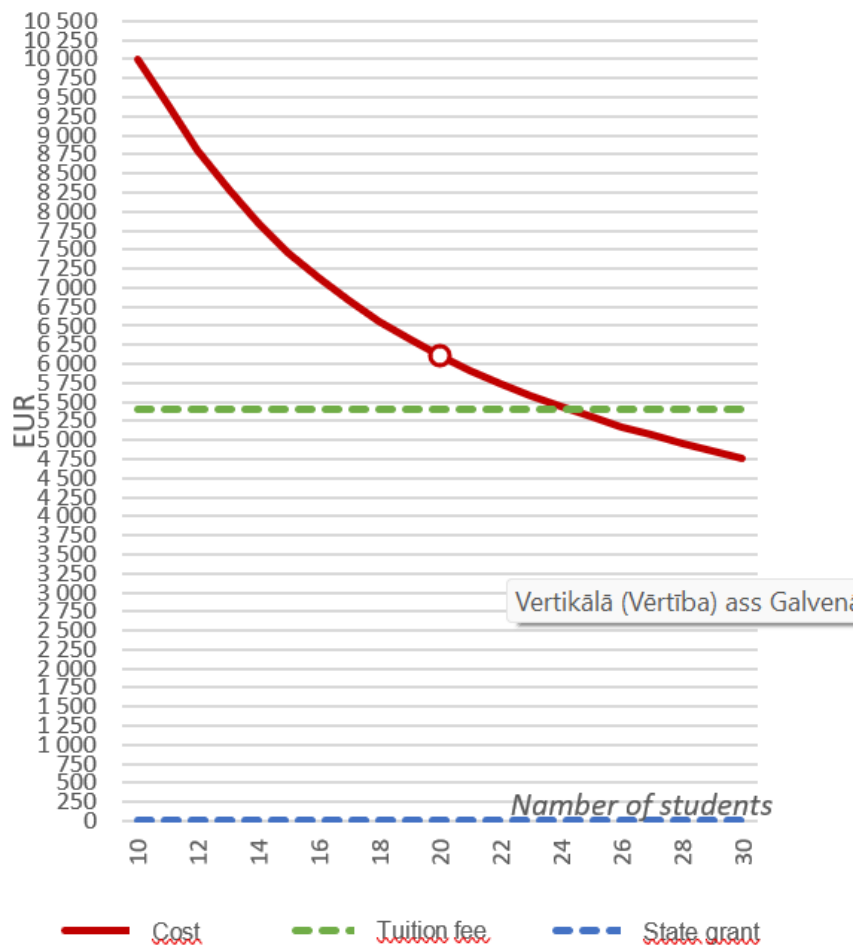


Figure 4.5. Cost per student enrolled for the MSP "Chemistry" (in English).

The calculation shows that for the programme to be cost-effective and for students to be able to study at high quality, the number of fee-paying international students in the programme (in all courses combined) must be at least 25.

At the start of the implementation of the programme in English, the number of students could be lower in the first years, in such case, the group can be formed only in one sub-direction. Taking into account that students of the Latvian classes can also take up to 16 CP restricted elective courses in English, it will be possible to form combined groups in some study courses, which could be profitable.

### c) Summary of the revenue and expenditure of the programme

Table 4.10 summarizes the programme revenue based on the number of students, state grants and

tuition fees, and the programme expenses for such number of students.

Table 4.10

*The result of the MSP "Chemistry"*

Type of study	Total	Total revenue	Total expenditure	Result	Profitability
	number	EUR	EUR	EUR	%
FTS (Latvian)	65	301 978	301 015	963	0,3%
FTS (English)	25	115 914	115 775	139	0,1%
Total	90	<b>417 892</b>	<b>416 790</b>	<b>1102</b>	<b>0,26%</b>

The data presented in the table 4.10 clearly show, that the Study Programme in all its forms of implementation (PLK) is profitable. The University of Latvia has sufficient resources to implement the study programme and ensure its further development.

Part of students tuition fee is below cost mainly for two reasons. Study fees are determined by competition with the study fees of related study programmes of Latvian universities and the small number of fee-paying students in chemistry study programmes. There is a mechanism that allows to change the tuition fee. Tuition fee is subject to change until necessary. Coordination of tuition fee changes is always the University-wide with the active participation of students. Insufficient budget grant funding (plus fees) is compensated from other Faculty own revenues. In addition, the development of the programme can be financed from the revenues received from lifelong learning and other services, as well as from the financial resources accumulated by the structural unit. Faculties also receive financial support for the development of programmes from the UL Study Quality Improvement Fund.

### 3.4. Teaching Staff

**3.4.1. 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.**

In academic year 2021/2022 20 lecturers from the Faculty of Chemistry, the Department of Environmental Science of the Faculty of Geography, the Department of Microbiology and Biotechnology of the Faculty of Biology, the Office of State Forensic Expertise and the Latvian Institute of Organic Synthesis participated in the implementation of the master's study programme. A total of 9 professors (one of them the guestprofessor), 8 associate professors, 3 assistant professors, 3 lecturers, 4 researchers and 7 guest lecturers. It should be noted that in several cases several teaching staff members jointly teach one course. Thus, the number of professors and

associate professors (17) fully complies with Article 55.1.3 of the Law on Higher Education Institutions, which states that "No less than five professors and associate professors, who have been elected to academic positions in the relevant higher education institution, together participate in the implementation of the compulsory part and the restricted elective part of the academic study programmes" (see Annex 20M Conclusion of the Council of Higher Education on the Master's programme "Chemistry" and appendix 26 M. Confirmation that the academic staff of MSP "Chemistry" meets the requirements set out in the third paragraph of the first part of Article 55 of the Law on Higher Education).

Highly qualified lecturers, leading specialists in the field of chemistry are involved in the implementation of the study programme: full member of LAS, professor K. Jaudzems, full member of LAS professor E. Sūna, full member of LAS professor D. Erts, professor of physical chemistry A. Actiņš, leading specialists in the field of analytical chemistry, professors A. Vīksna and V. Bartkevičs, as well as young talented scientists associate professor A. Bērziņš, assistant professor A. Kinēns, etc. In the implementation of the new study plan from 2023/2024, in the expanded sub-direction Organic and biomolecular chemistry, leading specialists of the field, professor K. Tārs, professor A. Line and Latvian Institute of Organic Synthesis researchers Dr. R. Bobrovs, professor A. Jirgensons (also RTU), Dr. A. Lends, Dr. T. Pantelejevs, Dr. E. Parisini etc. have been engaged as lecturers in teaching the courses. The lecturers' CVs and lists of publications is given in Annex 13 "Quantitative data on the scientific activity of teaching staff (Scientific projects, scientific equipment, dissertations)", Annex 14 "List of publications of the teaching staff for the reporting period". The high qualification of the teaching staff also enables the fulfilment of the Cabinet of Ministers Regulations No. 240. "Regulations on the State Standard of Academic Education" (13.05. 2014) (Part III, Paragraphs 15 and 16):

- The main goal of the master's study programme is to provide a set of knowledge, skills and competence in accordance with the level 7 knowledge, skills and competence of the framework structure determined in the Latvian education classification.
- The content of the master's study programme ensures the achievement of study results that include the acquisition of in-depth theoretical knowledge and the development of research skills and abilities in the chosen field of science or art.

The qualification of the teaching staff helps to achieve the study results of the MSP "Chemistry", because highly qualified teaching staff - professors and associate professors - dominate among them. 90% of the teaching staff have a doctor's degree.

In addition, the teaching staff is specialized in various sub-disciplines of chemistry (analytical chemistry, environmental chemistry, organic chemistry, biomolecular chemistry and physical chemistry), as well as in other branches of science (molecular biology and environmental science), which determines the possibility of providing students with the latest scientific discoveries, insights and modern practical skills in a wide spectrum of natural sciences. For example, professor K. Jaudzems research includes the use of nuclear magnetic resonance and other physical-organic chemistry methods in solving the problems of organic chemistry, stereochemistry, as well as biomolecular chemistry and the courses taught by him ("*Nuclear Magnetic Resonance Spectroscopy*", "*Organic Chemistry*", "*Stereochemistry*", "*Chemistry of Natural Compounds*") are closely related to these research topics. The research of professor E. Sūna and assist. professor A. Kinēns is related to the development and application of new organic synthesis methodologies (including electrochemical synthesis methods) in medicinal chemistry, which overlaps with the course topics taught by them ("*Organic Synthesis I*", "*Organic Synthesis II*", "*Organic Synthesis III*", "*Electrochemical Synthesis*", "*Medicinal Chemistry*", "*Organic Chemistry*", "*Stereochemistry*", "*Molecular Computer Modeling*"). Assoc. professor A. Bērziņš and professor A. Actiņš, as well as assoc. professor L. Orola conducts research in the field of physical chemistry, focusing on the use of

X-ray methods, where an important part of research is data analysis. These research topics are closely related to the subjects of the courses taught by them ("*Physical Chemistry*", "*X-ray Methods in Chemistry*", "*Physical Chemistry of Solid Materials*", "*Methods of Data Analysis in Chemistry*"). Similarly, professor A. Vīksna and professor V. Bartkevičs conducts research in analytical chemistry using modern methods of analysis (i.e. chromatographic, spectrometric and electrochemical methods) in order to characterize the chemical composition of chemical, pharmaceutical and food products and their presence in the environment, which corresponds well to the course topics they teach ("*Modern Analytical Methods*", "*Spectrometric Analysis Methods*", "*Methods of Electrochemical analysis*", "*Chromatography*", "*Metrology in Chemistry*", "*Sample Preparation in Analytical Chemistry*", "*Bioanalytical and Pharmaceutical Analyses*", "*Analysis of Foods*" ).

It is important that there are several young teaching staff members among assistant professors, researchers, leading researchers and lecturers who can replace professors and associate professors in the future. The knowledge of the national language and English of the teaching staff is sufficient to teach the programme in both Latvian and English.

**ANNEX 26M.** Confirmation that the academic staff of MSP "Chemistry" meets the requirements set out in the third paragraph of the first part of Article 55 of the Law on Higher Education

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

During the reporting period, the qualifications of the teaching staff have increased significantly, and the number of the teaching staff has increased. During the accreditation period, the composition of the teaching staff has been renewed, this was determined both by the change of generations of lecturers and by the need to improve and modernize the quality of study programmes. Since the previous accreditation (in 2013), nine lecturers of the Faculty of Chemistry no longer participate in the teaching of programme study courses, while thirteen lecturers have been elected to the position for the first time since the accreditation. During the reporting period, several teaching staff members have raised their qualifications and were elected to higher positions: V. Bartkevičs, K. Jaudzems, D. Erts, E. Sūna - as a professor, G. Vaivars, V. Rudoviča, L. Orola, A. Bērziņš, E. Pajuste were elected to the position of associate professor. All of them are recognized specialists in their field, which is indicated by high-quality publications, participation in projects, as well as the obtained Latvian Council of Science expert rights in the field of chemical science. In the master's programme, due to the expansion of the organic chemistry sub-direction (now "Organic and biomolecular chemistry"), as well as the creation of new courses in the analytical and physical chemistry sub-directions, the teaching staff now includes 3 lecturers from the Faculty of Biology (in 2013 only 1 lecturer), 2 lecturers from the Faculty of Geography and Earth Sciences (1 lecturer in 2013) and 1 lecturer from LU Institute of Solid State Physics. It should be noted that previously students of the master's programme could choose courses from other Master's programmes up to 8 CP, according to their direction of research. Now the free choice is 2CP, but the part of the restricted elective in the Master's programme has been expanded with courses in other natural sciences. It is planned to involve 4 young scientists from the Latvian Institute of Organic Synthesis and three guest lecturers, including one foreign specialist, in the implementation of the programme. Changes to the teaching staff compared to academic year 2021/2022 are clearly visible in the table 4.11.

Table 4.11.

*Teaching staff involved in the implementation of MSP "Chemistry" study courses from 2023/2024*

<b>Name Surname</b>	<b>Academic position</b>	<b>Course</b>
Linda Ansone-Bērtiņa	Researcher	Environment Protection
Eduards Baķis	Leading researcher, Dr.chem.	Sustainable Chemical Processes
Māris Bērtiņš	Researcher/ PhD student	Methods of Electrochemical analysis, Methods of Data Analysis in Chemistry, Chemistry of Environmental Systems II
Raitis Bobrovs*	Guest lecturer, Dr.chem.	Molecular Computer Modeling
Vitālijs Freidenfelds*	Guest lecturer	Forensic Chemistry
Aigars Jirgensons	Visiting Professor (RTU)	Medicinal Chemistry
Alons Lends*	Guest lecturer, Dr.chem.	Biomolecular Structure
Aija Linē	Professor, Dr.biol.	Molecular Biology and Genetics
Kārlis Pajuste*	Guest lecturer, Dr.chem.	Advanced Surface and Colloidal Chemistry
Teodors Panteļevs*	Guest lecturer, Dr.chem.	Chemical Biology

Emilio Parisini*	Guest lecturer, Dr.chem.	Chemical Biology
Toms Rēķis	Researcher, Dr.chem.	X-ray Methods in Chemistry
Linards Skuja*	Gest lecturer, Dr.hab.phys.	Synthesis, Processing and Applications of Modern Materials
Kaspars Tārs	Profesor Dr.biol.	Biomolecular Structure, Chemical Biology

\*Visiting lecturers - industry experts whose main job is at LOSI or UL ISSP or the State Forensic Expertise Bureau.

It can be concluded that the changes in the number and structure of teaching staff involved in the programme have increased the quality of education, because the academic staff involved in the programme qualitatively and quantitatively ensure the achievement of the tasks of the study programme.

**3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of 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 or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).**

**3.4.4. 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).**



**3.4.5. 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 programme and 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 promote improvement and interconnection of study courses, mutual cooperation between teaching staff takes place regularly. This is facilitated by the fact that, in many cases, several teaching staff members jointly teach one course. Proposals for improving the study process (improvement of course content, e-learning environment, etc.) are discussed and considered at the meetings of the Study Programme Council and, since May 2020, at the meetings of the Study Field Council, taking into account the students' assessment of the study courses and current scientific trends.

The cooperation of teaching staff is also promoted by the programme director, who, through regular meetings and/or electronic communication with lecturers, discusses and coordinates the study process. Issues of the study process are discussed in individual conversations, in departments and are periodically examined by the Study Direction Council.

If the students' recommendations are expressed in a discussion with the programme director or the head of the department and it concerns the teaching of a specific course, then the lecturer of this course is informed and the comments made by the students are evaluated and solutions are sought for the improvement of the study course.

If one study course is taught by several lecturers, then one of them is responsible for updating the content in the LUIS system, as well as for coordinating topics and time allocations, according to the course description and other relevant issues.

20 lecturers were involved in the implementation of the MSP "Chemistry" in the 2021/2022 academic year, which makes the ratio of the number of students and teaching staff 2.4 students to one teaching staff. However, in practice, the ratio is higher, because not all courses of the restricted elective part B2 are taught every year.

# Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	19_M_A sample of the diploma and its annex to be issued for completing the study program.docx	19_M_Par studiju programmas apgūšanu izsniedzamā diploma un tā pielikuma paraugs.docx
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)	20_M_Opinion of the Council of Higher Education_Article 55 of the Higher Education Law.docx	20_M_Augstākās izglītības padomes atzinums_Augstskolu likuma 55.pants.pdf
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	21_M_Statistics on students in the reporting period.docx	21_M_Statistika par studējošajiem pārskata periodā.docx
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard	22_M_Compliance of the study program with the national education standard.docx	22_M_Studiju programmas atbilstība valsts izglītības standartam.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (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	25_M_Mapping of study courses for achieving the study results of study programs.xlsx	25_M_Studiju kursu kartējumsstudiju programmas studiju rezultātu sasniegšanai.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	23_M_Study program plan.docx	23_M_Studiju programmas plāns.docx
Descriptions of the study courses/ modules	24_M_Descriptions of study courses.docx	24_M_Studiju kursu apraksti.docx
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	26M_AL_55.3_pants_Apliecinājums_veidlapa_ENG.edoc	26M_AL_55.3_pants_Apliecinājums_veidlapa_LV_2022.edoc

# Chemistry (43441)

Study field	<i>Chemistry, Chemistry Technologies, and Biotechnology</i>
ProcedureStudyProgram.Name	<i>Chemistry</i>
Education classification code	<i>43441</i>
Type of the study programme	<i>Academic bachelor study programme</i>
Name of the study programme director	<i>Jānis</i>
Surname of the study programme director	<i>Švirksts</i>
E-mail of the study programme director	<i>janis.svirksts@lu.lv</i>
Title of the study programme director	<i>Dr. ķīm., asoc. profesors</i>
Phone of the study programme director	<i>+371 26465796</i>
Goal of the study programme	<i>Is to provide students with theoretical knowledge and research skills in the basic areas of chemistry and related natural sciences, thus preparing chemistry specialists who can enter various sectors of the labour market and continue their studies at the Master's level.</i>
Tasks of the study programme	<ul style="list-style-type: none"> <li><i>• theoretical knowledge and skills in the basic areas of chemistry: inorganic, analytical, organic, physical and biological chemistry, as well as the necessary knowledge of mathematics, biology and physics,</i></li> <li><i>• practical and research skills in basic chemistry laboratories and the ability to carry out research in a sub-discipline of chemistry and to summarise the results in the bachelor's thesis,</i></li> <li><i>• knowledge and skills in selected courses in a sub-discipline of chemistry,</i></li> <li><i>• general skills in the context of chemistry that can be applied in other contexts (communication skills, work organisation, self-organisation skills, etc.)</i></li> <li><i>• a standard of knowledge and skills that gives them access to the degree programmes of the second cycle,</i></li> <li><i>• understanding of high professional ethics,</i></li> <li><i>• understanding of the importance of international cooperation in scientific work.</i></li> </ul>

Results of the study programme	<p><b>KNOWLEDGE</b></p> <p>1. Demonstrate basic and specialised knowledge and critical understanding of inorganic, organic, physical, analytical and biological chemistry and selected specialised chemistry courses, and apply appropriate knowledge and skills in mathematics, physics and biology.</p> <p>2. Understand the key concepts and laws of chemistry and demonstrate knowledge of the advances, highest achievements and sustainability of chemistry.</p> <p><b>SKILLS</b></p> <p>3. Is able to apply the acquired theoretical knowledge and skills to carry out practical and research activities in chemistry, plan experiments, carry out syntheses, measurements and evaluate results.</p> <p>4. Is able to analyse concepts, perform various calculations, solve practical tasks, apply information technology skills in data selection, processing and summarizing.</p> <p>5. Present their own results (written and oral) and to discuss in a reasoned way chemistry problems and their solutions with specialists or non-specialists.</p> <p>6. Structure one's own learning independently and understand the importance of continuing education and professional development in chemistry.</p> <p>7. Is able to take responsibility and initiative, to work individually, as part of a team or managing a team, as well as to adapt to new circumstances and make appropriate decisions.</p> <p><b>COMPETENCE</b></p> <p>8. Is able independently select and evaluate scientific information, creatively and comprehensively solve chemistry problems and make scientifically based decisions, contributing to the development of the field of chemistry.</p> <p>9. Demonstrate the understanding of professional ethics and is able to assess the impact of their professional activities on the environment and society.</p>
Final examination upon the completion of the study programme	Bachelor's thesis

## Study programme forms

### Full time studies - 3 years - latvian

Study type and form	Full time studies
Duration in full years	3
Duration in month	0
Language	latvian
Amount (CP)	120
Admission requirements (in English)	Secondary education

Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	<i>Bachelor's degree of Natural Science in Chemistry</i>
Qualification to be obtained (in english)	-

#### **Places of implementation**

<b>Place name</b>	<b>City</b>	<b>Address</b>
University of Latvia	RĪGA	RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050

### 3.1. Indicators Describing the Study Programme

**3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.**

Since the previous accreditation report, there have been no significant changes in the parameters of the BSP "Chemistry". The location of the study programme has changed. It is now located in the newly built House of Nature of the Academic Centre of the University of Latvia, Jelgavas iela 1, Riga.

Previous accreditation took place in 2013, the goals and objectives of the study programme have been updated in the reporting period, and the learning outcomes have been reassessed and expressed in the form of knowledge, skills and competences.

Since the accreditation, BSP "Chemistry" has undergone minor changes in the scope of programme courses, in order to modernize teaching/learning environment and expand students' opportunities of the study course choice (see Table 3.1.). In general, the structure of the program has been maintained. The volume of the compulsory part has been reduced by 4 CP. By modernizing the basic chemistry courses, their volume has been reduced (1-2 CP), and this allowed to include in the program some courses that are important for the further development of the program for providing students with relevant skills, which are required by the chemistry labor market, (for example, *Course project*, *Chromatography Methods*). The compulsory part also includes study courses *Civil protection* and *Environmental protection* in accordance with MK No. 240 "Regulations on the State Academic Education Standard" (2014.13.05).

The volume of the restricted elective part has been increased by 4 CP. The restricted elective part is divided into two parts: I "Professional specialization study courses" – 22CP, including five new study courses developed in cooperation with employers. A new section "Social and humanitarian science study courses" has been created in the restricted elective part – 2 CP. Some courses have been integrated into other courses, but some courses have been removed from the program because they have lost their relevance. The detailed description of changes in the study program is given below in the chapter "Programme content analysis".

All changes in the program have been made to ensure the achievable results, improve the quality of studies and increase the competitiveness of graduates in the labor market.

Table 3.1.

*Comparison of study courses of the accredited study program and the study program aimed at accreditation*

2013/2014		2023/2024 planned	
Study Course	CP	CP	Study Course
<b>Compulsory part (A)</b>	86	82	<b>Compulsory part (A)</b>
Analytical Chemistry I	5	4	Analytical Chemistry I
Analytical Chemistry II	5	3	Analytical Chemistry II

Structure of Atoms and Molecules	2	2	Structure of Atoms and Molecules
Higher Mathematics I	5	4	Higher Mathematics I
Higher Mathematics II	5	4	Higher Mathematics II
Biology	5	4	Biology
Biological Chemistry	5	4	Biological Chemistry
		1	Civil Protection
		1	Occupational Health and Safety in Chemistry Laboratories
Physics for Natural Sciences	5	4	Physics for Chemists
Physical Chemistry I	5	4	Physical Chemistry I
Physical Chemistry II	5	4	Physical Chemistry II
		4	Chromatography Methods
Methods of Instrumental Analysis	4	4	Methods of Instrumental Analysis
Kinetics and Catalysis	5	4	Kinetics and Catalysis
		4	Research project
Inorganic Chemistry I	4	4	Inorganic Chemistry I
Inorganic Chemistry II	6	4	Inorganic Chemistry II
Organic Chemistry I	4	4	Organic Chemistry I
Organic Chemistry II	6	6	Organic Chemistry II
Spectroscopy of Organic Compounds	3	3	Spectroscopy of Organic Compounds
		1	Environment Protection
General Chemistry	5	5	General Chemistry
Purification and Analysis of Organic Compounds	2		<i>integrated in other courses</i>
Bachelor's Thesis	10	10	Bachelor's Thesis
<b>Restricted elective part (B)</b>			<b>Restricted elective part (B)I Professional specialization study courses</b>
English for the Students of Natural Sciences I	2	2	English for Chemists
Chemistry of Natural Resources and Applied Chemistry	4		<i>partially integrated in other courses</i>
Occupational Health and Safety	2		Course1CP Part A
Computer Application in Chemistry	3	3	Computer Application in Chemistry
Energy Containment Chemistry	2	2	Energy Containment Chemistry
Heterocyclic Compounds	5	4	Heterocyclic Compounds
Chromatography methods	4		Part A
		2	Introduction to Materials Science
		4	Methods of Instrumental Analysis in Biology
Coordination Chemistry	2		

Crystal Chemistry	2	2	Crystal Chemistry
		4	Quality Assurance in the Laboratory
Chemical Information and Principles of Chemical Research	2	1	Introduction to Studies and Research
		4	Chemistry Technology
Macromolecules	4	4	Macromolecules
		4	Mathematical Processing and Modelling in Chemistry
Massspectrometry			<i>integrated in other courses</i>
Nanochemistry	2	4	Nanochemistry
Organic Analytical Reagents	2		
Preparation of Organic Compounds	4	4	Preparation of Organic Compounds
Practical Analytical Chemistry	4	4	Practical Analytical Chemistry
Consumer Products Chemistry	2		
Environmental Science	5		Part A 1CP and integrated in other courses
General Food Chemistry	4	4	Principles of Food Chemistry
			<b>Restricted elective part (B) II Social sciences and humanities study courses</b>
		2	Emotion and Communication Psychology
		2	Business management and entrepreneurship
		2	Project Management Fundamentals
<b>Elective part (C)</b>	2	2	<b>Elective part (C)</b>
Total	120	120	Total

**3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.**

The BSP "Chemistry" (code 43441) has been developed and is implemented at the Faculty of Chemistry as one of the stages of full-cycle academic education in chemistry. The programme was accredited in 2013 for 6 years, and later its accreditation was extended until 30 June 2023. The implementation of the Bachelor's programme is in line with the aim and objectives of the study field "Chemistry, chemical technology and biotechnology", as well as the development trends of the national economy and the needs of the labour market. According to the Cabinet of Ministers Regulation No. 322 "Regulations on Classification of Latvian Education" (13.06.2017), the pro-



programme code is determined by the level of education - higher (4), type - academic Bachelor education (3) and belonging to the group of educational programmes - chemistry (441). Its relevance to the Study Field is determined by its affiliation to the natural sciences, as evidenced by the Bachelor of Science degree in Chemistry. The title of the BSP "Chemistry" and the degree to be obtained are interrelated. Aims and objectives of the programme, as well as the study outcomes corresponding to the Bachelor's degree in Chemistry, follow from them. The knowledge, skills and competences acquired in the framework of the study programme correspond to the Latvian Qualifications Framework (LQF) level 6, as evidenced by the mapping of study courses attached in the Annex. (see Annex 25B "Mapping of study courses for the achievement of learning outcomes of the study programme").

The BSP "Chemistry" fully meets the [higher education standard](#). (Only in Latvian)(see Annex 22B "Correspondence of the bachelor's degree programme to the national education standard"). The duration of the bachelor's degree programme is 3 years (6 semesters), during which all students of this programme are required to master 120 CP. These are divided into: compulsory study courses (92 CP, including a Bachelor's thesis of 10 CP), restricted elective study courses (26 CP) and free elective study courses (2 CP). The duration of the Bachelor's degree programme is 3 years, in line with the Lisbon Convention (1997), the Bologna Declaration (1999) and other international documents governing higher education. A secondary education is required to start studies at BSP "Chemistry".

The design and formulation of the outcomes also take into account the requirements of the *European Chemistry Thematic Network Association* (ECTN) for the award of the "Chemistry Eurobachelor" label (guidelines can be found at <http://ectn.eu/committees/label/labels/>). This quality label was already awarded in 2012, it was re-awarded in 2017 (certificates No. EB1104, 18.04.2012, No. EBR1603, 21.03.2017) and extended until the accreditation of the programme in 2023 (ECTN letter of 29.06.2021). The Quality Label Awarding Committee had two face-to-face visits at the University of Latvia and positively evaluated the study programme.

The organisation and content of the BSP "Chemistry" at the Faculty of Chemistry is also comparable to the Bachelor chemistry programmes of other universities (see Table 3.2), e.g. in our region with the programme of the Daugavpils University (DU) and in Europe with the BSP of the University of Ljubljana (Slovenia). DU awards its graduates a Bachelor of Science degree in chemistry (in the sub-direction of renewable-resource chemistry or practical bioanalysis). The amount of compulsory and restricted elective study courses is very similar in both programmes, the amount of free elective study courses differs more, which in UL programme is 2 CP, while in Daugavpils University study programmes it is 6 CP. Comparing the concrete study courses that students must acquire, we can already see significant differences. The courses offered at DU provide graduates with a rather narrow specialisation in the field of renewable resources or bioanalytics. The DU programme does not offer students a choice in the restricted elective part of study courses. If students choose to specialise in the chemistry of renewable resources or bioanalytics, they are offered 12 study courses each with a total of 28 CP, so they have to choose them all. In the restricted elective part of the UL programme, a wide range of courses is offered, allowing the student to choose courses in analytical, physical and organic chemistry that are relevant to his/her interests, similar as it is in the Bachelor of Chemistry programme at the University of Ljubljana.

Table 3.2.

*Comparison of the BSP "Chemistry" with chemistry bachelor study programmes of other higher education institutions of Latvia and abroad*

University/ college	University of Latvia	Daugavpils University (DU)	University of Ljubljana
Title of the study programme	Chemistry	Chemistry	Chemistry
Duration of studies	3 years	3 years	3 years
Scope of the study programme (CP, ECTS)	120 CP /180 ECTS	120 CP /180 ECTS	180 ECTS
Comparison of study courses and their scope	Compulsory study courses 92 CP (138 ECTS), restricted elective courses 26 CP (39 ECTS), free elective courses 2 CP (3 ECTS)	Compulsory study courses 86 CP (129 ECTS), restricted elective courses 28 CP (42 ECTS), free elective courses 6 CP (9 ECTS)	Compulsory study courses 160 ECTS, restricted elective courses 15 ECTS, free elective courses 5 ECTS
Learning outcomes	Knowledge, skills and competences related to chemistry	Knowledge, skills and competences related to chemistry	Knowledge, skills and competences related to chemistry
Final examinations	Bachelor's thesis 10 CP (15 ECTS)	Bachelor's thesis 10 CP (15 ECTS)	Bachelor's thesis 15 ECTS
Internet address	<a href="https://www.lu.lv/en/studies/faculties/faculty-of-chemistry/undergraduate-studies/chemistry/">https://www.lu.lv/en/studies/faculties/faculty-of-chemistry/undergraduate-studies/chemistry/</a>	<a href="https://du.lv/studijas/studiju-programmas/akademiska-bakalaura-studijas/kimija/">https://du.lv/studijas/studiju-programmas/akademiska-bakalaura-studijas/kimija/</a> (Only in Latvian)	<a href="https://www.rtl.si/en/study/first-cycle-study-programmes/university-study-programme-chemistry-20212022/#c1444">https://www.rtl.si/en/study/first-cycle-study-programmes/university-study-programme-chemistry-20212022/#c1444</a> (full information in Slovenian)

The knowledge and skills acquired by students are sufficient for graduates of the study programme to continue their studies in the academic master's study programme "Chemistry".

**ANNEX 19B.** Sample of Bachelor's programme "Chemistry" Diploma template and Diploma Supplement

**ANNEX 20B.** Conclusion of the Council of Higher Education on the Bachelor's programme "Chemistry"

**ANNEX 22B** Compliance of the Bachelor's study programme "Chemistry"

with the State Education Standard

### 3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

Not only the University of Latvia, but also Riga Technical University and Daugavpils University train chemistry specialists in Latvia. The study programme "Chemistry and chemical technology" of the RTU specialises in the training of chemical technology specialists, and its graduates are awarded a Bachelor of Engineering degree in chemical technology. The Bachelor's degree programme in Chemistry at DU prepares specialists in environmental chemistry and bioanalysis. Graduates of the BSP "Chemistry" programme at the University of Latvia receive an academic, broadly applicable education in chemistry and hold an important position in the chemical labour market. Potential employment places for graduates in Latvia are chemical and pharmaceutical manufacturing companies (e.g. Grindeks, Olainfarm), scientific research institutions (e.g. Latvian Institute of Organic Synthesis, Latvian State Institute of Wood Chemistry, Latvian Institute of Hydroecology, Institute of Food Safety, Animal Health and Environmental Research "BIOR"), quality control and forensic laboratories, environmental protection services and educational institutions, as well as a wide variety of companies related to chemistry and life sciences. Graduates of the BSP can enter the labour market immediately after graduation, which is what a great part of graduates do, but also most graduates continue their education in the MSP "Chemistry", combining studies with work.

The training of science specialists complies with overall national development trends, for example, the [Latvian National Development Plan Report 2021-2027](#) (Only in Latvian), where the action line "Qualitative, accessible, inclusive education" states that the share of science, mathematics and information technology graduates in the total number of graduates in higher education should increase from 6.8% (2018) to 12% (2027). The good employment prospects of graduates are also

confirmed by the graduate monitoring data from the Ministry of Education and Science. The data show that the demand for graduates of this study programme is relatively high and that the graduates of this programme enjoy a wide range of job opportunities. The future need for specialists is forecasted in the ["Informative Report on Medium- and Long-term Labour Market Forecasts"](#) (Only in Latvian) of the Ministry of Economics, which indicates that by 2027 the shortage of specialists with the highest qualification in STEM fields could increase to about 14 000.

The vast majority of graduates of the bachelor programme continue their studies in chemistry or other related master study programmes: 2015 - 80%, 2016 - 68%, 2017 - 89%, 2018 - 90%, 2019 - 85%, 2020 - 92%, 2021 - 87%, and 2022 - 88%.

The courses in biology, physics and higher mathematics included in the study programme, in terms of scope, allow graduates to continue their studies or work in various other sectors where chemistry specialists are also needed, such as food industry, pharmaceuticals, forestry, environmental science and conservation. Thus, every year, some graduates enter Master's programmes in interdisciplinary fields, such as the Master's programme "Nutritional Science" and the Professional Master's programme "Occupational Environmental Protection and Expertise", as well as the Master's programmes "Biology", "Environmental Science", "Physics", and "Geology" at the University of Latvia. 1-2 students continue their Master's studies abroad each year.

In recent years, the number of students who choose related master's programs has increased. The graduates of the bachelor's program in 2020, 69% entered the master's study programme in chemistry, 23% other master's study programmes; 8% work in industrial companies related to chemistry. The graduates of 2021, 64% continued their studies in the master's degree in chemistry, 23% in other master's study programs, including studies abroad; 13% work in the fields of chemistry and computer science. The graduates of 2022, 72% continue their studies in the chemistry master's study programme, 19% in other master's study programmes, incl. studies abroad; 7% work in chemical industry; 2% parental leave. Most of those students who continue their master's studies also work in parallel; typical workplaces are the Institute of Organic Synthesis of Latvia, the Institute BIOR, Latvian State Institute of Wood Chemistry, the UL Institute of Solid State Physics, the joint-stock company "Grindeks" etc. The BSP "Chemistry" graduates successfully enter the labour market once they graduate. This is due to the fact that part of students have the opportunity to start working successfully in their profession already during their studies. After graduation students often continue working in the research institutes where they did their bachelor's thesis. Currently, the most demanded are workers in different analytical chemistry laboratories and specialists in organic synthesis. There is also a shortage of chemistry teachers in general comprehensive schools, colleges and vocational schools. The academic bachelor's degree in chemistry also allows the interested students to continue their studies in pedagogical study programmes, leading to a qualification of a chemistry teacher.

Surveys and interviews of graduates and employers show that the Bachelor's programme meets the requirements of the labour market. Employers are keen to recruit graduates of the BSP "Chemistry". More than half of the employers have indicated in the survey that they experience a shortage of chemistry specialists. This problem is more pronounced in manufacturing companies. The fact that students often start working in the field after their second year of study (see Annex 8 "Results of student and graduate and employer survey ") is serves as a sign of the shortage of employees.

**3.1.4. 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 into different study forms, types, and languages.**

Statistical data on students enrolled in BSP "Chemistry" throughout the reporting period (starting from the academic year 2013/2014) are summarised in detail in Annex 21B "Statistics on students enrolled in the reporting period" and show that the overall number of students is stable and ranges from 194 to 170 students, see the main indicators in Table 3.3. Over the last four academic years, it has been stable between 170 and 175 students. The majority of them are state budget students, the number of fee-paying students is small. Compared to the previous four academic years, the number of students in the programme has decreased by about 6%, which could be explained by the wide range of studies offered to secondary school graduates in Latvia and abroad, as well as by the general demographic trends leading to a decrease in the number of students in Latvia.

The minimum number of enrolled students (63 students) was in the academic year 2020/2021, but already in the academic year 2021/2022 it reaches the highest number in the reporting period - 75 students. This could be due to the efforts that the FC invested in the work of the "Young Chemists' School" and other activities to attract secondary school learners to university studies. The number of graduates during the reporting period varies between 26 and 49 each year, usually around 33-35 graduates. There has been a slight increase in the number of graduates in the last two years. Comparing the total number of graduates with the total number of enrolled students (without adjustment for the shift between the number of enrolled students and the number of graduates) over the reporting period, it appears that on average only a bit more than 50 % of enrolled students graduate with a bachelor's degree.

*Table 3.3.*

*Statistical data on students in the BSP "Chemistry"*

Year of studies	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
Number of students	186	181	178	194	186	170	172	173	175	151
Number of students enrolled in the first year	66	64	68	74	70	69	74	63	75	55
Graduates	49	36	28	35	33	40	26	39	43	

The reasons for the drop-out are manifold, often students need to work in paid jobs and it is difficult to combine it with full-time studies, another reason is health problems - in the last two years, it is also the impact of the COVID-19 pandemic. The drop-out rate is observed in different years of studying, but it is highest in the first year. Different methods have been used to reduce the drop-out rate during the reporting period. For example, in academic year 2013/2014, the initiative of the FC was implemented and first year students were divided into small groups (4-5 students). Each group was provided with two faculty support persons, a lecturer and a PhD student, to help with both academic and everyday problems. Unfortunately, this system was not effective, as students in

the so-called "risk group" were absent from classes and did not participate in activities. The following year, a centralised mentoring support movement was established at the University of Latvia. In 2015/2016, curators/trustees started to act as consultants. Mentors and curators received additional training and guidance in working with the first year students. In recent years, both mentors and curators have worked with students, and from the first year of 2020, the so called 'study groups' were set up for students. Unfortunately, Covid-19 distance learning started and no visible results were achieved. In the spring of 2021, the Study Field Council decided to introduce the study course "*Introduction to Studies and Research*" for the first year students, which would allow them to get acquainted with the study environment, to find out how to succeed in their studies, and also to meet employers and find out what chemistry professionals do. In the academic year 2021/2022, the study course was successfully implemented and "study groups" were running in parallel, which taken together now allows hoping for a slight improvement: in 2022, 85% of students in relation to the enrolled first-year students participated in the spring session.

**ANNEX 21B.** "Student statistics in the Bachelor's study programme "Chemistry"

**3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).**

## **3.2. The Content of Studies and Implementation Thereof**

**3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.**

The BSP "Chemistry" is developed on the basis of the following external and internal normative acts: the [Law of the Republic of Latvia on Higher Education Institutions; Cabinet of Ministers Regulations No. 240 \(13.05.2014\) "Regulations on the State Standard of Academic Education"](#) (only in Latvian) and the [Regulations on University of Latvia Study and Continuing Education Programmes](#) (Senate Decision No. 102 of 24.04.2017).

The content of the BSP "Chemistry" is designed to taking into consideration the interrelation and sequence of the study courses, thus providing the possibility of the maximum achievement of the objectives of the study programme. To ensure this, nine outcomes of the study programme in the form of acquired knowledge, skills and competences have been formulated. The set of knowledge, skills and competences to be acquired in each individual study course has been developed in

accordance with the outcomes of the study programme. The correlation of the objectives and outcomes of the study programme with the learning outcomes of individual study courses can be found in each course description, which includes an annotation of the study course, prerequisites required for the study course, a description of the course content and course plan, the requirements for obtaining credit points, the outcome of the study course, a list of the literature to be used (see Annex 23B "Plan of the study programme ", Annex 24B "Course descriptions" and Annex 25B "Mapping of study courses to study programme learning outcomes"). The distribution of credit points for the BSP "Chemistry" corresponds to the requirements for academic study programmes set out in the National Standard for Academic Education, see Table 3.4.

Table 3.4.

*Correspondence of the content and credit points of the BSP "Chemistry" to the National Standard for Academic education*

Study programme and its parts	National Standard for Academic Education, CP(ECTS)	BSP "Chemistry" (2013/2014), CP(ECTS)	BSP "Chemistry" (as of academic year 2023/2024), prepared for accreditation, CP(ECTS)
<b>Bachelor study programme</b>	<b>120 - 160 (180-240)</b>	<b>120 (180)</b>	<b>120(180)</b>
Compulsory study courses (Part A)	At least 50(75)	86(129) (not counting Bachelor's thesis)	82(123) (not counting Bachelor's thesis)
Bachelor's thesis	At least 10(15)	10 (15)	10(15)
Restricted elective study courses (Part B)	At least 20 (30)	22(33)	26(39)
Free elective study courses (Part C)	Not defined	2(3)	2(3)

As can be seen from Table 3.4, the study programme consists of compulsory study courses (Part A), restricted elective study courses (Part B) and free elective study courses (Part C). The compulsory part consists of a total of 92 CP (including the bachelor's thesis) or 76.7% of the total credit points.

The study programme was previously accredited in 2013 and minor changes have been made during its implementation until 2022, without changing the size of the compulsory, restricted and free elective parts. The first changes were made in 2014. Following the assessment of the quality of the Bachelor's thesis (after discussions with employers, supervisors and students), the decision was made to introduce the study course "Research project" 2CP into the programme to give all students the opportunity to acquire the first research skills in chemists' workplaces and to help them develop their Bachelor's thesis more successfully. The research project was included in the programme by reducing the volume of 5th semester study courses "Biological Chemistry" and "Physical Chemistry II" from 5 CP to 4 CP. In the new programme prepared for accreditation (starting from academic year 2023/2024), the research project has been increased to 4 CP on the recommendation of the employers.

Following the requirements of the University of Latvia, and the requirements put forward by the Student Council of the FC and the administration of the UL, regular foreign language study was started in the 1st year of the Bachelor's programme in the autumn semester of 2015. The study

course "English for Chemists I" 2 CP was included in the programme for all students in the autumn semester. In turn, "English for Chemists II" 2 CP was included as an elective course in the spring semester, thus providing all students with the opportunity to learn a foreign language related to their professional field. In accordance with the Cabinet of Ministers No.240 "Regulations on the State Academic Education Standard " (2014.13.05), the course in environmental protection "Sustainable Environmental Development" 2 CP was included in the Bachelor's programme and from the academic year 2016/2017, the course "Civil Protection" 1 CP was also included in Part A to be acquired in the 3rd semester. In order to make these changes without changing the total number of Part A credit points, the study course "Biology" was revised and reduced from 5 CP to 4 CP, as some topics of this course overlapped with the topics of the new course on environmental protection. The topics of the study course "Physics for Chemists" were assessed and revised in detail in parallel with the study course "Higher Mathematics II". The content of these two courses was aligned with that of study courses "Physical Chemistry I" and "Physical Chemistry II". As a result, both Physics and Mathematics courses were reduced by 1 CP. The cross-harmonization of the content of courses was performed several times because it was relevant according to the recommendations given by the accreditation experts.

The study course "Analytical Chemistry I" was also reduced from 5 to 4 CP, as the study course on occupational safety "Occupational Health and Safety in Chemical Laboratories" (1 CP) was included in Part A of the programme, whereas previously the 2 CP occupational safety course was in the elective part and was taken by about half of the students. The inclusion of this course in the compulsory part of the study programme is also corresponds to the recommendations of the accreditation experts on occupational safety.

The content of the BSP "Chemistry" prepared for accreditation in comparison with the study programme in the academic year 2021/2022 has been further improved and updated, taking into account the experience of previous studies, as well as evaluating academic chemistry study programmes in Europe and following the latest recommendations of the *European Chemistry Thematic Network* (ECTN) (<https://ectn.eu/about-us/>). The changes have been proposed and evaluated in joint meetings by the employers, experts, students, graduates and the teaching staff. The overall structure of the BSP has been only minimally affected by the changes proposed for the accreditation (see Table 3.4). The volume of compulsory study courses has been reduced from 86 CP to 82 CP, the volume of restricted elective courses has been increased from 22 CP to 26 CP, and the volume of free elective courses has remained unchanged at 2 CP. The block of restricted elective study courses has been divided into two parts: professional specialisation courses (24 CP) and social sciences and humanities study courses (2 CP).

In the academic year 2007/2008, the BSP "Chemistry" was transformed from a 4-year programme into a 3-year Bachelor programme. Introducing this change, in consultation with all stakeholders in the learning process: employers, graduates, students and the teaching staff, the number of contact hours set for laboratory work was increased. This is necessary for students to acquire practical skills in the laboratory. The calculation formula: the number of laboratory hours in relation to the overall UL calculation given in the *Guidelines for the development and updating of study courses at the University of Latvia* is as follows: in Part A courses 2 : 1 and in Part B courses 1.5 : 1. The different number of contact hours is compensated for by independent work hours and does not affect the total number of hours allocated to 1 CP. This approach was also accepted in the 2013 accreditation and recognised as useful in the previous accreditation period and it is being continued in the programme prepared for accreditation.

**The compulsory study courses** are designed in such a way that as a result of their study students acquire basic and specialised knowledge and practical skills in inorganic, organic, physical, analytical and biological chemistry, are able to use relevant knowledge and skills of mathematics,



physics and biology to solve interdisciplinary problems. They can also demonstrate a critical understanding of the key concepts and regularities of chemistry and knowledge of the highest achievements and sustainability of chemistry. In the first semester of studies, students acquire the compulsory study courses "General Chemistry" (5 CP), "Inorganic Chemistry I" (4 CP), "Biology" (4 CP), as well as "Occupational Health and Safety in Chemical Laboratories" (1 CP), which is an essential prerequisite for any workplace.

As can be seen from the Study Plan (Annex 24B "Descriptions of courses of the Bachelor's study programme "Chemistry""), chemistry and mathematics courses are divided into two or three parts. For example, "Analytical Chemistry I" (4 CP), where students learn the basic principles and theoretical aspects of the field, then in the next semester they deepen their knowledge in "Analytical Chemistry II" (3 CP) and learn the practical application of methods in more detail in the study course "Methods of Instrumental Analysis" (4 CP). The course "Chromatography Methods" (4 CP) is also delivered separately in this block, as the knowledge and skills acquired are in high demand in a wide variety of contexts in the labour market, as proved by the employer and graduate surveys. This course has been moved to the compulsory part of the study programme compared to the previous plan and the amount of laboratory work in the course has been increased by 16 hours.

The core requirements of the "Chemistry Eurobachelor" developed by the ECTN for chemistry degree programmes have also been taken into account when designing the compulsory part of the study programme, where the total volume of basic courses includes at least 90 ECTS (60 CP) in the main fields of chemistry - general chemistry, analytical, inorganic, organic, physical and biological chemistry, as well as physics and mathematics should be included in the basic courses (see Table 3.5). The compulsory part of the Bachelor's programme also includes study courses which, to some extent, are related to the different fields: "Spectroscopy of Organic Compounds" (3 CP), "Structure of Atoms and Molecules" (2 CP); the regulated courses "Environment Protection" (1 CP), "Civil Protection" (1 CP), and the study course "Biology" (4 CP) which is a prerequisite for the study course "Biological Chemistry" (4 CP). The compulsory part of the programme includes the study course "Environment Protection" (1 CP) as it is offered by the UL to all programmes in accordance with the provisions on the standard of academic education, thus replacing the previous course "Sustainable Environmental Development" (2 CP).

In the fifth semester of studies, students consolidate the acquired theoretical knowledge and experimental skills in the study course "Research project" (4 CP), which students work out in production companies, scientific institutes and also in the chairs of the Faculty of Chemistry. Students carry out experiments, summarise and present the results. To some extent, this research project can also be considered as academic practice.

The second half of the sixth semester is devoted to the development of "Bachelor's Thesis" (10 CP).

Table 3.5.

Comparison of the volume of basic chemistry courses in the BSP "Chemistry" with the ECTN recommendations

Basic courses recommended by ECTN, ECTS	Relevant study courses of the UL BSP	Total volume of the UL study courses, CP/ ECTS
General chemistry	General chemistry	5/7.5



Analytical chemistry	Analytical Chemistry I and II Methods of Instrumental Analysis Chromatography Methods	15/ 22.5
Inorganic chemistry	Inorganic Chemistry I and II	8/12
Organic chemistry	Organic Chemistry I and II	10/15
Physical chemistry	Physical Chemistry I and II Kinetics and Catalysis	12/18
Biological chemistry	Biological Chemistry	4/6
Mathematics	Higher Mathematics I and II	8/12
Physics	Physics for Chemists	4/6
<b>Total at least 90</b>		<b>Total 66/99</b>

**Restricted elective courses.** The total offer of restricted elective study courses in the study programme prepared for accreditation is divided into two parts: 1) the total offer of chemistry related professional specialisation study courses is 52 CP, of which students have to choose 24 CP, 2) the total offer of social sciences and humanities study courses is 6 CP, of which 2 CP are to be chosen.

The acquisition of the restricted elective professional specialisation study courses allows gaining in-depth knowledge in one of the sub-disciplines of chemistry - analytical chemistry, organic chemistry or physical chemistry.

In the first semester, all students acquire the course "*Introduction to Studies and Research*" (1 CP), where students learn about the course of studies at the University of Latvia and the Faculty of Chemistry, they are informed about the organisation and content of studies, and develop their universal (transfer) skills, in particular self-directed study skills. In this course, students broaden their understanding of academic ethics, they develop the skills of theoretical research and presentation skills; they also get acquainted with employers and work in the chairs of the Faculty. In the first semester, all students take the course "*English for Chemists I*", which develops students' knowledge and skills in English in the field of chemistry. This is necessary for students to be able to participate successfully in lectures and seminars in English, to be able to read and summarise scientific literature and to communicate in their field of specialisation. All first-year students also take the course "*Computer Application in Chemistry*" (3 CP), where they learn the software necessary for a chemist's professional work, data processing methods and the basics of analytical statistics, etc.

In the second and third semesters, students do not have restricted elective courses included in their study plan.

From the fourth semester onwards, the Part B course offer is designed to allow students to specialise slightly in one of the areas of chemistry - analytical, physical or organic chemistry (see Table 3.6), which is in line with the sub-disciplines of the Master's programme. For example, the course "*Crystal Chemistry*" (2 CP), which introduces students to the basic principles of crystalline

structure and the classification of crystalline structures, and the relationship between the crystal structure of a substance and its physical and chemical properties. This forms the basis for the study of crystal structures, which is one of the main research areas of the Chair of Physical Chemistry. The course "*Energy Containment Chemistry*" (2 CP) is important in the context of the research carried out at the Institute of Chemical Physics and several bachelor theses are defended each year in this field. Students' choice is completely free, some courses are designed to be suitable for several specialisations.

Table 3.6.

*Restricted elective professional specialization study courses in the BSP "Chemistry"*

Area	4th semester	5th semester	6th semester
Organic chemistry	Heterocyclic Compounds 4 CP	Methods of Instrumental Analysis (in Biology)** 4 CP <b>Macromolecules 4 CP*</b>	Preparation of Organic Compounds 4 CP
Analytical chemistry	Quality Assurance in the Laboratory** 4 CP	Practical Analytical Chemistry 4 CP	<b>Principles of Food Chemistry* 4 CP</b>
Physical chemistry and/or materials	<b>Introduction to Materials Science** 2 CP</b> Crystal Chemistry 2 CP	Mathematical Processing and Modelling in Chemistry** 4 CP	Energy Containment Chemistry 2 CP Nanotechnology 4 CP
For all students			<b>Chemical Technology 4 CP**</b>

\*Study courses suitable for all areas (*bold*)

\*\* Newly-developed study courses

For those students who wish to specialise in organic chemistry, the study course "Heterocyclic Compounds" (4 CP) introduces the classes of heterocyclic organic compounds, methods of production, physical and chemical properties and uses of heterocyclic organic compounds. The course "*Methods of Instrumental Analysis (in Biology)*" (4 CP) is also offered in the BSP "Biology" programme, which will be useful for students planning to specialise in organic and biomolecular chemistry later in their Master studies. For students more interested in analytical chemistry, the study course "*Quality Assurance in the Laboratory*" (4 CP) is designed to provide an opportunity to acquire knowledge and skills in the workings of a testing laboratory and the processes by which the accuracy and reliability of test results are ensured in the laboratory.

Compared to the study programme implemented in the 2021/2022 academic year, 5 completely new restricted elective study courses are offered. Their development was mainly initiated by employers and graduates. These are "*Introduction to Materials Science*" (2 CP), "*Quality Assurance in the Laboratory*" (4 CP), "*Mathematical Processing and Modelling in Chemistry*" (4 CP), "*Chemical Technology*" (4 CP) and "*Methods of Instrumental Analysis (in Biology)*" (4 CP).

The range of courses developed is also well in line with the ECTN recommendations, where the minimum of elective courses is recommended to be 5 ECTS, (which in the UL programme is slightly wider at 6 ECTS) and examples of such courses include "*Macromolecules*", "*Mathematical Processing and Modelling in Chemistry*", "*Chemical Technology*", "*Principles of Food Chemistry*".

The part of the restricted elective study courses prepared for the accreditation offers a section of social sciences and humanities study courses. This is similar to the University of Ljubljana and to the practice in many bachelor programmes, where restricted elective study courses are also divided

into general study courses and professional specialisation study courses. Students are offered to choose one 2 CP study course out of 3 offered: "*Business Management and Entrepreneurship*" (2 CP), "*Project Management Fundamentals*" (2 CP) and "*Emotion and Communication Psychology*" (2 CP). The ECTN guidelines support the need for even more such courses, with a particular focus on entrepreneurship.

**Free elective study courses.** The free elective part of the Bachelor's programme consists of 2 CP. Students may choose a study course that suits their interests from any study programme of the University of Latvia, provided that their prior knowledge meets the requirements specified in the study course.

In general, the results of all surveys of students, employers and graduates were used to improve the content and quality of the study programme. (see Annex 8 "Results of students, graduates and employer surveys"). Regular surveys on the quality of study courses have been carried out by surveying students on individual study courses. Practically all of them have been highly rated, but the development plan of the study programme foresees to continue to work actively to further increase the rating of the courses.

In the last year's surveys, students have given both evaluations and suggestions about the content and organisation of the study programme. The importance of students' opinions is reflected in the fact that in the 2021 survey, students gave the highest rating to the statement "*Opportunity to participate in improving the quality of the study programme*". Students' views on the development of new elective courses was also taken into account when developing the content of the BSP "Chemistry".

Graduates in the survey generally rate the knowledge and skills acquired in the Bachelor's programme highly and are satisfied with their choice of the study programme. The statement "*Acquired skills in the use of modern information technologies*" has a positive but relatively lower rating. This has been taken into consideration in the improvement of the study programme by revising the content of the study course "*Computer applications in chemistry*" and also by offering the elective course "*Mathematical processing and modelling in chemistry*".

Many discussions with employers have taken place during the implementation of the study programme. They are held regularly, usually after the defence of the Bachelor's thesis. During the preparation for accreditation in spring 2021, joint chair meetings were organised with employers to identify key needs and issues, and again in November 2021, when the learning outcomes of the programme were specified and the content of the updated courses was analysed. Employers participated in both the Working Group of the Study Field Accreditation and the Study Field Programme Board in updating the content of the programme. Consequently, the above mentioned 5 new restricted elective study courses have been developed in the programme prepared for accreditation following the employers' recommendations.

According to the interviews and survey results, employers in general have a high opinion of the qualification of the graduates of the study programme, praising their theoretical and practical training, their ability to acquire new knowledge and skills, and their ability to work independently. Employers have also given a wide range of suggestions for improving the quality of the BSP "Chemistry". It should be noted that many of these suggestions are already being implemented now, but many will continue to be implemented in the future. For example, employers recommend that *more students should be encouraged to start working in a chemistry-related field from the start of their research project, rather than only when they start developing their Bachelor's thesis*. A survey of students in the second semester of 2022 shows that 17% of students have already started doing research in chemistry. The strategic plan of the study field aims to increase the involvement of 1st and 2nd year students in research (this does not imply paid work) in order to

become more familiar with the profession, to reduce drop-out and gradually acquire research skills. Several employers have similar views: *"to provide longer internships in the working environment of companies, to offer students a wide variety of practical work with real applications and tasks with different problem situations; to include more laboratory work and internships to learn the analytical equipment and instrumental methods in practice. Students should be encouraged to participate in conferences at the University to acquire the skills of presenting their results, etc."*. Although an academic study programme does not provide for internships as a compulsory study course, many students take advantage of internship opportunities offered by companies on their own initiative. Also, increasing the research project from 2 CP to 4 CP will facilitate the acquisition of research skills in the place of doing the research project, which in many cases is also the student's future workplace.

Some of the employers' recommendations are related to the specific field of activity of the company and are not relevant for other employers. One of the employers' specific recommendations is *to increase students' real knowledge of physics*. In the study programme submitted for accreditation, the content of the higher mathematics courses and the physics course and the study courses *"Physical Chemistry I and II"* were evaluated and the sequence of their acquisition was also agreed. Thus, the study course *"Physics for Chemists"* has been moved from the first semester to the 3rd semester after the course *"Higher Mathematics I"* and will be taught in parallel with the study course *"Higher Mathematics II"*.

The number of students working at the Institute of Solid State Physics has increased very rapidly in the last two academic years. Employers from various ISSP laboratories recommend that the *bachelor programme should provide more opportunities to specialise in inorganic or physical chemistry, to ensure the cooperation with the Faculty of Physics, Mathematics and Optometry so that students can take courses in solid state physics, research methods for various inorganic and organic materials, that more time should be devoted to studying various reactions for the synthesis of inorganic substances: solid-phase, sol-gel, hydro-thermal, etc.* The recommendations for more in-depth study of methods for the synthesis of inorganic materials can be partially implemented already now by replacing the descriptions of the synthesis of existing inorganic compounds in the laboratory work with synthesis methods recommended by employers. The other recommendations require the development of new Part B courses, possibly in collaboration with the Faculty of Physics, Mathematics and Optometry.

A/S Grindeks representatives have indicated that *courses in industrial pharmacy, drug registration, project management* are needed. In the programme offered for accreditation, students can study a course in project management in Part B. Some of the recommendations are implemented in the study courses *"Practical Analytical Chemistry"* and *"Chemical Technology"*, as well as by including some topics in the MSP *"Chemistry"* courses.

The content of the study courses is updated in line with the trends in the chemical industry, the labour market and scientific developments, which are discussed at regular meetings with industry representatives working in production companies and scientific institutions. The content of study courses is regularly revised and corresponds to the latest scientific trends in chemistry. For example, the study course *"Nanochemistry"* includes the latest information on the synthesis of various nanostructured materials, the study of their properties and prospective applications. The content of the study course *"Macromolecules"* includes the latest findings on radiochemical modification of polymer materials, which improves their physico-mechanical and physico-chemical properties. The study course *"Inorganic Chemistry II"* also examines the synthesis of inorganic polymers, the immobilization of inorganic compounds on polymer surfaces. Computational chemistry and computer modeling play an increasingly important role in the field of chemistry, these insights are included in the study courses *"Structure of atoms and molecules"*, *"Kinetics and*

*catalysis*", " *Computer Application in Chemistry*", " *Mathematical Processing and Modelling in Chemistry*".

Science is becoming more and more interdisciplinary and programs include several courses that provide knowledge on topics on the border of two or more natural science disciplines, e.g. "*Biological chemistry*", "*Introduction to material sciences*", "*Chemical technologies*", "*Principles of Food Chemistry*", "*Methods of Instrumental Analysis in Biology*". The frequency of updating (renewing) of course descriptions varies, being more frequent for Part B study courses than for Part A courses.

Student mobility is important for students to learn new skills, gain new experience in the organisation of the study process, and usually study modern and interesting courses. According to the Faculty's plans, it is planned that there are at least two outgoing students each year, but unfortunately this aim was not fully met. In 2013-2015, students were active, but two years in a row the nominated students had difficulties in their studies (because studies were in German and French) and they had to catch up when they returned. In the field of chemistry, the majority of bachelor programmes are in national languages and students are therefore most often required to use tutorials instead of lectures. Now, in recent years, it has been possible to establish contacts with the University of Thessaloniki, where lectures are also in Greek, but the lecturers are supportive and the students are successfully studying in English. So, there are hopes of expanding contacts.

The number of incoming exchange students is satisfactory. These are not only chemistry students, but also students of biology and other study programmes who choose to take chemistry courses. In general, lectures are not delivered in English, but laboratory works and seminars are bilingual. Students from Greece have already started to apply regularly for exchange studies. In 2022, an exchange student both studied and worked on her Bachelor's thesis. The "*Chemistry Eurobachelor*" quality label also contributes to the interest of exchange students in the study programme (see Annex 17 "Statistics on the outgoing and incoming mobility of BSP "Chemistry" and MSP "Chemistry").

**ANNEX 22B.** Compliance of the Bachelor's study programme "Chemistry"

with the State Education Standard

**ANNEX 23B.** Plan of Bachelor's study programme "Chemistry"

**ANNEX 24B.** Descriptions of courses of the Bachelor's study programme "Chemistry"

**ANNEX 25B.** Mapping learning outcomes of the BSP "Chemistry"

**3.2.2. In the 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. In the 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 (if applicable).**

**3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.**

During the study courses and examinations, both oral, written and combined study and assessment methods are used.

In order to achieve the learning outcomes - to acquire and consolidate knowledge, skills and develop competence - the study process uses a variety of knowledge acquisition and consolidation methods, such as introductory lectures, interactive lectures, and problem-oriented lectures. Practical assignments, seminars, individual, pair and group work, discussions and project development, laboratory work, study excursions to industry organisations are widely used. Employers are involved in the implementation and development of the study courses, e.g., in the course "*Practical Analytical Chemistry*" students regularly visit companies and some lectures are given by industry experts. The newly developed courses "*Quality Assurance in the Laboratory*" and "*Chemical Technology*" also plan to involve employers in the teaching of several topics.

Laboratory work plays an important role in chemistry education, accounting for almost half of the contact hours in the programme. This is necessary to foster students' practical and research skills. Students have the opportunity to gradually improve their knowledge and explore problems of their interest in depth in successive courses, e.g. in the compulsory part - the study courses "*Organic Chemistry I*" and "*Organic Chemistry II*" students acquire basic theoretical knowledge and practical skills, which are further developed in the elective course "*Preparation of Organic Compounds*" and finally both theoretical and practical skills are consolidated and applied in solving complex problems of the research project and bachelor thesis. In this way, students learn to organise their work, model situations and solve real problems in the field. In the seminars, students' speaking, presentation and discussion skills are promoted, e.g., in the courses "*Biological chemistry*", "*Introduction to Studies and Research*", Organic chemistry II etc.

In order for students to achieve the learning outcomes - to acquire and consolidate knowledge, skills and develop competence - the study process is dominated by methods in which student activity and mutual communication are important in the performance of study tasks, so different course tasks have to be performed in groups. The largest group assignment is the so-called literature synthesis in the courses "*Organic Chemistry II*" and "*Inorganic Chemistry II*", which is a group research project.

The physical environment of studies is also gradually changing: classrooms are easily transformable for group work, individual work, students can use digital technologies. The teaching staff mainly use methods that encourage students' active participation, critical thinking and reflection. The e-learning environment is used in the study process and to promote independent studies. Each study course has an e-learning environment (Moodle) where students have access to lecture materials, task descriptions in addition to course-related learning materials and study tasks (tests, forums, seminars, conferences, etc.). Interim tests and examinations can be provided in this environment, final assessment grades of the study courses are recorded, and each student can keep track of their results in the e-learning environment.

The use of information technology was particularly advanced during Covid-19 distance learning. The MS TEAMS environment was used for lectures, seminars, group work and discussions. It was applied to a wide variety of tasks up to virtual laboratory work.

The individual approach to each student is a key element in the implementation of the study programme, and this is manifested in several aspects. Firstly, students have the opportunity to consult individually with any member of the teaching staff at specified consultation times. In the first year, there is also a curator who helps students to settle into the study environment. Secondly, the use of e-learning also enables collaboration with students and lecturers. Teaching staff are obliged to regularly check their e-mail inboxes and answer students' questions. Thirdly, students have free access to the faculty's general staff, study methodologists and administration.

The student-centred approach is followed in updating the study programmes and the respective study courses, paying special attention to meaningful formulation of learning outcomes, thus promoting a dialogue between the teaching staff and students on the content of studies, forms and methods of organization. Well-formulated learning outcomes, on the other hand, promote students' understanding and co-responsibility for their own learning, self-assessment, and understanding of the assessment they receive. During the study process, lecturers use methods, examination forms and assessment criteria that are appropriate to the aim of studies and expected learning outcomes.

Students receive support and feedback from the lecturers during the study process. Grading criteria for marking are made public in advance. The assessment gives students an opportunity to demonstrate the extent to which they have achieved the expected learning outcomes.

Following the principles of student-centred studies, student mobility (recognition of learning outcomes) is promoted, students engage in academic research initiated by the academic staff, thereby gaining significant experience through testing gained knowledge and skills in practice. By implementing the internal quality assurance policy, study programmes are implemented to encourage students to actively participate in the improvement of the study process. There are procedures and regulations for submitting student proposals and complaints and reviewing student appeals. The results of student surveys are evaluated and taken into account for the improvement of the study process. Students willingly express their proposals for the improvement of study programmes and study process in discussions with the teaching staff and programme directors.

Independent or individual work plays an important role in the studies of students, the amount, content and type of control of which depend on the specific study course. Students' independent work is organised individually (in preparation for lectures, homework) and in small groups (seminar classes, group work, homework, presentations). Students are required to independently study the required literature specified in the course description, as well as to follow and read the latest publications and articles related to the course topics, work with e-learning environment, internet resources and other study materials, prepare reports or projects, presentations, etc. Thus, students acquire theoretical knowledge in lectures and independently, by exploring and analysing scientific literature, completing tasks assigned by the lecturer and other activities envisaged in the study course. Students are also offered opportunities to participate in research projects implemented at the Faculty.

The evaluation of study achievements is carried out in accordance with the requirements of the MoES and the UL: the Procedure for the Organisation of Study Course Examinations at the University of Latvia (Senate Decision No. 211 (29.06.2015)). Students' achievements are assessed according to the learning outcomes at two levels: (a) qualitative assessment - (grade on the 10 point scale); (b) quantitative assessment - number of credit points. Experts in the field are involved for the evaluation of the research project and bachelor thesis, and a specially developed form with

evaluation guidelines is used for reviewing theses. For the preparation, presentation and evaluation of the research project (course paper) and thesis, the Faculty of Chemistry of the UL has developed methodological guidelines, which include samples for the preparation of work plans, interim reports of students' work, as well as forms for reviews and evaluation guidelines (approved by the Faculty of Chemistry Council on 13.04.2022).

**3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).**

**3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).**

**3.2.6. 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 marks of the final theses.**

The Bachelor's thesis is the final stage of the Bachelor's study programme "Chemistry". Bachelor theses are developed in accordance with the Order of the University of Latvia "Requirements for the development and defence of final theses (bachelor, master, diploma and qualification theses) (Order of the UL 11.02.2020 No.1/454) and the Methodological Regulations for the preparation, presentation and evaluation of course papers and final theses approved by the Council of the Faculty of Chemistry" (2022). Bachelor theses are assessed by the Bachelor Final Examination Commissions. Two of them are set up: one for the defence of bachelor theses in the field of organic chemistry and the other for the defence of bachelor theses in the fields of analytical, physical and inorganic chemistry. Representatives of employers take part in the work of the commissions, together with the academic staff of the faculty.

The choice of the topics for the Bachelor's theses is made on an individual basis in consultation with the academic staff of the faculty. A large part of students choose the topic of their research work in the 5th semester in the study course "research project". At the same time, there are many students whose research work in one of the laboratories has already started in the 1st semester of studies, both at the UL and at scientific institutes (OSI, ISSP, ICP, etc.)

The bachelor thesis must meet the basic requirements of a scientific work:



- be a research study in one of the sub-disciplines of chemical science;
- the result must be based on data obtained in the experimental part of the thesis, on relevant literature, other sources of information and personal research;
- the research must be logical, sequential, generalisable and unambiguous.

During the reporting period (from the academic year 2013/2014 to the academic year 2020/2021), the graduates of the study programme have developed 286 bachelor theses in the research areas of the Faculty of Chemistry. Bachelor theses have been developed both at the FC of the UL and at other faculties and scientific institutes of the University of Latvia: the Institute of Organic Synthesis, the Institute of Wood Chemistry, production enterprises of a/s "Grindeks", a/s "Olainfarm" and other institutions, which are often the future workplaces of the graduates of the Bachelor programme. The research content of the bachelor thesis is most directly related to the research themes, projects, contract work of the faculty, as well as to other needs and current developments of companies where the bachelor student is usually already working.

Of the three most important areas of research work at the Faculty, as outlined in section 2.4 above, a very large number of bachelor theses are in the *Chemistry and Nanotechnology* area. Typical examples of bachelor theses in the sub-direction *Development of innovative functionalised or chemically modified materials and development of new analytical research methods* are:

- Preparation and characterisation of sulfonated poly(ether ether ketone) and modified illite clay mineral composite membranes (2017)
- Formation and analysis of solid solutions of selected pharmaceutically active substances (2018)
- Characterisation of partially strontium-substituted hydroxylapatite coatings (2018)
- Effect of ionic liquid structure on solvent properties (2020).

Examples of bachelor thesis topics in the sub-direction *Nanomaterials for Energy and Sensor Applications* are:

- Photo- and thermo-stimulated luminescence of nanostructured alumina doped with various element ions (2018)
- Synthesis and properties of graphene and bismuth selenide heterostructures (2018)
- Formation and characterization of doped and undoped bismuth selenide nanolaminates (2019).

Examples of titles of bachelor thesis in *Radiation Chemistry and Radiochemistry* are:

- Radiolysis of modified lithium orthosilicate minilayers (2015)
- Tritium accumulation in beryllium matter of the walls of the Joint European Thor vacuum chamber (2015)
- Tritium in beryllium materials of the Joint European Thorium Vacuum Chamber after the ITER-type wall campaign (2019).

In the second most important direction of the scientific research of the faculty, related to organic synthesis and research in the field of medicine and life sciences, bachelor theses are developed mainly at the Faculty of Chemistry and the OSI, e.g.

- Synthesis of polyaromatic and polydentate ligands and their use for porous metal-organic frameworks (2018)
- Electrochemically generated carbocation cyclisation reactions (2019)
- Synthesis of 3H-1,2-benzoxatetrapyrene-2,2-dioxide aryl derivatives (2019)
- Development of chiral C-2 symmetric pyridine-chain organocatalysts (2014)
- Synthesis of a 4-(dimethylamino)pyridine-modified zeolite-like imidazole scaffold (2017)

- Carbonylation of cobalt-catalyzed C(sp<sup>2</sup>)-H bond (2020).

In the *direction of development of innovative instrumental and analytical methods*, bachelor theses have been developed both at the FC of the UL and in cooperation with "BIOR" and the Faculty of Geography and Earth Sciences of the UL. Typical examples of such works are:

- Assessment of soil contamination with heavy metal elements in the vicinity of a rail-road (2018)
- Determination of bisphenol A in food contact materials and utensils (2019)
- Determination of chlorinated paraffins in baby food samples by liquid chromatography-high-resolution mass spectrometry (2020).

The bachelor theses have also been developed in cooperation with such Latvian research institutions as LSFI "Silava", Latvian Institute of Wood Chemistry, Latvian Institute of Hydro-ecology, Institute of Agresources and Economics, Stende and Priekulji Research Centres, Dobeles Institute of Horticulture. Examples of titles of such bachelor theses are:

- Application of a prediction model to the fermentation process of *Kluyveromyces marxianus* (2019)
- Use of non-polar solvents in pine bark for the production of lipophilic solvents (2019)
- Production of solid polyurethane foams for cryogenic thermal insulation from sustainable polyols (2020).

The topics of the bachelor theses are relevant to the title and content of the study programme, and the results of the research carried out by students are also topical in the field of chemistry. The results of research and projects presented in the theses demonstrate that the degree candidates have advanced knowledge in one of the fields of chemistry, the ability to independently obtain, summarise and interpret the results obtained, which allow them to carry out research activities and develop a research project at a high professional level.

The Bachelor's theses assessments (see Figure 3.1) show that graduates are able to demonstrate a high level of knowledge, skills and competence, in line with the requirements set for the Bachelor's thesis.

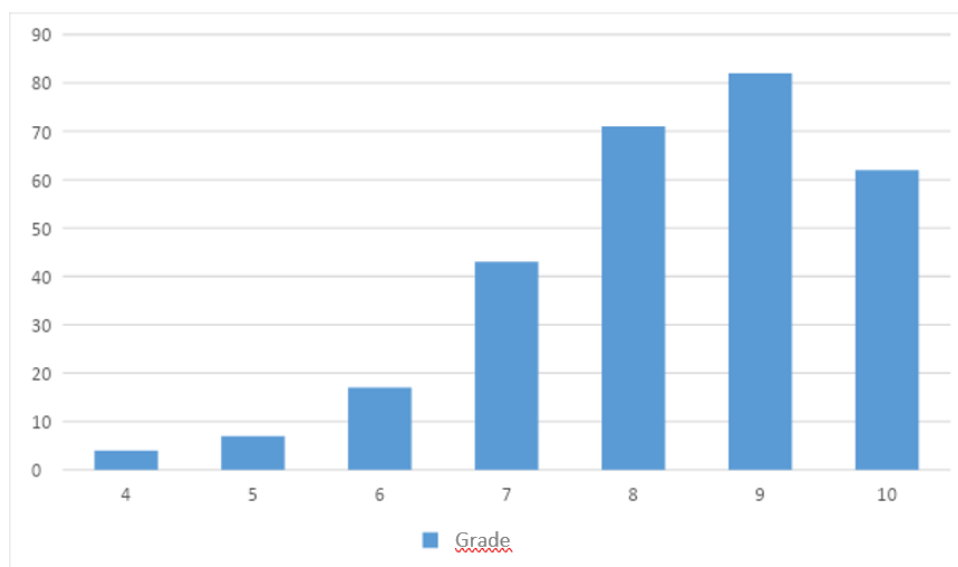


Figure 3.1. Assessments of Bachelor's theses from academic year 2013/2014 till academic year 2020/2021

In total, more than 90% of the bachelor's theses developed and defended during the reporting period were graded between 7 (good) and 10 (outstanding). A very small number of bachelor's

theses were graded with less than 7 points. Grades of the bachelor's theses by academic year are summarised in Figure 3.2. The analysis of the data shows that the overall quality of bachelor's theses, which is already quite high, has shown a slight upward trend since the academic year 2017/2018: there has been a slight increase in the proportion of bachelor's theses awarded 7 points or more. In the academic years 2019/2020 and 2020/2021, due to COVID-19 pandemic the bachelor's theses have been defended on-line remotely, and there have been various restrictions on working out the practical part of the bachelor's thesis. The analysis of the data shows that these difficulties have not, however, reduced the quality of the bachelor's theses produced and defended.

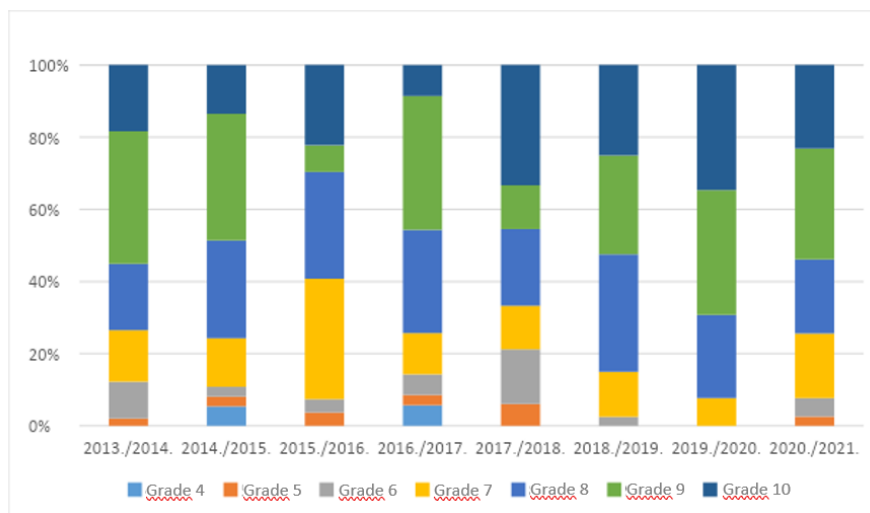


Figure 3.2. Assessments of Bachelor's theses from academic year 2013/2014 till academic year per academic year

All graduates have completed the survey on the final thesis in spring 2021. The supervisor's average score is 6.4 (on a 7-point scale), and students' own skills are rated at 6.1 on average. On average, students score 6.3 on their understanding of the requirements for a bachelor's thesis. The most emphasised aspect of the comments is the good cooperation with the supervisors.

The themes and quality of the bachelor's theses show that the outcomes of the study programme have been achieved and that the tasks of training specialists have been fulfilled.

### 3.3. Resources and Provision of the Study Programme

**3.3.1. 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.**

The University of Latvia has a modern material and technical base, which provides a high-quality advanced learning environment. Facilities and laboratory equipment of the Centre of Natural Sciences offer a wide range of research and learning opportunities for students. The total area of the Faculty of Chemistry is 1900 square metres, of which the teaching/learning and scientific laboratories occupy 1220 square metres. The student teaching/learning laboratories are equipped

with modern teaching equipment, including analytical balances, rotary evaporators, pH meters, TitraLab880 and Karl Fisher titrators, UNB500 thermostats, UV-ViS spectrometer Lambda 25, IR spectrometer FT-IR Frontier, air analysers (ozone analyser, NOx analyser, aerosol particle analyser) as well as various types of gas and liquid chromatographs and AutoLab potentiostats.

Chemistry students use the research infrastructure available at the FC, including a high-performance liquid chromatograph/mass spectrometer with a TOF detector (Agilent Technologies), inductively coupled plasma triple quadrupole mass spectrometer ICP-QQQ, differential scanning calorimeter, nuclear magnetic resonance spectrometer, isotope ratio elemental analyser, S8 Advanced and S8 Tiger powder X-ray diffractometers, TG/DTA600 thermogravimeter, Aminco Bowman AB-2 fluorescence spectrometer, etc. for laboratory work and especially for research (research project, bachelor's thesis). All study and research equipment available to students is given in Annex 13. "Summary of quantitative data on scientific and applied research activities in the reporting period.

Students of the study programme also have access to the extensive resources of the UL Science Library in Latvian, English and other languages. The Science Library and the adjacent Library of the House of Sciences are available 7 days a week, 24 hours a day, including during the summer. The Science Library has more than 100 workstations, including 20 computer workstations.

All study courses of the programme are provided with a wide range of textbooks. The stock of textbooks is gradually being restored. As can be seen in chapter 2.3.3. (tables 7. and 8.), a total of 526 new books have been purchased over the last ten years, of which 261 books are available in the Nature House library. Most of the books are in English. Older editions of books are also used in the basic chemistry courses, some of which are in Latvian. Lecturers in some study courses have also prepared appropriate theoretical and practical materials in Latvian available in e-studies..

In line with the UL Strategic Plan, the UL Library is increasing the share of e-resources and developing remote access to e-resources. In total, 37 e-resource platforms (both e-book platforms - VLeBooks, ProQuest Ebook Central and e-journal databases) are subscribed to by UL in 2021.

Multidisciplinary e-resources subscribed to by the LU, which include materials for direct use in the Bachelor's programme: Scopus, Scopus, Web of Science, ScienceDirect, Cambridge Journals Online, EBSCO Academic Search Complete, LVS Latvian Standards Online Reading Library, Oxford Journals Online, SAGE Journals Online, SAGE Research Methods - a research methods library with over 1000 books, SpringerLink Contemporary Journals, Taylor & Francis Social Science & Humanities Library. For a full list of e-resources subscribed to see <https://www.biblioteka.lu.lv/en/resources/subscribed-e-resources/>) see chapter 2.3.3.

The study courses in the study programme are created in the e-studijas.lu.lv Moodle environment. Materials necessary for studies, as well as instructions for successful course acquisition are regularly placed there; it is also the place for daily communication between students and the teaching staff. Interim tests and exams are created on e-studijas.lu.lv, as well as midterm grades are recorded and the final course grade is calculated. By logging in with the student profile details, students can keep track of their progress and the topical information.

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

**3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).**

### Revenues of the programme

To ensure the necessary funds for the implementation of the BSP "Chemistry", the University of Latvia uses:

- a state budget grant from the Ministry of Education and Science, which in the academic year 2021/2022 is 3097 EUR for full-time studies;
- tuition fee, taking into account all the factors referred to in the section "Financial support", which in the academic year 2021/2022 is 2200 EUR for full-time studies.

Taking into account the above, the total budget of the study programme is expected to be a bit more than 500 thousand EUR per year, the data are shown in Table 3.7.

Table 3.7.

*Estimated annual income of the BSP "Chemistry"*

Type of studies	LV state funded	LV for tuition fee	Total	State subsidy	For tuition fee LV and EU/EEA/Swiss citizens	Annual income
	Number	Number	Number	EUR	EUR	EUR
	1	2	3	4	5	1*4 + 2*5
FTS (Latvian)	158	17	175	3097	2200	<b>526 726</b>

**Program costs.** In order to estimate the amount of funds required for financial provision, the cost of study programmes at the University of Latvia is calculated according to the methodology developed by the UL, which takes into account the costs of study process support described in Section 2.3.1 "Financial Support" and information about the plan of the study programme, the involved teaching staff, the planned number of students, and other aspects, thus ensuring the reliability of the forecasts.

**The full-time study programme costs.** For calculations, the implementers of the study

programme BSP “Chemistry” use student data of the academic year 2020/2021 - 175 students study in the programme at the FTS, the existing plan of the study programme and the structure of the involved academic staff. Taking into account the above, the estimated full-time cost per full-time student of the program is 2978 EUR per year, and the total cost of the program 521150 EUR per year. A more detailed percentage cost breakdown is shown in Table 3.8.

Table 3.8.

*Percentage breakdown of costs in the BSP “Chemistry”*

Expenditure item	Percent of total
Teaching staff costs	43.7%
General staff costs	7.6%
Other payments	1.3%
Infrastructure expenditure	15.7%
Property and services	5.7%
Indirect costs	26.0%
<b>TOTAL COST</b>	<b>100%</b>

In Figure 3.3 the prime cost of the study programme is visually represented by the red line (vertical axis) depending on the number of students (horizontal axis), indicated average weighted tuition fee (green line).

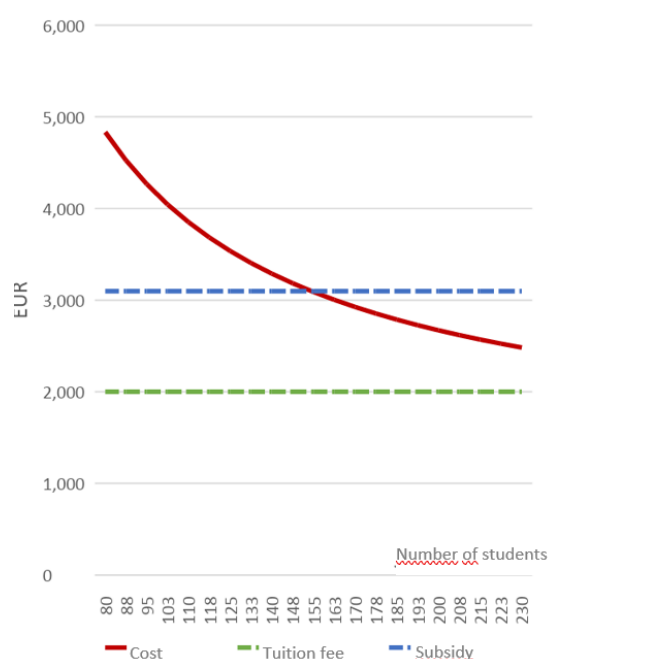


Figure 3.3. Prime costs per number of students of the BSP “Chemistry”

Based on the calculation, it can be seen that for the programme to be profitable and provide students with a quality study process, the number of state-budget paid students in the programme

(all courses combined) must be at least 156 (intersection of red (cost) and blue (tuition fee) lines projected on the x-axis).

### Summary of the revenue and expenditure of the programme

Table 3.9 summarizes the programme revenue based on the number of students, state subsidy and tuition fees, and the programme expenses for such a number of students.

Table 3.9.

<i>Results of the BSP "Chemistry"</i>					
Type of study	Total	Total revenue	Total expenditure	Result	Profability
	number	EUR	EUR	EUR	
FTS	175	526 726	521 150	5 576	1 %
Kopā	<b>175</b>	<b>526 726</b>	<b>521 150</b>	<b>5 576</b>	<b>1 %</b>

The data presented in Table 3.9 clearly show that the University of Latvia has sufficient resources to implement the bachelor study programme and ensure very minimal its further development. Increasing the number of students and tuition fees would be necessary to increase the cost-effectiveness of the study programme. In addition, the development of the study programme can be financed from the revenues received from lifelong learning and other services, as well as from the financial resources accumulated by the structural unit. Faculties also receive financial support for the development of programmes from the UL Study Quality Improvement Fund.

## 3.4. Teaching Staff

**3.4.1. 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.**

In academic year 2021/2020, 34 academic staff members from the Faculty of Chemistry, Faculty of Geography and Earth Sciences, Faculty of Biology, and Faculty of Physics, Mathematics and Optometry participated in the implementation of the BSP "Chemistry". In total, there are 4 professors, 10 associate professors, 9 assistant professors (docents), 2 lecturers, 7 researchers and 2 research assistants. This number does not include academic staff who only participate in the implementation of the programme as supervisors of Bachelor's theses. In many cases, several academic staff members jointly teach one course, e.g. in academic year 2021/2022, in the study course "General chemistry", lectures were given and seminars were led by assistant professor

I.Ancāne. Three groups were formed in the laboratory work of the course "*General Chemistry*", for which the laboratory work was supervised by assist.prof. I.Ancāne, V.Valkovska (lecturer) and PhD student (K.Saršūns). In the study course "*Methods of Instrumental Analysis*" lectures were given by prof. A.Vīksna, and laboratory work was supervised by assoc. prof. V.Rudoviča and lecturer Z.Balcerbule. Similar examples are found in practically all study courses, which include lectures and seminars as well as laboratory work.

In the study program prepared for accreditation, the number of optional courses has been expanded and the number of lecturers has increased. Involved staff are the following: 7 professors, 5 of whom are teaching elective courses and one of whom is planned as visiting professor from Vilnius University; 9 associate professors, 7 assistant professors, 8 lecturers and 4 researchers. The number of elected professors and associate professors (15 in total) fully complies with the Law on Higher Education Institutions Article 55.1.3 which defines that *the number of professors and associate professors in the implementation of the compulsory part and the restricted elective part of the academic study programmes shall not be less than five professors and associate professors in total who are elected to the academic positions of the respective higher education institution*. See Annex 20B "Conclusion of the Council of Higher Education on the Bachelor's programme "Chemistry"" and Annex 26B "Certification that the staff of BSC "Chemistry" meets the requirements of Article 55.1.3 of the Law on Higher Education".

Highly qualified teaching staff, leading specialists in the field of chemistry are involved in the implementation of the programme: full member of the LAS, professor D.Erts, professor of Analytical Chemistry V.Bartkēvičs, professor of Analytical Chemistry A.Vīksna, professor of the Faculty of Biology K.Tārs, as well as young and talented scientists, e.g. associate professor A.Bērziņš, associate professor E.Pajuste, associate professor V.Rudoviča, assistant professor A.Kinēns, etc. Researchers L.Ansons-Bērtiņa, T.Rēķis, M.Bērtiņš and lecturers L.Buša, M.Feldmane, V.Valkovska will be additionally involved in the teaching courses of the new study plan.

The qualifications and scientific interests of the teaching staff correspond to the study courses taught. For example, professor D. Erts is one of the leading specialists in the field of nanochemistry, manager of many projects, and he teaches the course "*Nanochemistry*". Assoc. professor E. Pajuste carries out her scientific activities in the field of physical chemistry, in the sub-field of radiation chemistry, which corresponds to her study course "*Energy Containment Chemistry*" and "*Computer use in chemistry*". One of the areas of scientific activity of assistant professor I. Reinholds is the research of polymer materials, which is directly related to the study course "*Macromolecules*" and "*Introduction to Materials Science*". Professor A. Vīksna is one of the leading specialists in the field of analytical chemistry in Latvia and his scientific activity is closely related to the study course he teaches "*Methods of instrumental analysis*" etc.

Knowledge of the national language and English of all the teaching staff meets the requirements (see Annex 11 "Certificate of lecturers' knowledge of the national language" and Annex 12 "Certificate of lecturers' knowledge of English". The high qualifications of the teaching staff make it possible to fulfil points 4 and 5 of the Regulation on the national academic education standards:

- the main aim of the Bachelor's study programme is to provide a set of knowledge, skills and competences in accordance with the knowledge, skills and competences of level 6 of the Latvian Framework of Education;
- the content of the bachelor's study programme shall ensure the achievement of scientifically sound results of a wide range of studies.

The qualifications of the academic staff contribute to achieving the results of the BSP "Chemistry", as they are dominated by the highest qualified teaching staff - professors, associate professors and assistant professors. Academic staff are specialised in various subfields of chemistry (analytical



chemistry, organic chemistry, physical chemistry, inorganic chemistry, chemistry of macromolecular compounds, environmental chemistry, food chemistry), as well as in other branches of science (physics, mathematics, biology, environmental science), which makes it possible to provide students with the latest scientific knowledge and up-to-date practical skills in a wide spectrum of natural sciences. 73% of the staff members have a doctor degree.

It is also important that the number of assistant professors, researchers and research assistants includes a large number of young faculty members, who will form the future succession of professors, associate professors and assistant professors.

**The qualifications of the selected teaching staff allow to ensure a qualitative study process and the achievement of the objectives and outcomes of the study programme.**

**ANNEX 26B.** Annex 26B .Confirmation that the academic staff of BSP "Chemistry" meets the requirements set out in the third paragraph of the first part of Article 55 of the Law on Higher Education

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

During the reporting period, the qualification of the teaching staff involved in the programme has increased significantly, as has the number of teaching staff. During the accreditation period, the number of teaching staff has been renewed, due to both the generational change of the academic staff and the need to improve and modernise the quality of the study programme. Since the previous accreditation (2013), seven lecturers from the Faculty of Chemistry and four lecturers from other faculties are no longer involved in the teaching of the programme courses. The programme has been supplemented by 14 new lecturers.

During the reporting period, several members of the teaching staff have improved their qualifications and were elected to higher positions: V. Bartkevičs, D. Erts - as professors, G. Vaivars, V. Rudoviča, L. Orola, A. Bērziņš, E. Pajuste - as associate professors, I. Reinholds, A. Kinēns - as assistant professors. All of them are recognized experts in their field, which is indicated by high quality publications, participation in projects, as well as the rights of LAS expert in the field of chemical science. Newly elected lecturers K. Parasiga-Parasiņa, L. Buša and V. Valkovska and M. Feldmane have also started their academic work. The number of the teaching staff involved in the implementation of the Bachelor's programme in 2021/2022 in the basic courses from the Faculty of Biology, Faculty of Geography and Earth Sciences and Faculty of Physics, Mathematics and Optometry has not changed numerically, but there has been a generational change and the relevant study courses are taught by younger generation lecturers (assist.prof. I. Dauškane, assist. prof. R. Bēts, researcher L. Ansone-Bērtiņa, assoc. prof. A. Šarakovskis).

The plan of the study programme for accreditation includes new study courses taught by faculty members not only from the Faculty of Chemistry, but also from other faculties, such as professor K. Tārs from the Faculty of Biology. The programme plans to have one guest professor in the study course "*Nanochemistry*", Professor A. Ramanavicius (Vilnius University), with whom a productive cooperation has been established since 2019. The programme has also added lecturers for elective courses in social sciences and humanities. The addition of the teaching staff compared to the academic year 2021/2022 is shown in Table 3.10.

*Table 3.10.*

*Teaching staff who are involved in the teaching of study courses of the BSP "Chemistry" for the first time as of academic year 2023/2024*

<b>Name, surname</b>	<b>Academic position</b>	<b>Study course</b>
Linda Ansone-Bērtiņa	Researcher	Environment Protection
Daiga Āboltiņa	Lecturer	Project Management Fundamentals
Vadims Bartkevičs	Professor	Principles of Food Chemistry
Māris Bērtiņš	Researcher /PhD student	Quality Assurance in the Laboratory
Henrijs Kalķis	Professor	Business Management and Entrepreneurship
Alla Plaude	Assistant professor	Emotion and Communication Psychology
Kaspars Tārs	Professor	Methods of Instrumental Analysis in Biology
Lauma Buša	Lecturer	Analytical Chemistry I and II
Toms Rēķis	Researcher	Physical Chemistry I
Māra Feldmane	Lecturer	Kinetics and Catalysis
Valda Valkovska	Lecturer	Chromatography Methods General Chemistry

In general, all lecturers in the programme have been elected to academic positions, which shows the quality of selection. Therefore, it can be concluded that the changes in the number and structure of the teaching staff involved in the programme are positive and the quality of education is being increased, as the academic staff involved in the programme are qualitatively and quantitatively able to ensure the achievement of the objectives of the study programme.

**3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of 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 or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).**

**3.4.4. 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).**

**3.4.5. 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 programme and 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).**

Regular cooperation among the teaching staff takes place to foster the development and interconnection of study courses. This is also facilitated by the fact that in many cases several teaching staff jointly teach the same course. Proposals for improving the study process (course content development, e-learning environment, etc.) are discussed and considered at the meetings of the Board of Study Programmes and, since May 2020, at the meetings of the Study Field, taking into account students' evaluation of the study courses and current scientific trends.

The programme management also facilitates the cooperation of the teaching staff by regularly meeting and/or communicating electronically with them to discuss and coordinate the study process. Issues connected with the study process are discussed in individual conversations, in the chairs and periodically in the Study Field Council.

If students' suggestions are made in discussion with the programme director or head of chair and concern the teaching of a particular study course, the lecturer of that course is informed at the beginning and the comments made by the students are evaluated and solutions are sought for the improvement of the course.

If several lecturers teach the same study course, one of them is responsible for updating the content in the LUIS system, as well as for coordinating the topics and time allocations according to the course description and other topical issues.

Cooperation among the teaching staff is important for the achievement of outcomes of study courses, for example, in the laboratory work of the study course "*Inorganic Chemistry II*", students synthesise inorganic compounds. For the determination of their qualitative composition, the course lecturer organises cooperation with the lecturers of the study course "*Analytical Chemistry II*", while for the identification of the resulting crystalline compounds by X-ray analysis, additional cooperation with the lecturers of the study course "*Physical Chemistry*" is organised.

In the academic year 2021/2022, 34 lecturers were involved in the implementation of the BSP "Chemistry", which represents a student-teaching staff ratio of 5.1 students per lecturer. However, in practice the ratio is higher, as not all study courses of the restricted elective part are taught each

year. Most of the teaching staff also participate in the implementation of other study programmes at the Faculties of Chemistry, Medicine, Biology and others.

# Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	19_B_A sample of the diploma and its annex to be issued for completing the study program.docx	19_B_Diploms_un tā pielikums.docx
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)	20_B_Conclusion of the Council of Higher Education.docx	20_B_Augstākās izglītības padomes_atzinums_Augstskolu likuma 55.pants.pdf
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	21_B_Statistics on students during the review period.pdf	21_B_Statistika par studentejiem paskata perioda.pdf
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard	22_B_Compliance of the study program with the national education standard.docx	22_B_Studiju programmas atbilstiba valsts izglitibas standartam.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (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	25_B_Mapping of study courses for achieving the study results of study programs.xlsx	25_B_Studiju kursu kartejums studiju programmas studiju rezultatu sasniegšanai.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	23_B_Study program plan.pdf	23_B_Studiju programmas plans.pdf
Descriptions of the study courses/ modules	24_B_Descriptions of study courses.docx	24_B_Studiju kursu apraksti.docx
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	26B_AL_55.3_pants_Apliecinajums_veidlapa_ENG.edoc	26B_AL_55.3_pants_Apliecinajums_veidlapa_LV_2022.edoc