APPLICATION

Study field "Physics, Material Science, Mathematics, and Statistics" for assessment

Study field	*Physics, Material Science, Mathematics, and Statistics*
Title of the higher education institution	*Latvijas Universitāte*
Registration code	*3341000218*
Legal address	*RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050*
Phone number	*67034301*
E-mail	*lu@lu.lv*

Self-evaluation report

Study field "Physics, Material Science, Mathematics, and Statistics"

University of Latvia

Table of content

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 University of Latvia is expressed in its motto *Scientiae et Patriae* (For Science and Fatherland). The University of Latvia (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. The activities of the University of Latvia form the basis for the sustainable development and economic transformation of the Republic of Latvia.

Values:

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

The University plays an important 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 University 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 University of Latvia focuses its efforts on providing quality studies and developing scientific excellence, creating structures open to interdisciplinary and transdisciplinary research and studies, ensuring high return on invested resources, sustainable and environmentally friendly use of resources. The University 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, Kuldiga, Madona and Tukums.

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

The UL offers study programmes at all levels, covering 28 branches of science and 22 fields of study. The UL 13 faculties offer 140 study programmes. See Table 1 for the fields of study, the number of study programmes and the accreditation periods.

Table 1.1.1.

Study fields, 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	3	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.

No	Study fields	Number of study programmes	Accreditation period
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.

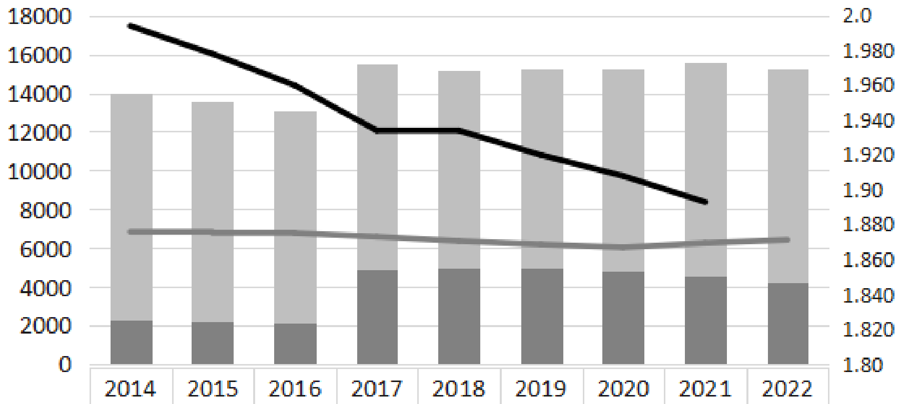
Table 1.1.2.

Number of study fields and study programmes implemented in the regional branches of the University of Latvia, 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 1st, 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.



	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of students studying full-time at UL	11715	11360	10967	10630	10203	10240	10457	11054	11023
Number of students studying part-time at UL	2305	2240	2133	4870	4997	5010	4803	4536	4227
Number of students studying on budget at UL	6837	6784	6768	6583	6359	6181	6029	6253	6417
Population in Latvia (million)	1.994	1.978	1.960	1.934	1.934	1.920	1.908	1.893	

Fig. 1.1.1. Number of students at the University of Latvia against the population of Latvia, 2014-2022

The UL medium-term development strategy for the period from 2021 to 2027 (UL Strategy 2027) was approved on June 28, 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 University of Latvia, the mission of the University of Latvia 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 organizational culture, environment and governance. The UL Strategy 2027 envisages the further development of the University 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 University continues the work initiated in the previous strategic period to achieve the highest level of scientific excellence, as well as to promote student-oriented studies and develop a modern study environment. The involvement and contribution of the University to the society of Latvia is being purposefully promoted. The University is improving the working conditions and environment necessary for talent development. Sustainable growth is playing an increasingly important role and is becoming a cross-cutting principle in all its areas of activity. Significant attention is paid to ensuring academic integrity and strengthening the value-oriented organisational culture of the University. See Table 3 for the current strategic goals and development directions of the University.

Table 1.1.3.

UL Strategic Goals Map, 2021-2027

Development directions	*Strategic goals*
DEVELOPMENT OF PRINCIPAL ACTIVITIES	
1.V. Scientific excellence	1.M. Internationally recognized research university
2.V. Development of studies	2.M. Unique study offer and high competitiveness of graduates
3.V. Contribution to society	3.M. University activities as a basis for the growth of Latvia
INSTITUTIONAL DEVELOPMENT	
4.V. Talent development	4.M. Development- and excellence-oriented HR policy
5.V. Environment and governance	5.M. Green thinking, attractive, sustainable university environment and effective administrative support
6.V. Organisational culture	6.M. Inclusive, cooperation- and innovation-focused culture

The outcomes of the implementation of the UL Strategy 2027 will be measured by twenty-one performance indicators, five of which have been designated as UL Key Performance Indicators (KPIs). - These 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 commercialization 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%

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

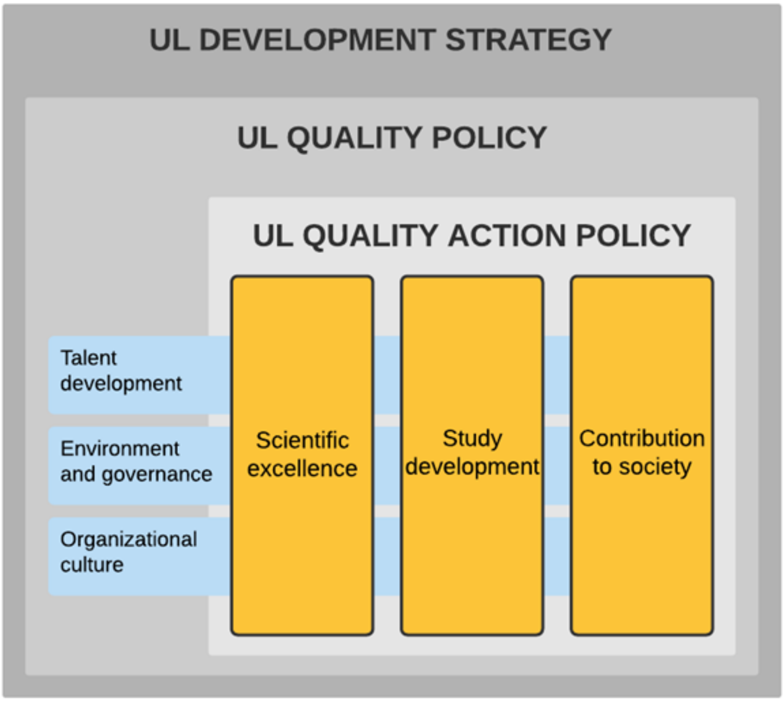


Figure 1.3.1. UL Quality Management System and Principles of the Quality Assurance System

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*)

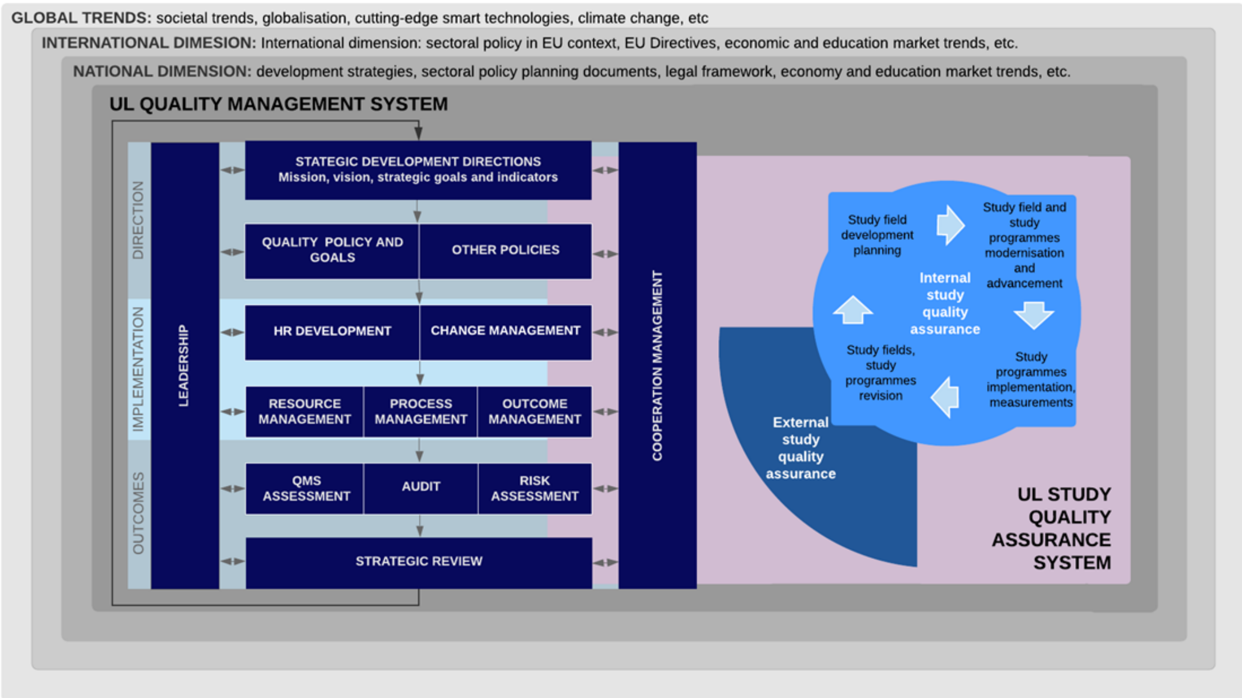


Figure 1.3.2. UL Quality Management System and Principles of the Quality Assurance System

To ensure the quality of higher education, the University of Latvia 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 national legislation, the European Standards and guidelines for quality assurance in the European Higher Education Area (ESG), as well as for internal needs. The University of Latvia provides planning for the development of the study field and improvement of the existing study programmes for a period of 6 years. The procedure for the implementation of study programmes is laid down in the internal legal acts of the University, including 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 placements, organization of examinations and final examinations, rotation, the principles of academic integrity and their observance, matriculation, issuance of diplomas and certificates, recognition of previous education or professional experience, the procedure for conducting surveys, submission of student proposals and complaints, contestation of administrative decisions, doctoral dissertation promotion process, etc. The University 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, to the UL Strategic Action Plan. For more information on quality assurance of studies, see Section 3.1 of the *UL Quality Management System Manual*. 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 University's 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 main stakeholders are defined in point 12 of the *UL Quality Policy*. For the description and examples of the roles of key stakeholders in quality management, see Section 3.2, sub-section 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.	The UL has formulated the Quality Policy, which is detailed in the Quality Action Policy in line with its strategic core activities. 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) 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.

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.	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. 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.
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.	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. 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.
4.	Internal procedures and mechanisms for assuring the qualifications of the academic staff and the work quality have been developed.	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.

5.	The higher education institution/ college ensures the collection and analysis of the information on the study achievements of the students, employment of the graduates, satisfaction of the students with the study programme, efficiency of the work of the academic staff, the study funds available, and the disbursements thereof, as well as the key performance indicators of the higher education institution/ college.	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. 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. 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.
6.	The higher education institution/ college shall ensure continuous improvement, development, and efficient performance of the study field whilst implementing their quality assurance systems.	The development of each study field is planned in accordance with the 6-year development strategy of the University. The monitoring of the plan and the evaluation of its effectiveness are carried out within the frame-work of the annual self-assessment of the study field. These processes take place at the level of the 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. The UL provides the external evaluation required by the legislation, ob-taining additional external quality certificates for individual programmes. For more information, see Part II, Section 2.4 of this report. To promote the quality and competitiveness of the study programmes of the University of Latvia, the University of Latvia creates and finances internal grant projects (University of Latvia Study Quality Improvement Fund), as well as attracts external funds (European Social Fund (https://www.ozolzile.lu.lv/projekti/eiropas-socialais-fonds/), Erasmus+ (https://www.ozolzile.lu.lv/projekti/erasmus/)).

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.

Abbreviations

PBSPMS – Professional Bachelor Study Programme “Mathematician Statistician” (42460)

ABSPP – Academic Bachelor Study Programme “Physics” (43443)

ABSPM – Academic Bachelor Study Programme “Mathematics” (43460)

AMSPP – Academic Master Study Programme "Physics" (45443)

AMSPM – Academic Master Study Programme “Mathematics”, the new name for accreditation “Mathematics and Data Science” (45460), abbreviation AMSPMDS

All abbreviations are included in the section "Other Annexes" under the heading “Abbreviations used in the self-evaluation report”.

Study field PMSMS has six study programmes shown in Table 2.1.1.1.

Table 2.1.1.1

Study field PMSMS study programmes

1. Professional Bachelor’s Study Programme “Mathematician Statistician”	
LRI code	42460
Duration and extent	4 years, 160 KP
Type and form of studies	Full-time
Language of study	Latvian
Degree and/or qualification	Professional bachelor's degree in Statistics Mathematics, Statistics Mathematician qualification
Requirements for admission	Secondary school education
Place	UL FPMO
2. Academic Bachelor’s Study Programme “Physics”	
LRI code	43443
Duration and extent	3 years, 120 KP
Type and form of studies	Full-time

Language of study	Latvian
Degree and/or qualification	Bachelor’s degree of Natural Sciences in Physics
Requirements for admission	Secondary school education
Place	UL FPMO
3. Academic Bachelor’s Study Programme “Mathematics”	
LRI code	43460
Duration and extent	3 years, 120 KP
Type and form of studies	Full-time
Language of study	Latvian
Degree and/or qualification	Bachelor’s degree of Natural Sciences in Mathematics
Requirements for admission	Secondary school education
Place	UL FPMO
4. Joint Academic Master Study Programme "Physics"	
LRI code	45443
Duration and extent	2 years, 80 KP
Type and form of studies	Full-time
Language of study	Latvian, English
Degree and/or qualification	Master’s degree of Natural Sciences in Physics
Requirements for admission	Bachelor's degree or a second-level professional higher education (or equivalent higher education) in physics or mathematics or bachelor's degree or a second-level professional higher education (or equivalent higher education) in a natural sciences or engineering and technologies and the successful completion of courses of study in physics (at least 5 credits) and mathematics (at least 4 credits) attested by a diploma or other educational document. Studies in English require English language skills at least at B2 level.
Place	UL FPMO and Daugavpils University

5. Academic Master Study Programme “Mathematics”, the title of the study programme for accreditation “Mathematics and Data Science”	
LRI code	45460
Duration and extent	2 years, 80 KP
Type and form of studies	Full-time
Language of study	Latvian, English
Degree and/or qualification	Master’s degree of Natural Sciences in Mathematics
Requirements for admission	Bachelor's degree or a second-level professional higher education (or equivalent higher education) in mathematics or bachelor's degree or a second-level professional higher education (or equivalent higher education) in natural sciences or engineering and technologies, or in social sciences and successful completion of study courses in mathematics (at least 8 credits) attested by a diploma or other educational document. Studies in English require English language skills at least at B2 level.
Place	UL FPMO

6. Joint Doctoral Study Programme “Particle Physics and Accelerator Technologies”	
LRI code	51443
Duration and extent	4 years, 192 KP
Type and form of studies	Full-time
Language of study	Latvian, English
Degree and/or qualification	Doctor of Science (Ph.D.) in Mechanical Engineering and Mechanics or Doctor of Science (Ph.D.) in Physics and Astronomy
Requirements for admission	Master of natural sciences or engineering, or comparable education. Studies in English require English language skills at least at B2 level.
Place	UL FPMO and RTU Center of High Energy Physics and Accelerator Technologies

Of these six study programmes, the Academic Master's Study Programme “Physics” is reorganised under the 8.2.1.0/18/A/015 project implemented by UL, “Creating internationally competitive and Latvia economic development-enhancing study programmes at the University of Latvia”, and is licensed in 2021 as a joint study programme with Daugavpils University. The doctoral study programme “Particle Physics and Accelerator Technologies” is a new programme, it is a joint doctoral programme with Riga Technical University.

The 2013 accreditation in the field of studies, PMSMS, includes two other doctoral programs, “Physics, Astronomy and Mechanics” and a doctoral program called “Mathematics.” The two study programmes will be closed by the end of 2023, because the 8.2.1.0/18/A/015 project implemented by UL, “Creating internationally competitive and Latvia economy-enhancing research programmes at the University of Latvia”, has created two new wider doctoral studies programmes, “Natural Sciences” and “Computer Science and Mathematics”, which include the doctoral study program “Physics, Astronomy and Mechanics” and the doctoral study program “Mathematics”, and these consolidated doctoral programs are in other fields of study. During the reporting period, both doctoral programmes have worked successfully and have contributed significantly to the development of physics and mathematics in UL.

UL has defined its mission, vision as well as UL Development Directions and Strategic Goals in UL Strategy 2021-2027. It was developed on the basis of a vision of UL management, employees, students and the public on the needs and trends of institution, society and economic development. The same principles and the priorities identified by UL were used to define the objectives of the field of study (FS). The objectives of the FS are based on the Latvian and international developments in the relevant science fields of the FS and on the international topics of the academic environment and higher education. The objectives of the FS are structured according to six UL developments under the operational and institutional development sections. The objectives highlight the priorities of the FS within the framework of the UL Strategic Goals, focusing on the challenges facing the FS level. The defined objectives are considered in Table 2.1.1.2.

Table 2.1.1.2

Objectives of the field of study and their relevance to the Development and Strategic Goals of UL

No.	UL Development Directions	UL Strategic Objectives	FS targets
Development of core activities			
1	Science excellence	University as an internationally recognised science centre	Ensure international visibility of directional studies and international recognition of study programmes
2	Development of studies	Unique offering of studies and high graduates' competitiveness	Implement personalised, inclusive, student-oriented and science-based studies
3	Investment in society	University action as the basis for Latvia's growth	Develop a field of study as a knowledgeable, trusted and supportive partner for Latvian society
Institutional development			

4	Talent development	Development and excellence-oriented personnel policies	Directing staff towards excellence and cooperation in science, industry, teaching and teacher training
5	Environment and management	Green thinking, attractive, sustainable university environment and effective administrative support	Ensuring an open, collaborative and creative learning and research environment
6	Organisation culture	An inclusive, collaborative and innovation-oriented culture	Promoting innovation for the development of studies and research

The interlinking of the six programmes covered by the FS can be characterised by a number of aspects. In terms of administration, all programmes are carried out within the framework of one UL basic body FPMO. This means that it is easier to link the objectives and priorities of the FS and its programmes to the objectives and priorities of the faculty. It should be noted that two of the programmes are shared with other universities, thus including additional administrative steps in the management of the programmes. Thematic programmes can be divided into two study fields: mathematics and physics. The nature of each sector ensures continuity at all levels of study, thereby providing students with opportunities for consecutive studies up to doctoral studies. On the doctoral level, it should be noted that, as regards the choice of UL to consolidate doctoral programmes, the doctoral programmes covering the broader fields mathematics and physics, “Computer Science and Mathematics” and “Natural Sciences” are being monitored within the framework of others, while the academic staff and capacity of the IU ARE closely involved in their implementation.

Programmes also have significant content linkages. ABSPM and PBSPMS have a series of common courses at the beginning of studies. Physics programmes, meanwhile, have the largest volume of mathematics courses among all UL study programs, not counting the mathematics programmes themselves, which also means overlapping academic staff. Students also assess content linkages and, with the support of study programme directors, tend to choose study courses from other programmes of FS PSMS in a limited part of their choice, or, even at the next level, choose to study in the study programme of the other sector. The programmes are thus closely linked, both administratively and thematically and in terms of content, which provides ample opportunities for effective, interdisciplinary and innovative implementation of the FS PMSMS.

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.

On the basis of an analysis of the SWOT, the FS Development Plan for 2021-2027 (Annex 2.1) has been drawn up to meet the objectives. It consists of general tasks and more specific sub-tasks defined to achieve each objective, including the responsible people. To check whether sub-tasks will be achieved, the indicators to be reached and the corresponding values will be formulated at the beginning and after 3 and 6 years. Where possible, the indicators are linked to the performance indicators identified in the UL strategy.

Developing the FS targets, the Development Plan and the SWOT was carried out in several steps. Initially, a working group set up by the directors of the programmes and the heads of the corresponding departments, accompanied by an industry representative, prepared draft documents. These were discussed in several iterations in both the Development Plan Working Group and the SWOT Analysis Working Group and the FS Council. The Development Plan was then also discussed with representatives of the Academic Department and student representatives from the Physics, Mathematics and Optometry Faculty (FPMO) Student Councils. The discussion of draft documents at the meeting of the FS Council followed. In each of the steps, recommendations, notes and critical remarks were used to improve documents. The final version of the development plan was approved by the FS Council on 31.01.2022and FPMO Council on 02.02.2022.

The study field SWOT analysis is shown in Table 2.1.2.1.

Table 2.1.2.1

Study Field SWOT Analysis

Internal factors	
Strengths	**Weaknesses**

1 Study Field combines major physics and mathematics study programmes in Latvia, and their teaching staff are the country's leading specialists/scientists, including international experience 2 Research environment and infrastructure are among the most advanced in Europe 3 Students already have the opportunity to gain employment experience in their speciality. This is supported by practice-oriented study courses integrated into programmes 4 Experience in the development of a science-based, student-oriented approach and active training methods, validated in individual study courses 5 A sufficient percentage of junior-generation teaching staff 6 In the framework of study programmes, extensive learning of digital skills, in line with job demand 7 Active cooperation with teachers in the relevant study fields and their organisations in promoting student engagement	1 The small number of students, high drop-out rate, small number of graduates make it difficult to develop study programmes 2 Recruitment of teaching staff with international experience (including attending professors) 3 Insufficient activity in public relations and marketing communications during the previous reporting period 4 Small number of foreign students 5 Age structure of professors (high proportion of professors is in retirement/pre-retirement age) 6 Poor opportunities for inter-sectoral studies
External factors	
Opportunities	**Threats**
1 Developing closer links with high-level research in the relevant industries in Latvia, benefiting from close placement with virtually all research institutes in Latvia 2 The involvement of graduates, employers, foreign research partners and academics in improving the content of study programmes, promoting content in line with labour market demand and trends, and promoting inter-disciplinarity. 3 Implementation of Master's degree programmes in English 4 Improve communication with the public in order to promote awareness and reputation of study programmes in Latvia 5 Involvement in the development of joint and joint diploma programmes with foreign and Latvian universities	1 Poor training of high-school graduates in mathematics and physics 2 Precarious and unpredictable political, strategic, informative and financial support for higher education and research 3 Increased choice of potential students in favour of studies in foreign universities. 4 Low public awareness of needs and targets for STEM higher education 5 The funding of studies does not allow adequate remuneration of some of the essential teaching staff obligations

Abbreviations used:

PDFS - Plan for the development of the field of study

PDFS 2.1, PDFS 2.4.3 – PDFS tasks/sub-tasks accordingly

The following are the measures which, as appropriate, mitigate or eliminate the impacts of weaknesses and threats on the field of study, using the strengths and opportunities.

Weaknesses

1. **Small number of students, high drop-out rate, small number of graduates make it difficult to develop study programmes**

A planned package of measures to ensure and/or promote the following, according to PDFS 2.1.2, 2.2, 2.3, 2.4.3, 3.1:

- different forms of study according to the needs of students,
- inclusive studies,
- student-centred study process,
- request for higher-level studies,
- active cooperation with schools, pupils and teachers

In general, it will promote study programmes, promote student satisfaction with studies, directly and indirectly contributing to the increase in student numbers, by reducing drop-outs resulting in an increase in the number of graduates.

Strengths **1, 2, 3, 4, 6, 7** and opportunities **2, 3, 4** will be used to tackle the weakness.

2. **Recruitment of teaching staff with international experience (including professors)**

PDFS 1.1.1 is intended to ensure that the academic staff of the FS is complemented with internationally recognised specialists.

Strengths **1, 2, 5** and opportunities **1, 3** will be used to tackle the weakness.

3. **Insufficient activity in public relations and marketing communications during the previous reporting period**

A planned package of measures to ensure that, according TO PDFS 3.1, 5.1.2, 5.2, there is

- active cooperation with schools, pupils and teachers,
- the timely and accurate circulation of inside information,
- inter-institutional cooperation.

This will improve the circulation of internal and external information, including giving pupils and teachers more accurate information on study opportunities and the employment of graduates.

Tackling the weakness will take advantage of the strength **7** and opportunity **4.**

4. **Small number of foreign students**

Next to the AMSPP and AMSPMDS, the opening of the English flow will provide a package of measures for PDFS 1.2: promoting the international visibility of studies.

Strengths **1, 2, 3, 4** and opportunity **3** will be used to tackle the weakness.

5. **Age structure of professors (high proportion of professors is in retirement/pre-retirement age)**

A planned package of measures that, according to PDFS 1.1, 2.4, 4.1, contributes indirectly to the growth of teaching staff, which may result in young professors (including associate professors):

- promoting the development of internationally recognised research,
- science-based studies (attracting industry professionals from researchers),
- improved staff teaching skills.

In addition, PDFS 1.1.1 is directly intended to provide the development of the academic staff of the FS with internationally recognised specialists, including by promoting the growth of local staff members.

Strength **5** and opportunity **1** will be used to tackle the weakness.

6. **Poor opportunities for cross-sectoral studies**

Mechanisms for informing students about and choosing related sectoral courses will be defined and implemented, including recommending cross-disciplinary courses, as provided for in PDFS 2.1.1. The measures envisaged in PDFS 2.4.2 5.2 will indirectly improve the situation by supplementing the study programmes with interdisciplinary courses, by reinstating the content of programmes where the content of study courses is determined as a result of inter-institutional cooperation.

Strengths **3, 5** and opportunities **1, 2, 5** will be used to tackle the weakness.

Threats

1. **Poor training of high-school graduates in mathematics and physics**

Feedback will be developed on the knowledge of school graduates, PDFS 3.1.1, by providing schools with information on the knowledge of school graduates in physics and mathematics and by encouraging secondary schools to take concrete steps to improve graduates' preparedness.

The strength **7** and opportunity **4** will be used to mitigate the threat.

2. **Unstable and unpredictable political, strategic, informative and financial support for higher education and research**

It is planned to engage in activities in cooperation with society and the ME, which informs the importance of higher education and research for the development of a modern, economically strong society, as envisaged in PDFS 3.3.1

Opportunity **4** will be used to mitigate threats.

3. **Increased choice of potential students in favour of studies in foreign universities.**

Teachers and potential students will be informed, within the framework of PDFS 3.1, about the capacity of UL (“UL – your closest abroad”) and the benefits of the FS study programmes.

For the mitigation of threat, the strengths **1, 2, 3, 4, 7** and opportunities **1, 3, 4** will be used.

4. **Low public awareness of needs and targets for STEM higher education**

The public will be informed of the achievements of the FS graduates by targeting and actively participating in the production of popular scientific publications and radio/TV programmes, the “Night of Scientists” events, and by placing information on the social networks on the activities of the FS, as provided for in PDFS 3.3.

The strength **1** and opportunities **1, 4, 5** will be used to mitigate the threat.

5. **The funding of studies does not allow adequate remuneration of some of the**

essential teaching staff obligations

The objective of the PDFS 1.1.3 will contribute to the success of academic staff in attracting research funding, thereby increasing the stability of the overall remuneration of teaching staff (studies and research) and reducing the threat.

The strength **1** and opportunity **1** will be used to mitigate threats.

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.

Collegial responsibility for the management of the field of study is for the decision-making bodies of UL, the Senate, the UL Study Programme Quality Assessment Commission (hereinafter referred to as “SP QAC”), the Faculty Councils and the College Councils, which assess the quality of study and decide on measures to ensure the quality of study. The management of UL is responsible for the quality of studies by delegating responsibility for the functioning of the quality assurance system to the Academic Department. Responsibility for the quality of the field of study and the programmes implemented within it lie with the head and dean of the field of study, the directors of study programmes, as well as the heads of sub-programmes. Each faculty is responsible for the quality of the content and implementation of the training course, research activities and professional development. The responsibility of students is defined in their rights and obligations to contribute to the achievement and excellence of UL objectives in studies, participating in the collegial institutions of UL and regularly expressing their views in student surveys. For the management scheme of the direction of the studies and of the study programmes in UL, see: Figure 2.1.3.1.

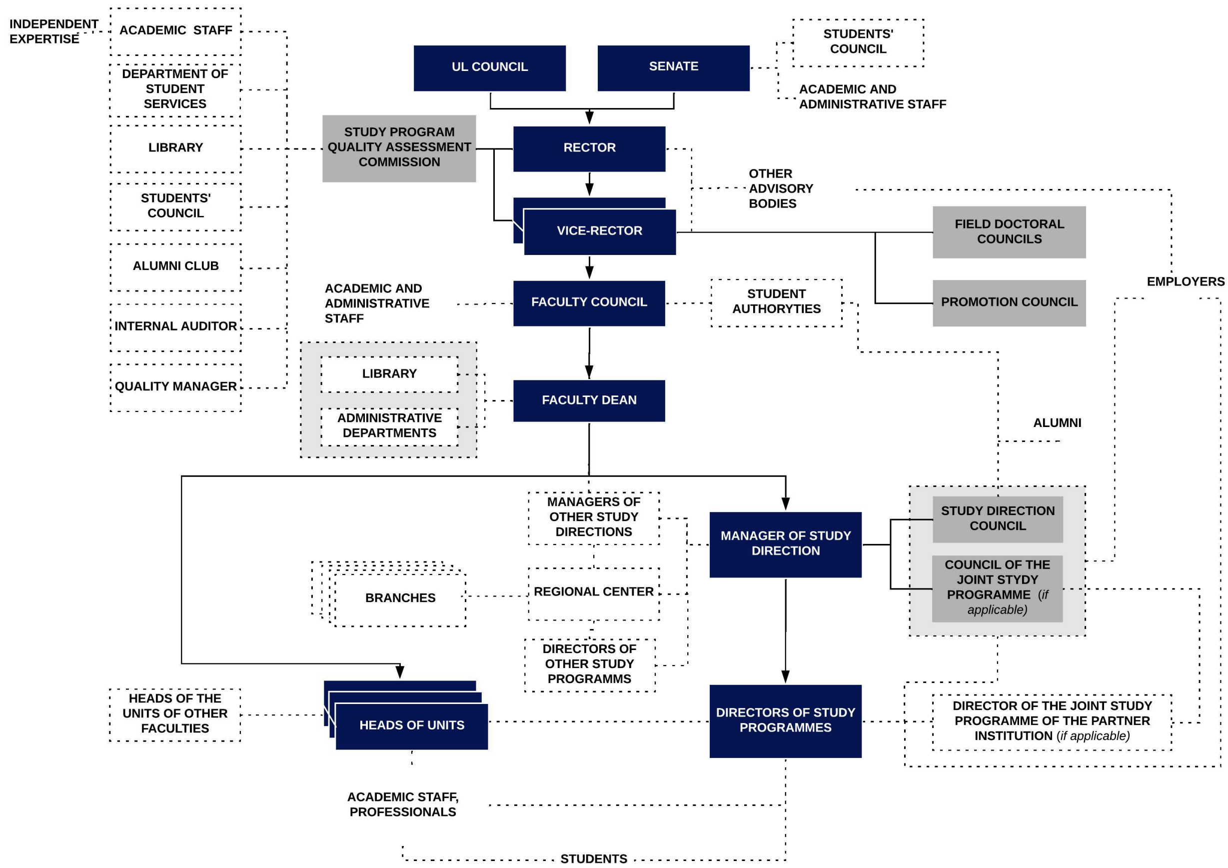


Figure 2.1.3.1. Administration structure of the study field and corresponding study programmes

Regulations on the University of Latvia Study Field Management (approved by Senate Decision No 70 of 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 and head of the sub-programme of the field.

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, the **sub-programme director** may be approved by the decision of the Faculty Council in each sub-programme. The Head of the sub-programme is approved by the Faculty Council. If several faculties are involved in the implementation of the study programme, the Head of the sub-programme shall be approved by the Faculty Council which grants the corresponding degree or qualification on the proposal of the deans of the faculties involved in the implementation of the programme. The sub-programme director is a member of the relevant Field Council. The Head of the sub-programme is accountable for their activities to the Director of the study programme. The responsibilities of the director of the study sub-programme include, in cooperation with the director of the study programme, organizing and managing the development and implementation of the sub-programme, as well as preparing the documentation required for the approval, licensing and accreditation of the sub-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 professors, associate professors and other qualified specialists (candidates are nominated by the heads of structural units, heads of fields and study programme directors). The Field Council approves the development strategy of the study programmes of the given branch, evaluates and submits the conceptualisation of new study programmes for approval to the Study Programme Quality Assessment Commission, evaluates and submits for Faculty Council's approval the annual reports of study fields, as well as changes in study programmes.

Faculty Councils, 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 and representatives, Representative of the Department of Study Services, Internal Auditor, Head of Quality, representative of the UL Library, a representative delegated by the Student Council 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. 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. (*Regulations of UL Administration, p.50-51, approved by Resolution No. 1-4 / 559 of the UL Senate of 15.11.2021 (Only in Latvian)*). By the new UL Administration Regulations, the **UL Academic**

Competence Development Centre is being established within the Department of Human Resources, whose functions will include developing and improving staff development, career and succession planning systems, implementing staff growth promotion measures.

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 University of Latvia.

The **UL Department of Information Technology** deals with various information technology tools, their maintenance, training and consulting. UL House of Science has two computer network administrators who ensure the work of computer equipment and presentation equipment. The House Manager **(Infrastructure Management Department**) ensures that the House of Science provides suitable conditions for work and studies - heat, ventilation, lighting, organizes furniture repair, room cleaning. The premises are cleaned by several cleaners. The work of the physics laboratory is ensured by five senior laboratory assistants and one laboratory assistant. The House of Science has enough technical staff to keep the building functioning, the teaching staff's workplaces and the auditoriums for the students to be maintained in good condition.

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.

Procedures and Requirements for the Admission of Students:

Terms of admission at University of Latvia

Admission requirements and criteria in basic studies (Only in Latvian)

Requirements and criteria for admissions in higher-level studies (Only in Latvian)

Regulatory frameworks 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 admissions process in UL and, consequently, the study programmes under the Study field “Physics, Materials Science, Mathematics and Statistics” are governed by *the Admission Rules* and the orders, which define the procedures for the academic year in question:

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. an estimate of the registration fee;
7. tuition fees in programmes;
8. number of study places for admission;
9. procedure for the preparation of entrance examination materials;
10. composition of the Admission Board;
11. composition of the entrance examination commissions;
12. date and place of entrance examinations.

Enrolment in undergraduate studies is centralised through the 'Single Enrolment in Undergraduate Programmes', which integrates the enrolment in 12 Latvian universities. The competition for study places is based on the results of the Centralised exams or the grades of the persons with secondary education obtained up to year 2004, the persons who have been exempted from the centralised exams or have completed their secondary education abroad. In the case of study programmes that do not have appropriate centralised exams, additional requirements for specific grades are added, 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 or other competitions winners (for more information on admission requirements, see the description of each study programme).

For example, taking into account the results of the centralised examinations in Latvian, foreign language (English or French or German), mathematics and physics (if they have taken physics), the applicant acquires a certain number of points with which they participate in competition at the ABSPP. However, they must have a successful (not lower than 4) annual grade in physics in the secondary education document, in addition to 100 points being obtained by the members of the UL School of New Physicists who have received a certificate for the given year of training. The winners of grades 1 to 3 of the Latvian State, European or international physics or mathematics Olympiads in the last three years or the winners of places 1 to 3 at the Latvian State School Physical Sciences conference (research) during the last three years; places 1-3 for Mathematics or Astronomy Olympiads and winners of awards over the past three years have advantages of starting the studies at ABSPP. Since there is a mandatory centralised exam in mathematics, there are no special conditions for the ABSPM and PBSPMS for the annual grade in mathematics, and the applicant takes points based on the results of the centralised exams in Latvian, foreign language (English or French or German) and mathematics, while in addition 100 points for attending UL Little Mathematics University (LMU) in the given year of studies and benefits are given to the winners of grades 1 to 3 of the State of Latvia or international mathematics, physics or informatics (programming) Olympiads during the last three years; winners of grades 1 to 3 of the National Student Conference of Latvia in the last three years; the winners of 1-3 places in physics or mathematics Olympiads over the last three years.

Enrolment in master-level study programmes is decentralised, at each faculty, but with uniform deadlines. Enrolment is based on grades obtained during the 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.

People who have a bachelor's degree or a second-level vocational higher education in science, computer science, mathematics, engineering, managerial science or equivalent higher education are admitted to AMSPMDS. Discussions are scheduled to assess whether the applicant’s previous education and work experience will provide successful studies in the programme. Individuals who have identified shortcomings in mathematics knowledge and skills should also undertake the necessary college courses at the Bachelor of Mathematics level during their studies. The eligibility for non-competitive registration is the corresponding academic year UL's academic bachelor's degree programme “Mathematics” and the professional bachelor's degree programme “Mathematician statistician” graduates with a weighted average grade of not less than 8 points in basic studies and a bachelor's paper score of not less than 8 points.

AMSPP have similar admission requirement, but in this case, it is a joint programme of UL and DU, so the admission of students takes place in accordance with the Agreement between the two universities on the implementation of a joint Academic Master's Study Programme “Physics”. For more information on the reception requirements, see the description of AMSPP.

Admission to doctoral studies takes place centrally. The applicant must submit the topic of the promotion thesis and the name of approved supervisor. The applicant's eligibility is assessed by the doctoral council of the branch.

The only doctoral study program in the FS is doctoral programme “Particle Physics and Accelerator Technologies” together with RTU. The applications of the Studies Programme “Particle Physics and Accelerator Technologies” are evaluated by the Council established by the Studies Programme from UL and RTU in accordance with its mandate. A mandatory requirement for the evaluation of the application is a master's degree in an appropriate field of science. Appropriate fields of science include physics, chemistry, mathematics, engineering and information technologies. Evaluation and enrolment of applicants with master's degree in other areas can be made subject to an individual assessment of the candidate. The directors of the study programme evaluate applications using quantitative and qualitative indicators and the relevant points system. Applications which have received at least 4 points in those criteria or which are otherwise considered to be of sufficient quality are submitted to the Council for further consideration. See the full conditions for the enrolment in the PhD programme “Particle Physics and Accelerator Technologies” in the self-assessment report Part 8.

The requirements and criteria in the study programmes are reviewed and updated annually and published on the UL website by 1 November in accordance with Section 46 of *the Law on Higher Education Institutions*.

UL also provides the possibility to start studies at later stages, in accordance with the Regulations for commencing studies in subsequent study stages at the University of Latvia *(Order No 1-4/332 of UL 07.06.2022)* (Available only in Latvian language). The prerequisite for starting studies at later stages is the recognition of previous study courses or of knowledge, skills, competences acquired outside formal education, results of studies attained in previous education, as governed by the *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* (Decision No 2-3/86 of the UL Senate 28.06.2021.) (hereinafter - Statute) and *the Regulations for the Recognition of Study Courses and the Recognition of Knowledge, Skills and Competencies acquired from Vocational Experience Outside Formal Education and Results of Studies in Previous Education at the University of Latvia* (Order No 1-4/543 of UL 04.11.2021.). On the basis of the student’s application, the possibility of recognising study courses acquired in another Latvian higher education institution, an institution of higher education abroad or a period of previous studies in UL is examined. In accordance with paragraph 8 of the Procedure, previously acquired study courses may be recognised at the same or lower level of study. On 10.02.2022, there were 55 students from all active students who have had recognised study courses, but since the previous accreditation period 29.05.2013, 343 students have had courses recognised.

When applying for later stages, application must be completed and accompanied by the necessary documents. The UL Commission for the Recognition of Knowledge, Skills, Competences, Studies in

Higher Education (Recognition Commission) or the Director of the Programme, if the student resumes studies in the same UL programme, evaluate and recognise those previously acquired study courses, the results of which correspond to the results of studies of the UL study programme. Study courses is recognised if their amount in credit scores in both comparable study programmes is equal or the number of credits in the corresponding course previously acquired is higher. In addition, the total number of study courses to be completed may not exceed 20 credit points. Learning additional study courses or sorting out tests is a fee service. For students from another university or college, when starting studies at the later stages of UL, budget funding for studies is not maintained. Final examinations completed in other universities are not recognised.

Upon the submission of the applicant, UL also evaluates and recognises the knowledge, skills, competence acquired outside the formal education and the results of studies achieved in previous education. When submitting an application, documents certifying the results of the studies achieved - certificates, employer attestations, recommendations, project results, job descriptions, etc must be added. The results of studies achieved in professional experience may be recognised only in that part of the relevant study programme which consists of the practice, or in the results of studies to be achieved in the field of study or study module of a study programme attesting the practical knowledge acquired. In certain cases, in order to recognise the knowledge, skills and competence acquired in professional experience as corresponding to the results of the course of the study programme, the applicant may be set examinations provided for in the relevant study course or part thereof.

In the Bachelor's degree programme, the most common recognition of study courses takes place in such cases: the return of a student from an exchange programme (Erasmus + or others), as well as persons enrolled in a bachelor's study programme may request to recognise study courses acquired during previous studies if their size and content are appropriate in a study programme with existing courses. Students have every opportunity to recognise courses if they have failed to complete their studies at another university. In such cases, the Recognition Commission performs a comparison of the size and content of the study courses previously acquired and takes a decision regarding the possibility of recognising study courses. In some cases, the study courses previously acquired for students who have a second or further higher education programme in the field of study programmes is recognised. For example, if a student has already acquired a “Civil Protection” course while studying in the bachelor's study program “Chemistry”, then if they continue to study ABSPP or ABSPM, or PBSPMS, they do not need to listen to that course for a second time. In the same way, renewal after the break in studies will result in the recognition of courses due to changes in the study programme plan.

The most common recognition of study courses in master programmes takes place in cases where students have returned from studies of mobility programmes, participated in various projects, such as the Summer School, or have entered this programme from other Latvian universities and have failed to complete their studies. In such cases, the programme director or the Recognition Commission perform a comparison of the size and content of the study courses previously acquired and take a decision regarding the possibility of recognising study courses.

At the level of the master, the recognition of courses from previous studies is rather an exceptional situation, which shows that FS PMSMS at the master's level (another study programme) is rare and therefore does not require the recognition of courses. In some cases, students have an interest in recognising the results of so-called summer/winter school studies, but these schools generally have insufficient levels of study.

The doctoral study programme also has the possibility of recognising previously acquired study courses. In this programme, however, such applications are rarely received and the recognition of study courses has been linked to a return from Erasmus + studies or to changes in the study programme plan. In addition, the requirements of the UL doctoral programme can also be assimilated to academic activities carried out outside the doctoral programme. The criteria and procedures for this alignment are also laid down in the Procedure.

The possibility of recognising the results of studies acquired in previous education (including the continuous education programme) or professional experience is less frequent. The recognition of the results of such studies has not taken place until now.

For UL students who make use of the possibility of studying or taking internship with different international exchange programmes, the recognition and alignment of the results of studies acquired during mobility is carried out in accordance with the legislation governing recognition of the former in UL, as well as *The arrangements for organising mobility of the Erasmus + programme in UL* (Order No 1/363 of UL 18.12.2014) (Only in Latvian). In accordance with these rules, the recognition of the results of studies acquired in mobility take into account: (1) the compliance of the results of studies acquired during mobility with the conditions of international exchange programmes and (2) the compliance of the results of studies acquired during mobility with the requirements of the UL study programme. The alignment of the results of studies acquired during mobility is carried out by the director of the relevant study programme or by the Recognition Commission on the basis of extracts of performance from the partner high school or from the place of practice. The results of studies recognised after the evaluation are included in the academic commitments performed by the student.

All students participating in exchange programmes, before leaving for mobility, coordinate their preliminary mobility studies course or internshipe plan with the programme directors. If changes are made to this plan during the exchange, it is agreed with the Director of the study programme. The preliminary study or practice plan also includes a process of alignment, the director of the study programme approves the student's selected study courses in a foreign university and notes to which course it will be replaced or assimilated from the student's study plan UL. If a student participates in internship mobility, the student coordinates how the internship will be recognised with the relevant study programme director before leaving for mobility. If the internship is provided in the UL study plan, practice mobility is aligned with practice from the UL programme.

For example, in the autumn semester of 2019, a PBSPMS student took advantage of the possibility of Erasmus+ practice in a Portuguese company, spending her full time in internship. After returning to Latvia, the student had to submit an internship report and perform a presentation to a commission for defending the internship. She also submitted feedback from the internship site on the work she had done. In the light of the feedback, the internship report and presentation, the Commission decided on a successful final assessment of the internship.

All procedures have been made public and available in the UL Regulatory Framework, which is available to all UL employees and students when logging in with the UL user name and password.

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* which determines that information regarding the conditions for the acquisition of each study course, objectives, tasks, requirements for obtaining credits, the content of the study course, the contact activities of study process organisations, the organisation of studies and tasks of students' independent work, the intended results of studies (knowledge, skills, competence) and their testing methods and evaluation criteria should be included in all the study course descriptions available to students in the UL Information System (LUIS) and UL e-studies environment. Recording of student results takes place in the appropriate e-environment of the field of study. UL has formulated the results of studies for each study programme and for each study course as a set of knowledge, skills and competences. Courses in study programmes have been developed in accordance with the principles of gradation and succession. In order to ensure this, study programmes have carried out a mapping of the results of studies planned at the level of the study programme and studies at the level of study courses, see Annex 8 to the self-assessment report in Parts III to VIII on study programmes, as well as mapping analysis in the corresponding section 2.1.

At the beginning of studies, students are informed of the organisation and implementation of studies in the relevant study programme, but when beginning the acquisition of each individual study course, staff members inform them about the organisation, content, learning requirements, planned study results, examinations and evaluation criteria, as well as explain the nature of the study course in achieving the overall results of the study. Students may familiarize themselves with the criteria and conditions for evaluating student achievements and the binding procedures in study course descriptions and e-study environments, as well as at the beginning of the acquisition of each study course in the first class, when each teacher presents studies with the learning organisation, requirements, briefly describing the requirements of test and final examination, evaluation criteria and the procedures for testing. without changing these requirements and evaluation criteria during the semester.

The organisation 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 Organization of Examinations of Study Courses 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 results of full-time and part-time students enrolled in LU study programs at all levels.

There are two types of tests 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 assessment of the students' achievements is performed by resorting to the form of the tests and the methods corresponding to the teaching methods used in the study process, both during contact lessons and in the organisation of students' independent work.

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 are: quiz, individual work, practical work, laboratory work, report, 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. The acquisition of a course may be positively assessed even if the examination has been failed but this possibility has been specified in the study course description. The overall assessment of course acquisition is calculated in the UL e-studies environment according to the algorithm specified in the course description, taking into account the assessments obtained in interim tests and examinations.

In accordance with the specific nature of the study course, the requirements for attending classes may also be determined.

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 course paper, final thesis project, term paper, field course and internship is stipulated in UL normative acts.

For example, in the study course "Differential Equations I" (4 CP, taught in the 3rd semester of both ABSPM and PBSPMS) 3 test works are to be written within the certain deadlines, the summative assessment of which gives 50% of the total grade. There is also a final test - an oral examination, which tests the understanding of the lecture material as well as the ability to solve the problems, which gives 50% of the total grade. Tests and the exam are organised in such a way that they achieve and cover all 9 learning outcomes of the course. But, for example, the result of competence - independently researching the simplest mathematical models of ordinary differential equations and interpreting the results - the student demonstrates in the final exam.

The AMSPP course "Numerical Simulation of Physical processes" (4 CP) is organised differently. In this study course 9 laboratory works have to be prepared in the laboratory and the protocols for them have to be prepared according to the requirements (45% of the total grade), the presentation of the results has to be prepared, the seminar presentation has to be made and the results have to be discussed (20% of the total grade), the final exam consists of an individual work developed during the semester and presented during the session (35% of the total grade). One of the objectives of this course is to train the presentation and communication skills of the research results. The development and presentation of the individual work covers 8 out of the 9 outcomes of the course.

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

For the evaluation of students' knowledge, skills and competence in each study course, the 10-point scale criteria described above are used. The criteria for each study course are based on the learning outcomes and assessment descriptions (see table 2.1.5.1), published in “Procedures for the Development and Actualization of Study Courses at the University of Latvia”.

Table 2.1.5.1

Assessment descriptions

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

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

In evaluating the results of studies, compliance with the basic principles for the valuation set by the

Cabinet regulations of the Republic of Latvia

No 141 (20.03.2001.) *Regulations regarding the State Standard for First Level Professional Higher Education*,
No 512 (26.08.2014.) *Regulations on the State Standard for Second Level Professional Higher Education* (Only in Latvian),
No 240 (13.05.2014.) *Regulations on the state standard of the academic education* (Only in Latvian)

is considered:

- **the principle of openness of the evaluation and clarity of requirements** — the University has established a set of requirements for evaluating the results of studies 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 evaluation** — the University has established the procedures for reviewing the obtained assessment;
- **the principle of mandatory evaluation** — it is necessary to obtain a positive assessment of the content of the entire study programme;
- **the principle of the variety of types of testing used in the evaluation** — different types of testing shall be used in the evaluation of the acquisition of the study programme;
- **principle of conformity of assessment** — in the course of testing, the student is given an opportunity to demonstrate knowledge, skills and competence in relevant tasks and situations. The content to be included in the tests corresponds to the content specified in the course programmes.

The basic criteria for the evaluation of final papers are determined by the UL Decree No 1/38 of 03.02.2012 *On the development and defence of the final papers (bachelor's, master's, diplomas and qualifications) at the University of Latvia.* Additional criteria may be determined for the evaluation of final papers, which shall be approved by the Faculty Council on a proposal from the relevant Study Programmes Council.

AMSPP Master Thesis is organised in two parts. The first part is the development and defence of the concept of a Master's Thesis, which is carried out during the third semester and which concludes with an assessment credited or uncredited. The second part is defending the Master’s at the end of the fourth semester. In other FS PMSMS programmes, there is no official defence of the concept of work and the graduation paper is being developed within one semester.

In FS PMSMS graduation papers are subject to electronic plagiarism control before defending, so the papers should be submitted a week before the defence commission meeting. The defence board is set up for each study programme, it is established once a year, its powers is to accept and review the gradation papers submitted throughout the year. In the PBSPMS commission, half of the members are employers' representatives, and employers' representatives may also be included in academic program commissions. All graduation papers are reviewed by a reviewer of the graduation paper, who is approved by the dean of the FPMO for each student. The reviewer submits a written review to the commission and expresses his or her assessment on the 10-point scale. On the day of defence, the students present his or her graduation paper (10 min Bachelor, 15 min Masters) to the commission. After the presentation, everyone participating in the defence session may ask questions about the content of the thesis and the presentation. The reviewer then presents the assessment of the work, as well as the scientific adviser of the graduation paper of the student. The defence procedure concludes with the final words of the student, which may include short answers to criticism. After all the students have finished their defence, a closed session of the final defence commission takes place, in which the scientific advisers and reviewers of the student papers participate along the members of the commission. The evaluation is expressed first by the reviewer, then by the adviser. These assessments are of a suggestive nature. The Commission determines student final grades assessing the content, relevance, references, presentation, assessment of student presentation and answers, the ability to discuss subject using industry-specific terminology. The matter at issue is settled by the Commission by means of an open vote.

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 respects the principles of fair and responsible conduct as stipulated in *The Academic Ethics Codex of the University of Latvia* (UL Senate 26.04.2021. decision No 2-3/46) and in the *Regulations for Academic Integrity at the University of Latvia* (UL Senate 26.04.2021. decision No 2-3/48) and publicly available to students of the UL and its staff.

To prevent violation of academic integrity, the UL has developed the Unified Computerized Plagiarism Control System (hereinafter – System), (UL 22.04.2014. Order No 1/125). 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 22.04.2014. supplement to Order No 1/125), 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 final theses uploaded to these university systems, incl. 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 final examination panel for final consideration.

At the beginning of the studies at FPMO, students are informed of the respect for the principles of academic integrity. The descriptions of the practice and n paper writing courses of the study programmes of FS PMSMS highlight the development of competences related to ethical conduct and academic integrity. There are no recorded plagiarism instances in the study programmes, but FPMO pays serious attention to informing students about the risks of plagiarism, particularly by emphasising the correct reference to other authors' works and the correct use of self-citation.

Cooperation between several universities in the field of the use of the system contributes to more effective control of study works in each institution of higher education and Latvia as a whole, and this system works successfully in practice, raising the significance and quality of closing work.

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 activities of the UL field of study and study programme are ensured by systemically defining and implementing quality assurance procedures, including ensuring continuous monitoring and analysis of the implementation of the study programme, the use of measurements for the operational implementation of prevention and development measures. The assurance of the levels of management involved in ensuring the quality of the study programme allows the implementation of the programmes in a predetermined form, following pre-defined procedures, in an operational response to possible changes in the situation, by taking quality decisions in a collegial manner or in accordance with the division of competences. An essential means of quality assurance is the UL *Quality Management Manual*, which includes a detailed identification of UL practices in the implementation of the ESG.

In implementing quality development measures within the internal quality assurance system, the following activities are key:

- **Monthly meetings of departments (PD and MD)** dealing with topical issues, including sector-specific study programmes. Academic staff and students participate in the meetings. Questions can be raised by academic staff or students offering bottom-up initiatives (new courses, changes in content, etc.). Evaluations and comments of student courses are reviewed once a semester when deciding on the action. Specific examples include:
    - discussions and decisions on ABSP Physics about the restructuring of parts A of Physics during the period between accreditations, in line with international principles for the development of physics programmes;
    - a decision on the reduction of the duration of ABSP Mathematics studies from 4 to 3 years;
    - setting up new courses or transforming courses by proactively following sectoral trends, for example by including the acquisition of machine learning methods.
- **Regular FSC meetings** involving study program directors, students and industry representatives deciding on the approval of bottom-up initiatives or the procedures for implementing downstream initiatives.
- **Regular FPMO management meetings together with the FPMO Student Council**, where, for example, student surveys about study courses are analyzed every semester. Student self-government also organizes mid-semester surveys about study courses. Faculty members are expected to respond promptly to critical comments made.
- **Centralised UL solutions**. In addition to an orderly and regularly updated legislative base, the introduction of a digital course survey solution should be highlighted as a concrete example. It requires feedback from students to be able to continue the course of their studies. This has increased the responses in the surveys and makes valuable comments taken into account in the manner described above.
- **Initiatives that turn into regular events** and encourage exchanges of thought and experience. In particular:
    - “Teacher Club”: a couple of events in the semester during which teachers share

experiences in an informal environment in the use of different teaching methods. The content initially focused on student-oriented methods (peer instruction, inverted class, etc.). During the Covid-19 pandemic, they allowed the collective to quickly acquire the necessary digital skills to realise a remote learning process;
    - observations – regular mutual observation of teaching activities, taking over experience and providing advice on the use of methods. A particularly important tradition to avoid losing the most valuable methods and approaches when generations change.
- **Individual initiatives**. Recent examples include:
    - moving to the UL Science house in 2019, collectively planning and adapting space solutions to an open, accessible and sharing-oriented environment where studies and science are closely together, as a number of scientific institutes are deployed in the Science house;
    - development funding for studies to be coordinated by department leaders with the dean. Helps to accelerate the development of study programmes, in line with priorities.

All of the above activities contribute to the effectiveness of internal quality assurance. But until now, no effective mechanism has been devised that would ensure such bachelor's level studies that the number of students does not decrease during the first year of study. A big challenge in all undergraduate study programs will begin in the autumn of 2023, when students with different secondary education levels of mathematics and physics will start their studies.

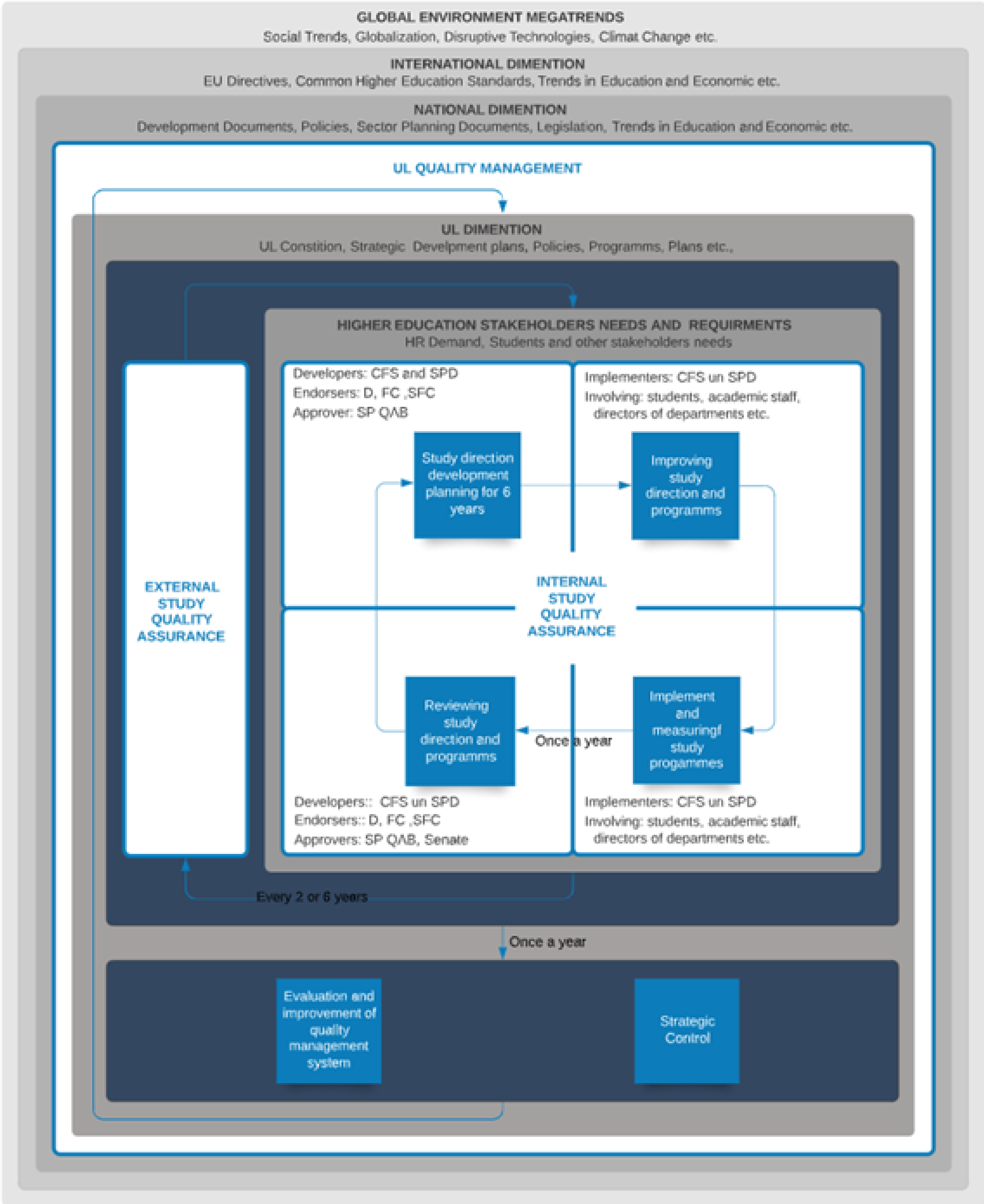
2.2.2. Analysis and assessment of the system and the procedures for the development and review of the study programmes by providing specific examples of the review of the study programmes, the aims, and regularity, as well as the stakeholders and their responsibilities. If, during the reporting period, 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).

Documents available in Latvian at ***https://www.lu.lv/par-mums/dokumenti/***

Documents in English are available at ***https://www.lu.lv/en/about-us/documents/***

The quality of the field of study and of the study programmes covered by it is guided by the planned, performing, testing, operational (Plan-do-check-act) cycle, development and development of the field of study for a period of six years, mapping its objectives and objectives to the level of each study programme and regularly monitoring the requirements of the parties concerned for effective programming purposes., needs and triggers, in line with the *UL strategy*, taking into account sectoral national and international frameworks and trends, and the impact of global environmental trends on UL activities up to the level of study programmes.

Quality assurance systems for UL studies (see table 2.2.2.1.), the development of the field of study and the interlinking of the study programmes covered therein, the establishment of new study programmes, as well as the results of the implementation of each existing study programme, are planned, controlled, evaluated and reviewed, ensuring the involvement of representatives of the principal stakeholders in ensuring the quality of the studies. The review of study programmes is regulated in the framework of *the annual accounts for UL Studies* (UL 13.07.2018 Order No 1/255) (Only in Latvian).



2.2.2.1. Fig. Quality assurance system for the courses of studies carried out by UL and the given study programmes

The development of new study programmes is regulated in the *Regulations on University of Latvia study and continuing education programmes* (approved by UL Senate Decision No 102 of 24.04.2017) and is implemented in a number of phases, including coordination and evaluation at all levels of management involved in ensuring the quality of the studies, twice, harmonising and validating the concept of the study programme, and harmonising and validating the study programmes at the end of the characterisation process. For a detailed description of the content of the design and concept of the programme, see page *In the quality management manual*, Chapter 3.1, Title II. (*The Quality Management Handbook* is available in the section *Other attachments*)

In the process of evaluating self-assessment and the development of new study programmes, the responsibilities are divided between the directors of study programmes, the head of the field of study, the FS Council, the Faculty Council, the Commission for Quality Assessment of Academic

Departments and Studies Programmes, as well as the Senate.

The FS leaders in UL, in cooperation with the directors of study programmes, prepare self-assessment reports for the field of study each academic year (“Self-assessment”). Self-assessments are approved by faculty councils and filed with the Academic Department. The academic department carries out a self-assessment compliance assessment and provides self-assessments for the SC QAB, which includes all UL field Vicerectors, Chairman of the UL Senate Academic Commission, UL student representative, UL alumni club representative, UL Library representative, Quality Manager, Internal Auditor, and Academic Department and Studies Services Department. The self-assessment reports reflect the implementation of the programmes, the spotlights, programme changes and the development process, the stakeholders' assessment – both the results of student surveys and the assessment of employers. In the process of self-assessment of study programmes, as well as the development of a new study programme, the Academic Department also provides an independent expert-examination, the incorporation of the proposals examined at the hearing of the SP QAB in a planned manner. Accreditation self-assessment reports is prepared using the annual self-assessment results. The recommendations of the Accreditation and Licensing Assessment Expert Group and the Study Quality Commission are evaluated in the field of study council by preparing a plan for expert recommendations, which is harmonised by the SC QAB. More information on the content of the self-assessment of study programmes and the external accreditation process *in the UL Quality Management Manual* in Chapter 3.1, Titles IX and X.

The shortcomings identified during the preparation of the annual Self-Assessments are addressed with care. It takes into account the findings in student surveys of study courses and satisfaction with study programmes in general, as well as the guidance of the academic department and the expert reports on Self-Assessment.

The findings of study course surveys allow for an assessment of the content of study courses, the study methods applied by the teaching staff to achieve the results of studies, as well as the contribution of a specific study course to the results of study programmes. Each semester, the Departments of Physics and Mathematics reinforce the assessment of low-rated study courses, with a special focus on low-performing courses. It is also the responsibility of each faculty member to familiarise themselves with student comments and to critically assess where improvement is needed. If a long-term study course has a low rating, it is usually the option of replacing the teaching staff.

The survey of overall satisfaction with study programmes clarifies students' views on the package of study courses, which should ensure that the results of a specific study programme are achieved. These surveys are one of the factors that has led to the changes described below in the characteristics of study programmes, along with their changes.

If the comments of the Academic Department relate to the Self-Assessment content defects to be addressed, the recommendations of the independent expert of the AcD may also contain elements of improvement in the study programmes. The response to these recommendations is recorded in the development plan for the field of study as specific tasks with activities, responsibilities and deadlines.

Examples of specific tasks resulting from the self-assessment process (taken from the 2020 Self-Assessment):

- stabilising the number of students in masters' programmes: at least 15 students after the first semester;
- improving the content of courses and the quality of teaching in low-ranking courses: an increase above 5, preferably at least 5.5;

- development of a support system for the learning of modern learning methods: number of academic staff who attended workshops (as a percentage of the total);
- Suitability of the materials available in the e-courses: raising the survey score above 5, preferably at least 5.5;
- changing the concept of study programmes with a low student and/or high drop-out count.

During the reporting period, a joint academic master's study programme "Physics" was licensed for DU and UL, programme code 45443, study duration 2 years, 80 credits, language of instruction - Latvian or English. The licensed study programme in this accreditation report replaces the previously implemented academic master's study programme "Physics" of the University of Latvia.

The study programme was developed on the basis of the Cooperation Agreement on the implementation of the European Social Fund co-financed project "Creation of internationally competitive study programmes at the University of Latvia promoting the development of Latvian economy" Agreement No 8.2.1.0/18/A/015 signed on 31 May 2019 by two higher education institutions, LU and DU. New programme is based on the Master of Physics programmes, merging and further evolving the existing programmes and eliminating the fragmentation of Master of Physics education in Latvia. The needs of physics-related research (including interdisciplinary topics) and high-tech companies call for specialists with a strong background in physics (provided by the BSc) and a strong specialisation in a specific sub-discipline of physics and possibly in a trans-disciplinary field, which the programme will provide.

The procedure for establishing a new study programme is described in the Regulations on Study Programmes and Continuing Education Programmes (UL) and the Regulations on the Opening and Management of Study Directions and Study Programmes (DU).

Therefore, the establishment of the joint UL-DU AMSPF on the UL side took place in successive stages:

1. development and approval of the study programme concept by the Study Programme Quality Assessment Commission (hereinafter referred to as SPQAC);
2. development and approval of the full-length study programme by the SPQAC;
3. approval of the study programme by the Senate of the University of Latvia;
4. licensing of the study programme (decision on 27.10.2022 at the meeting of the Study Quality Commission);
5. accreditation of the study programme, which is in progress and has not yet been completed.

Students and employers were involved in the development, evaluation and approval of the study programme alongside the teaching staff. University performance indicators related to students, staff, graduates and the study programme were analysed and taken into account in the modification and development of the study programme and the content of individual courses. In the context of the study programme, university performance indicators were analysed in terms of matriculation, student and graduate numbers, attrition, student mobility, faculty composition, graduate employment and employer satisfaction, study programme cost-effectiveness and industry trends.

Teaching staff engagement

The basic concept of the study programme was developed by the teaching staff of the Department of Physics of the Faculty of Physics, Mathematics and Optometry of the University of Latvia, taking into account previous discussions with students and representatives of employers. It defined the compulsory part of the study programme, the content of its courses and the outcomes. The content and outcomes of the compulsory part were then agreed with the teaching staff of the Department of Physics and Mathematics of the Faculty of Natural Sciences and Mathematics of DU, arriving at the final version of the study programme outcomes defined by the compulsory part of the study programme.

The study programme was supplemented with restricted elective courses in its specialisations, the design, content and outcomes of which, and their impact on the study programme outcomes, were developed in a broader dialogue between the teaching staff and representatives of employers in the sector, taking into account the views of students gathered through surveys and interviews.

Involvement of employers

In previous years, a constructive dialogue was maintained at both universities between the teaching staff and employers and, in the light of the experience gained, a concept was developed on how to modernise the content of the Master's degree programmes in Physics to better meet the needs of the labour market and ensure the transfer of physics knowledge to industrial enterprises. Separate meetings were held with the ISSP UL on the design of the new study programme and the inclusion of the courses developed in the CAMART2 project. Joint seminars were held with other research institutes in the sector to discuss the courses on offer.

Discussions with employers also showed a strong interest in AMSPP graduates as a future workforce.

Involvement of students and alumni

The opinion of students and alumni is very important, so the results of surveys of previous years' MSc Physics programmes and their courses at both universities were analysed when designing the programme. Equally important were the insights gained from informal conversations with students of these programmes, as well as graduates of physics bachelor programmes, to understand what changes are needed from the students' point of view.

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.

In keeping with the principles of democracy and equality, and in line with the UL Quality Assurance Policy, all stages of the study process, from admissions to finals, ensure the participation of applicants and students in the assessment of the UL study process. In matters relating to the admission procedure, the 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 *Terms of Admission at University of Latvia* (UL Senate 31.05.2021. decision No 2-3/68), specifying the procedures for the lodging, processing and appeal of the complaint.

To improve the quality of studies, students have the right to submit proposals and complaints concerning the study process, including the evaluation of examinations and finals. To ensure the quality of the UL study process, the UL has developed and implemented *Order of Submitting and Examining Proposals and Complaints of the Students* (UL Decision No 1/21 of 18.02.2002.). The procedure specifies the form for the submission of proposals and complaints, as well as the procedure for registration and resolution thereof. Proposals and complaints regarding the study process may be submitted to faculty deans (on the schedule of lectures, on the study process implementation, on the quality of studies administered by the respective faculty and on its development, on the non-fulfilment of the duties of faculty staff, etc.). The initial complaint should be acknowledged and a full response provided within 15 days or within 30 days if additional information is required. Significantly, paragraph 17 of that order expressly provides that: "At the end of each academic year, the Dean of the Faculty must report to the UL Board on the complaints received and decisions taken in the previous academic year." This demonstrates the importance of the internal control mechanisms and the cyclical monitoring of complaints, decision making, student rights and interests, which is important for the proper functioning and possible improvement of this system.

The *Procedure for the Organization of Examinations of Study Courses at the University of Latvia* (UL Senate 29.06.2015. decision No 211) (Available only in Latvian language) 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 interim and final assessment and the procedures for resolution of these complaints have been determined. The complaint is submitted by the student to the member of academic staff who has evaluated the examination, 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 shall submit the application to the Head of Department for consideration and decision.

The evaluation of graduation papers is determined by *Regulation on Graduation Examinations at the University of Latvia* (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 final examinations or to appeal against the final examination procedure.

The University of Latvia has an Academic Court of Arbitration, whose regulations determine the opportunity to apply to this collegial institution regarding 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 ex-matriculation in conformity with *Procedure for competition for state funded study places (“rotation”) at the University of Latvia* (University of Latvia Senate Decision No. 381 of 24.05.2010). In its turn, *Study Fee Relief Procedure* (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 University of Latvia, to be considered by the Rector within one month.

The *Procedure for Granting an Academic Leave of Absence in the University of Latvia* (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 a study break. The *The Procedures for the Initiation of Studies in Subsequent Study Stages at the University of Latvia* (UL Order No. 1/128 of 08.06.2009) also provides for the right to appeal within a specified period against the decisions made by the Dean.

With respect to students’ rights outside the study process, it should be mentioned, that the rights and obligations of the students who use the services of UL hostels are regulated by *Internal regulations of the dormitories of the University of Latvia* (Approved with the UL decision from 30 June 2009 No.1/171), including those to inform the hostel superintendent of any problems, submit proposals to improve performance and complaints. Hostel issues are addressed by the hostel superintendent.

Each student is entitled not only to the rights to apply to the UL Academic Ethics Committee for possible ethical violations as specified by the *Academic Ethics Codex of the University of Latvia*, but also to submit proposals to the UL Academic Ethics Committee as regards the improvement of the Code and its implementation.

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 UL normative level see "Regulations on the UL visiting student from Latvian higher education institutions" (UL Order No 1/17 of 25.01.2006), which define that visiting students in the UL have the same rights and obligations as the UL students, meaning that the system for submitting and addressing complaints and proposals applies equally 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 applies to enrolment at the UL as well as the full-cycle studies and final examinations.

During the reporting period, there have been no formally registered complaints, but four student proposals have been recorded, which are also satisfied, namely:

1. Proposal for consultation in 2017 in the course of "Mechanics";
2. Proposal 2 to set up a commission for examination in 2018 under the "Mechanics" study course;
3. Proposal for the Change of the auditorium for the Study Programme "Teacher" (Sub-programme "Mathematics Teacher"), from Zeļļu Street 23 to Jelgava Street 3 in 2019;
4. Proposal concerning the establishment of a chess group in 2019.

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.

In order 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 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.

There are no recorded plagiarism findings in the FS PMSMS study programmes, but FPMO pays serious attention to informing students about the risks of plagiarism, particularly by emphasising the correct reference to other authors' works and the correct use of self-citation.

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 organises and compiles data from the following surveys:

- a freshman survey of the first-year students on the commencement of studies, which is conducted electronically once a year. The aim of the survey is to find out the motivation for choosing the study field and programme and sources of information, as well as to evaluate the application and registration process in order to improve the student engagement package. Data is collected and analysed by the UL Department of Studies, but the necessary improvement measures are proposed by the UL governance, faculty governance, programme directors, in cooperation with the UL administrative departments;
- a survey of the first-year students on the first study experience, also conducted electronically once a year. The aim of the survey is to obtain an evaluation of the first study experience at the UL and study support measures to improve the study environment and facilitate student adaptation. The data are collected and analysed by the UL Department of Studies and presented to the faculty governance and departments. The necessary improvement measures are proposed by the faculty governance and the Department of Studies in cooperation with other departments of the University of Latvia;
- In order to find out the students' opinion about the content of the study courses and to obtain the evaluation of the work of the teaching staff, every semester an electronic survey is conducted on the study courses, including study internship, term papers and final papers. Data is collected by LUIS and is available to faculty, programme directors, and the Dean of the Faculty, as well as the Department of Studies. The data is analysed by the programme directors, the dean, and the necessary improvement measures are proposed by the programme director, the dean, and the council of study field. The results are used to prepare annual reviews of study areas, as well as to develop study programme development plans.
- In order to obtain students' evaluation of the study programme for its further development, improvement of the study process, improvement of the quality and study environment, a survey of the students of the last study year on the study programme as a whole is

conducted. The survey is conducted electronically once for each study programme. The results are compiled by LUIS and made available to programme directors and the Dean of the faculty. The data is analysed by the programme directors, the dean, and the necessary improvement measures are proposed by the programme director, the dean, and the council of study field. The results are used in the preparation of annual study field reviews, study field self-assessment reports for the field accreditation and re-accreditation, and in the preparation of study programme development plans.

- In order to identify the main reasons for discontinuation of studies and to facilitate the reduction of drop-out rates, a survey is conducted of students who have expressed a wish to discontinue studies or have already discontinued studies. The survey is conducted throughout the academic year, while the are compiled by the Department of Studies once a semester.
- The aim of the graduates’ survey is to obtain an evaluation of the graduates' satisfaction with the quality of the acquired programme, the knowledge, skills and competences acquired at the University of Latvia, the contribution of the graduated study programme to their employment, and plans to continue studies. The survey is conducted by the programme directors at their discretion, using the questionnaire prepared by the Academic Department;
- The aim of the employers' survey is to determine how employers assess the compliance of the knowledge, skills and competences acquired by UL graduates to the job market. The survey is conducted by the programme directors at their discretion, using the questionnaire prepared by the Academic Department.

Each year, the head of the field of study, in cooperation with the directors of study programmes, prepare a report on the activities of the field of study and the programmes included therein during the academic year. Statistical data is compiled and analysed in the preparation of the report and the information obtained is used for the assessment and development of the field of study. The report includes the following statistical data, which is compiled and analysed annually:

- the number of students in programmes, indicating the total number, the number of students enrolled during year 1, the number of graduates, dropouts, detailing the different study forms, types, languages separately;
- the outgoing and incoming mobility of students, their participation in exchange programmes;
- the composition of teaching staff, indicating the position, the number of academic staff with a doctorate, the mobility of teaching staff;
- the ratio between the number of students and the number of 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 on study courses and the overall programme.

The content of the study programme consists of study courses, so FS PMSMS are highly focused on the results of the survey on study courses. Each faculty member can see an evaluation of his or her study course, but the director of the study program sees the results of all study courses in the study program. The maximum score in each of the criteria is 7 points. The directors of the study programme summarize the students' assessment of study courses each semester, familiarize themselves with comments on each field of study, and, if the score is below 5 or there are problems in the comments, go to talk to the relevant faculty member about the content of the study course or the quality issues of teaching. In some cases, the results of surveys have provided a basis for changing teaching staff. The results of the study course survey are presented by the director of the study programme to the relevant students and discussed on the boards of the departments of Physics and Mathematics and in the Council of FS PMSMS. 2.3.3 “Improving the content of courses and the quality of teaching in study courses” of the FS FMS development plan indicates a percentage increase in the number of courses with an average score of more than 5.5. The results of the survey on study courses against a score of 5.5 in the period from autumn 2016 to autumn 2021 are presented in Annex 2.11 (before the autumn 2016 semester survey was voluntary, resulting in a small number of students). PBSPMS and ABSPM have seen an improvement in the evaluations of study courses over the past two years, in other study programmes valuations are volatile.

Regardless of the surveys of the UL study courses, the FPMO student authority organises mid-term surveys on the presentation of study courses and the quality of content. As a result, problem situations can be seen in the middle of the semester and can be addressed in time.

2.11. graduate questionnaires and results for 5 study programmes PBSPMS, ABSPP, ABSPM, AMSPP, AMSPM (New title for accreditation AMSPMDS) are listed in Annex 2.11. DSPPPAT has no graduates yet. The survey was conducted in the summer of 2021.

The graduates of FS PMSMS welcome the acquired skills to analyse information, operate independently, as well as acquired knowledge in the appropriate field of physics or mathematics. Welcomes the competence of teaching staff. But there are also notes and recommendations to improve study programs, which are a valuable element of feedback. Based on student advice and also taking into account the views of academic staff and employers, the recommendations are incorporated into accreditation-driven study plans and study programme structure. For example, in all four academic programmes, ABSPP, ABSPM, AMSPP, AMSPMDS specializations have been established which, on the one hand, extend the choice of study courses, and on the other, allow specialist in a sub-sector of science. Graduates encourage to allow students to go to practice in their study programmes – all study programmes have planned practices that can be performed either outside the FPMO company, in the UL institutes, or possibly in a FPMO laboratory. The updating and development of new study courses has been considered to address practical tasks, thereby preparing students for professional activities. Thanks directly to students' interest and support, maths courses have been restored in AMSPP limited choice part (“Mathematical physics techniques”, “Accidental processes”, “Complex variable function analysis”).

A survey of employers (Annex 2.11, third survey) shows similar trends as a survey of graduates. The vast majority of employers recognise that, in general terms, the graduates of FS PMSMS working in the company who have acquired their education over the last 3 years were able to carry out their duties after a short period of training/entry into the workplace. The analysis of employers' survey shows that graduates can work with a computer, they have the skills to learn new knowledge and skills, can adapt to new conditions (changing working environments), but not everyone can plan, manage and organise other jobs, make decisions and justify them, and work independently in determining working methods and performance times. The survey shows that graduates of FS PMSMS are competitive compared with graduates of similar programs.

As in the last Annex 2.11, an assessment of the satisfaction of students in the last year of study with the corresponding study programme is presented, i.e. the statement “I am satisfied that I chose this study programme” on the seven-point scale. This assessment shows that all 5 study programmes PBSPMS, ABSPP, ABSPM, AMSPP, AMSPM (AMSPMS) are not ideal (an average score ranging from 5,54 (PBSPMS) to 6.1 (AMSPM)), but is high enough to allow for further development.

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 familiarize themselves with the UL's activities as reflected in digital environment on the internet.

The site consists of the following sections:

- ROTATING NEWS - Significant UL information utilizing the UL visual identity, which has certain characteristics and strengthens the image of the university and promotes its recognition in the digital environment.
- NEWS AND EVENTS - UL current events and planned events. Information is prepared by UL structural units and communication and innovation department.
- 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 published by the Department of Communication and Innovation in cooperation with the Department of Studies and the Department of Student Services.

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 links 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 MORE THAN STUDIES inform 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 organised 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 resumption 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 https://www.lu.lv/par-mums/dokumenti/pasnovertejuma-zinojumi/ (Only in Latvian) contains annual study field self-assessment reports.

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. The content blocks are exactly the same as the blocks on the UL official site, but more specific information is posted directly about the respective faculty activities.

If someone provides a text for publication in a foreign language other than English, a translation of the text in Latvian or a brief summary must be added.

The heads of the departments of UL is responsible for preparing, correcting and updating the information within the competence of their departments on the site. The content administrators of the department websites is responsible for maintaining the homepage, inserting the prepared information and updating it on a regular basis. The person responsible for placing the content is a marketing or public relations specialist or coordinator under the supervision of an existing website, or an employee who has completed a short TYPO 3 training course in placing the content under the control of the ITD.

From the UL site you can reach the website of the Physics, Mathematics and Optometry Faculty (FPMO) through a faculty business card. The faculty website https://www.fmof.lu.lv/en/ is a central page that summarises the topical information of the faculty, informs about what is happening in institutes and organisations under the auspices of the faculty. Information is available in Latvian and English on the faculty page. On the faculty home page, the information is grouped in the following sections: "News," "I want to study at FPMO," "Students," "Research," an additional available event calendar, and a contact section. Individual information blocks summarise information on study opportunities, grouped as follows: "Bachelor's degree programmes", "Master's programmes" and "Doctoral Studies".

Sections include grouped information about possibilities for students at different levels, prospective students and pupils, and alumni. Under the heading "I want to study at FPMO", information is available on all levels of faculty programmes as well as classes and interest schools for high-school students, open-door days and opportunities to familiarise themselves with the life of faculty studies, as well as a special section on "Further Education".

In the "Students" section, current study information – lectures and schedules, scholarships, studies abroad is available. Links to e-learning, libraries, sports facilities, information on dorms and cultural developments in UL are listed. Useful resources, samples of various applications, practices and job offers are also available.

The "Research" section contains information on research departments, in total 10 departments, research projects and specific industry conferences.

Information on faculty departments, employees and academic staff is available under the heading "About Us". The Heading holds information about the faculty choir, the Student Council. This section also contains a summary of the media coverage of faculty, official logos and visual materials.

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 UL system for funding the field of studies and the corresponding study programmes is based on the *Law on Higher Education Institutions*, Cabinet of Ministers Regulations No. 994 (12.12.2006) *Procedures for Financing Institutions of Higher Education and Colleges from the Funds of the State Budget*, Cabinet of Ministers Regulations No. 445 (05.07.2016.) *Regulations Regarding Remuneration of Teachers* and other external and internal regulatory enactments.

For the successful implementation of the FS, UL should provide sufficient financial resources for the entire study process, including the remuneration of 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 associated with the organisation of the study process.

The remuneration of the teaching staff include:

- costs of contact hours (e.g., lectures, seminars, practical and laboratory work);
- costs for the management, advising and testing of independent work ;
- cost of methodological work (preparation for classes, preparation of new courses, etc.);
- costs of managing and evaluating student works, including reviews;
- costs of managing and organising practices;
- costs of research by teaching staff to ensure the development of new study materials.

The rules for the formation of the remuneration of teaching staff (standards for planning and accounting of the amount of work of academic staff) in UL is determined by an order of the rector for the whole university. Taking into account the specificities of studies and the resources available, the faculty management may prescribe different norms, in coordination with the Vice-Rector of the relevant field.

Costs related to the organisation of the study process:

- the costs of general staff include the costs of the remuneration of staff supporting the implementation of studies, organisation and provision of faculty activities;
- other costs are the other direct costs associated with the specific study programme, such as external services, premises, equipment rental, transport rental, etc.;
- infrastructure costs - cost of rooms, including utility charges, repairs and maintenance;
- the cost of goods and services includes material and methodological provision of the study programme, including technical equipment, visual materials, professional development (experience sharing, training), etc.;
- indirect costs include the University's total operating collateral (IT, finance, staff, marketing, etc.) costs and investment in development.

In order to assess the amount of funds needed for financial provision, UL calculates the cost of each study programme according to a methodology developed by UL that takes into account all the costs of providing the study process described above and the information on the plan for a specific study programme, the participating faculty, the planned number of students, etc. aspects, thereby ensuring the reliability of the forecasts.

Funding of studies in UL - sources of funding

For the provision of the resources necessary for the development of studies, UL uses (1) a State budget grant (taking into account the basic funding specified by the IZM, the level of the programme and the field of study) from the Education and Science Ministry and (2) study fees.

The tuition fee for UL is determined taking into account:

- the cost of the study place, including all the costs of the study process;
- study fees for similar programmes in other universities;
- the interest of potential paid students in the curriculum;
- the estimated funding of the State budget for the study place;
- the opinion of the UL Student Authority

Tuition fees are set for the following academic year at the end of each year in order to ensure timely availability of information. The fees to the student during the course of the studies do not change, except where the fees vary by year in the programmes, but also in that case they are determined at the beginning of the study.

For the development of study programmes (development of new courses, improvement of existing ones, development of methodological provision and other aspects of the programme), revenue from lifelong learning or other services may also be used, as well as the accumulated financial resources of the unit. Where necessary, financial support may be provided from the UL Quality Development Fund, where annually the budget of UL reserves an amount to address the various issues of faculty, including the development of new study programmes and the development of existing study programmes.

Research funding sources for academic staff, such as scientific activities, participation in international projects, publication of scientific articles, preparation of applications for international projects, organisation of scientific activities in UL, implementation of scientific development projects and long-term commitments etc, are also directed indirectly to the development of study programmes. In participating in these activities, academic staff develop their professional and research expertise, often involving students who have a positive impact on the quality of the study process.

For data on available funding for a specific study programme, see the description of study programmes in the relevant sub-chapter "Funding of the study programme".

Funding of studies in UL - Redeployment of funding received

All income from the State budget and study fees, as well as from other sources to be used to fund the study process, through prior deductions of indirect issues for centralised issues in accordance with the current reallocation arrangements, is channelled to Faculties for use.

Within the framework of the budget of the current year, Faculties act independently with the funding received. The dean of the faculty and the executive director who carries out operational financial management are responsible for the rational use of financial resources.

Accounting for actual profitability at the faculty level takes place without separately releasing the results of each programme or specific field of study. At the same time, the faculty management follow the outcome of the study process, the dynamics of the number of students and the factors affecting them, the cost balance of the specific programme with the State budget grant and study fees and, if necessary, make the permissible adjustments to the study process organisation in order to ensure the long-term viability and development of the direction of 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 material and technical support for the study process for FS PMSMS consists of:

- world level training and research facilities at UL Academic Centre in Riga, Jelgava Street 3,
- including two computer classes with 18 and 30 places;
- “simple” and specialised software, including *LabView*, COMSOL, *MatLab*, *Mathematica*, *Ansys*, *R* etc.

The study programmes have a synergistic effect in cooperation with the UL institutes, DU research laboratories (IN the CASE OF AMSPP), using the infrastructure of institutes in laboratory work and in the development of Master's Thesis.

The implementation of mathematical modelling courses is supported by the licences available at UL *for MatLab* and COMSOL.

Space provision in UL is sufficient. For example, table 2.3.2.1 shows the provision of spaces in the UL Sciences Building, as well as the equipment for these spaces.

Table 2.3.2.1

Room provision and equipment on Jelgava Street 3

Room number	Room Name	Area, sq. m	Number of seats	Comment	Chalk-board	Whiteboard	Projector	Presentation display	Interactive blackboard	Acoustic system
103	AUDITORIUM (medium)	82,9	42	Combinable	+		+		+	+
104	AUDITORIUM (medium)	98,6	56			+		+		+
103/104	AUDITORIUM (medium)	181,5	98		+	+	+	+	+	
105	AUDITORIUM (medium)	113,2	56	Combinable	+		+		+	+
106	AUDITORIUM (medium)	138,5	78			+		+		+
105/106	AUDITORIUM (medium)	251,7	134		+	+	+	+	+	
110	AUDITORIUM (large)	405	386			+	+			+
201	AUDITORIUM (small)	90,4	36			+	+			+
202	AUDITORIUM (small)	60,8	32			+			+	
203	AUDITORIUM (small)	76,8	40			+	+			+
204	AUDITORIUM (small)	76,9	36		+		+			+
205	AUDITORIUM (small)	62,2	32		+				+	

206	AUDITORIUM (small)	66,3	36		+	+			+	
207	AUDITORIUM (small)	92,3	42			+	+			+
208	COMPUTER CLASS	100,7	30			+	+			+
209	COMPUTER CLASS	57,8	18			+			+	
226	OPEN AUDITORIUM	350	210	Cordless microphone in equipment			+			+
301	AUDITORIUM (medium)	131,9	72			+	+			+
401	AUDITORIUM (medium)	108,4	63			+	+		+	+
501	AUDITORIUM (medium)	131,9	108		+		+			+
502	SCIENTIFIC LABORATORY	35,6	4	Demonstration office						
503	SCIENTIFIC LABORATORY	65,4	17	Electronics laboratory		+	+			+
505	TRAINING LABORATORY	60,6	24	Practicality		+		+		+
506	TRAINING LABORATORY	7	4	Practicality						
507	TRAINING LABORATORY	64,7	20	Practicality		+		+		+
508	TRAINING LABORATORY	77,6	28	Physics for non-physicists		+			+	
532	WORKSHOP ROOM	45,8	20		+				+	
650	WORKSHOP ROOM	45,9	20			+			+	
725	WORKSHOP ROOM	74,5	22			+	+			+
736	CONSULTATION ROOM	30,1	10	Equipped for video conferences	+				+	
801	WORKSHOP ROOM	38,8	14							
802	WORKSHOP ROOM	53,8	14						+	
804	WORKSHOP ROOM	56	14	Equipped for video conferences					+	

The technical engineering base for training and research departments provides strong and modern support for the implementation of the study programmes of FS PMSMS:

- in particular, the development of graduation papers and the implementation of academic practices;
- support for study courses in which laboratory facilities are used in one of the parts;
- The modern and major research infrastructure of UL is complemented by a significant number of facilities and infrastructure facilities at the disposal of institutes and laboratories, particularly useful for research programmes in the physics sector. FPMO is the Magnetic Soft Materials Laboratory, Laser Centre, Numeric modelling Institute, Statistical Studies and Data Analysis Laboratory, UL contains the Astronomy Institute, the Institute of Physics, the Institute for Mechanics of Materials, the Institute of Atomic physics and Spectroscopy, the Institute of Chemical Physics, as well as the Institute of Solid State Physics and the Mathematical Institute. institute of mathematics and informatics. For example, the UL Astronomy Institute has the largest optical telescope in the Baltics (Schmidt telescope), the UL Institute of Physics contains a powerful electromagnet (up to 3T), while the UL Institute of Solid State Physics contains a large number of installations, including clean rooms for the implementation of micro-and-nanotechnology processes, electron microscopes and equipment for microdevice prototyping.

The FS PMSMS is provided with the necessary support staff. The teaching staff and students have 2 senior methodologists 2 IT specialists, 2 senior secretaries, 4 senior technicians and 3 technicians, 1 space planning co-ordinator.

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 UL Library has been included in the Library Register (BLB1000) of the Ministry of Culture and accredited in the status of the State Library until 2022.

Access to UL Library Information Resources and Services, Working Time

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

Services are provided in the 8 sectoral libraries of the UL Library in accordance with the *Regulations for the use of the Library of UL* (07.01.2021. Order No 1-4/9 of the rector of UL). The services can be used by UL students, teaching staff, staff, other libraries, students from other universities, as well as every citizen, according to the terms of use. The UL Library provides basic free services and charging services.

The working time of sectoral libraries is tailored to the convenience of users. Working days from 9.00-20.00, in separate sector libraries from the beginning 9.00-18.00, on Saturdays from 9.00. -17.00. The Science Library and Science Building Library are available 7 days a week for 24 hours a day. Three industry libraries have been opened for customers throughout the year, also during the summer period.

In the Science Library, UL staff have the possibility to use throughout the day: free stocks, self-service books for home service, extension and transfer of usage, computers, mobile phone charges. In the Science Building Library, staff in UL have access throughout the day: a free-access stock, two self-service facilities for issuing books at home, extending and transferring usage times, and a self-service wall for the use of portable computers. The UL Library is the first in the Baltic States where such facilities and services are provided. The self-service equipment is equipped with 36 portable computers. UL personnel can remove portable computers and use them for 6 hours, not only in the library area, but throughout the building, using student or employee certificates. On all portable computers, users have access to licensed programs required to carry out their own work: *Wolfram Mathematica*, *Mathworks*, *MatLab*, *Autodesk Inventor*, *wxMacMolPlt* u. c.

The rooms of the Science Building Library, in which the collection of the physics and mathematics sector is located, are open to students at a comfortable time of 24 hours a day for 7 days a week. A free-access stock is available for users. The Science Building Library is located on the 2nd floor of the building alongside auditoriums, computer classrooms and the Information Centre in rooms with a total area of 533 m².

There are 110 places available to users in the Science Building Library. The user can use any workplace in the building to work with a portable computer.

Basic free services

- Electronic commissioning/reservation of information resources/extension of time limits for use in the national catalogue of libraries of State importance (Catalogue) and the receipt of information resources for use on the site in the library reading room or for taking home.

The service is available to people registered in the UL Library using the Catalogue from any mobile device and location where the Internet is available.

- Supply of information resources

The academic staff, researchers and doctoral candidates of UL, when ordering information resources in the Catalogue from any library, have the possibility to indicate the most convenient location for the reserved information resource, the branch library. For other users, this option is available when ordering information resources only from Storage.

- Self-service

A self-service scanner is available to users in all branch libraries. In 5 sector libraries, self-service facilities are available for the issue/transfer/extension of books. A wall of self-serving computers with 36 portable computers is available to users in the Science Building Library.

- Use of free-access reading rooms, computers and the Internet

Reading rooms can use reference literature and periodicals, fixed and portable computers (both UL Libraries and users' personal), internet connections, including WI-PI, operating in all UL buildings. There are 110 jobs available to users in the Science Building Library. Electricity connection rosettes are installed alongside the workplaces, allowing users to use portable computers (both personal computers and 36 portable computers from the Science Building Library) in any convenient place.

- Night subscription, advance reservation of information resources

The purpose of the “Night Subscription” service is to ensure that certain information resources outside the UL Library can be used free of charge from close to opening. You can reserve the information resource in advance for specific hours. If the information resource is not released on time, a contractual penalty is applied for delaying its term, according to the UL Library Paid Services Price List.

- Summer delivery of information resources

Once a week, users, in the most convenient branch library (Library on Raiņa Bulvāris, Science Library, Science Building Library), may receive the information resources reserved in the Catalogue from the Storage.

- Inquiries and consultations

User information services – counselling, referral, training and support for research is one of the main areas of work of the UL Library. The UL Library Consultant and the staff of the sectoral libraries provide bibliographical, thematic, factual, address, fine-tuning and counselling for UL students, academic, scientific and general staff.

The chief reference adviser of the UL Library (Library on Aspazijas Bulvāris) provides the official and total information service of the UL Library. Users are consulted electronically: info-bibl@UL.lv, telephone: 28623551, *WhatsApp* 28623551 via *Skype* - Address: UL Library Consultant. Advice is also provided by any industry library employee on the site in the library or by phone via email, *Skype*.

In cases of confusion, users can also use the options available in the Library section of the UL portal: "Ask the librarian", "Frequently Asked Questions", "Give your opinion".

- User training

Training is organised to develop users' skills to work independently, find, evaluate and use information resources and e-environment tools. The library is working actively with audiences – students, academics, scientific and general staff at all levels of study – to promote not only informational skills but to provide in-depth knowledge and skills in the work of electronic resources.

The library organises and leads presentations, classes in audiences and computer classrooms, on-site and remotely. Organise practical training tours in the Library so that users acquire the skills to work with free stock, self-service equipment and office equipment – self-service scanners, copiers, thereby improving the competence of self-learning.

Special attention is paid to foreign students. The library has prepared and conducted presentations in English, *"Step by step, the library of UL – for you!"*, teaching in computer classrooms with e-resources skills.

The following lessons are for students of bachelor's studies: presentation "Step by Step: Library for You", classes "Electronic co-catalogue and Primo for Your Successful Studies" (90 mins), "Know e-resources" (90 mins), "E-resources in the sector" (90 mins), e-Course "Introduction to information" (Part C course).

Masters and Resident students are guided by the "e-resources sector" lesson (90 mins), providing advanced skills to work with the electronic resources of the sector concerned.

Doctoral programmes provide students with the following lessons: "Introduction to the Scientific Publication Process" (90 mins), "Bibliography and Citing Management Tools" (90 mins), "Using Databases *Web of Science* and *Scopus* in Studies and Research" (90 mins).

Classes for academic and scientific staff include: "Using databases *Web of Science* and *Scopus in* study and research work" (90 mins), "Introduction to the drawing up of bibliographical references and references to information sources" (60 mins), "Reference management tools: a convenient solution for writing, quoting and preparing the list of authorities used (*Mendeley* and EndNote) online *or* Basic) "(90 mins), "Introduction to the Scientific Publication Process" (90 mins), "Open Access" (90 mins), "Doi *(Digital Object* Identifier) Index Registration" (30 mins), "Introduction to Research Data Management" (90 mins), "ORCID: Organisation, Registry, Profile Building" (30 mins), "deposit of research results in UL's e-resources repository (90 mins), "Introduction of publications and editing of publication lists on LUIS" (90 mins).

The employees of the UL Library also manage classes for students at the UL branches: Aluksne, Bauska, Cesis, Jekabpils, Kuldiga, Madona and Tukums.

Paid services

The list and price list of the fee services of the UL Library was approved by Order No 1-4/387 of the UL Rector of 10.08.2021. on the price of the UL Library's fee services.

- Create a list of information resources

The specialists of the UL Library prepare a list of information resources on the topic of interest to the user, such as in the process of developing studies or other types of work. The user may order the list by electronically completing the electronic application form.

- Interlibrary subscription (hereinafter - SBA) and International Interlibrary Subscription (hereinafter - SSBA) services

The UL Library offers to order information resources that are not in Latvian libraries from other libraries in Latvia via SBA and worldwide through the SSBA service. You can also receive an electronic copy of a scientific article in the form of printing and e-mail.

Library stock, stock replenishment procedure

The UL Library builds the stock according to the directions of UL studies and scientific work, the requirements of study programmes, providing information to all levels of UL studies – the fields of Bachelor, Master, Doctor and Scientific Research. Purchasing e-resources is a priority in creating an item.

The purchase of new information resources in the stock (purchase of books, subscription to databases and periodicals) is carried out in accordance with the funding allocated centrally by UL, which is approved annually by the UL order. The funding allocated is used to purchase the necessary books, to pay the databases subscribed to in the industry and to subscribe to recurring expenses.

The library provides for the purchase of information resources on the orders of UL academic staff, a proposal from the student authority or a proposal from Library employees that are entered BY LUIS and approved by the dean or CEO of the faculty.

In 2022, the Library's users have access to the **1.8 million** Information Resources Units. According to the UL study and research infrastructure, the UL Library stock is located in 8 sector libraries and Storage.

Literature available in the UL Library for the implementation of the FS "Physics, Material Science, Mathematics and Statistics" (PMSMS)

For the period from 1 January 2013 to 17 January 2022, the UL Library stock has been added to a total of 1124 names in the physics and mathematics sector, of which 440 titles is available in the Science Building Library (see page Table 2.3.3.1.). The printed item includes books, serial publications, periodical expenses, doctoral theses in the field and summaries thereof in Latvian, English and Russian. The printed stock is also supplemented by 52 titles 88 copies of digitally borne documents (CD-ROMs) in the mathematics and physics sector, which were admitted to the UL Library stock during the reporting period.

Table 2.3.3.1

Printed issues, UL Library stock

Printed issues entering the inventory from 01.01.2013 to 17.01.2022.			
Total in the UL Library		***of which*** in ***Science Building Library***	
Titles	Copies	Titles	Copies
1124	**5956**	**440**	**1445**

The UL Library stock has been supplemented by 416 titles issued after 01.01.2013, of which 248 titles are in the library of the Sciences Building (see page Table 2.3.3.2.).

Table 2.3.3.2

Printed editions, Science Building Library Collection

Printed issues issued from 01.01.2013 to 17.01.2022.			
Together in the UL Library		***of which from Science Building Library***	
Names	Copies	Names	Copies
416	**1113**	**248**	**462**

Stock digitization level

The UL Library, in collaboration with the UL Information Technology Department, provides customers with free online access to the UL e-resources repository http://dspace.lu.lv. A mobile version of the repository is also offered for user amenities. In the UL e-resources repository, UL Library, publishing authors, representatives of UL departments regularly place electronic versions of their publications, digitised information resources with cultural and historical value, doctoral theses of UL teaching staff and summaries thereof in order to ensure free and constant online access to UL scientific achievements.

Digitised issues covered by the copyright; the UL Library offers to be used on-the-spot in the sector library reading rooms.

At present, more than **3143** publications under the heading "Physics, Material Science, Mathematics and Statistics" (PMSMS) are available in the eResources Repository.

Electronic resources

In line with the UL Strategic Plan, the UL Library is increasing the share of e-resources and developing remote access opportunities for e-resources.

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

In total, 42 e-resource platforms are available in UL in 2022 (both e-book platforms *VLeBooks, ProQuest Ebook Central* and e-magazine databases - *Cambridge Journals Online* (available archive until 31.12.2018.), *EBSCO Central & Eastern European Academic Source*, *Emerald eJournals Premier* (available archive up *to* 28.02.2020.), JSTOR I-XII, XIV, XV and Life Sciences Collections, HeinOnline, Oxford Journals Online, Sage Journals, ScienceDirect, SpringerLink Contemporary Journals, Taylor & Francis Social Science & Humanities Library, Physical Review Journals, Westlaw, Wiley Online Library E-Journals Full Collection and separately purchased e-journals (*e.g.* Nature), *both Lursoft Times Library NEWS.LV* and Reference Resources - *Online LETA news (LETA)* Archives *and Nozare.lv*, Letonica, both tools – *Sage Research Methods, Passport, Orbis, Overleaf Commons,* MarketLine and mixed databases – *ClinicalKey, Culturethèque, European Pharmacopoeia, LVS Latvia Standards Online Reading Room, OECD iLibrary, ProQuest Dissertations & Theses Global, ScienceDirect, Scopus, UpToDate, Web of* Science Core Collection). In total, there are 17 357 full-text e-logs (including individual subscriptions), approximately 211 296 e-books, more than five million full-text and annotations of world dissertations and master works. UL has access to verified 174 open access databases with multi-format materials.

Each year, the UL Library offers an average of 110 new electronic resources. Total to 01.02.2022. The UL Library has purchased 1555 e-books, with ~ 211 296 e-books available in the subscribed collection *of ProQuest Ebook Academic Complete*.

The UL Library evaluate and analyse the interoperability of the subscribed databases twice a year. Data from the statistics of the e-resources subscribed to UL for 2021 show that, overall, the availability has increased by an average of 9.72% compared to 2020. There is a marked increase in individual usability for foreign multisectoral databases, a slight fall for the Latvian database *LETA* (soc. direction), the foreign database *OECD iLibrary*, *Oxford Journals Online*, the cityability databases *Scopus* and *the Web of Science*. In 2021, the use of *the Physical Review Journals* database subscribed to UL FPMO decreased by 36.79%, while the use of the *Overleaf* tool co-financed by UL Facularies of Science, including Physics, Mathematics and Optometry Factors, shows the relevance of its availability to UL in 2021.

The UL Library regularly provides pilot access to different databases, on average around 10-15 access is organised per year for pilot resources. This information is available in both Latvian and English on the home page of the UL Library under the heading "News", "E-resources available for trial period", "E-resources A to Z" and LUIS "My Portal" under the headings "Databases," "Libraries" and "Students and Employees".

The information collected on e-resources is available on the website of the UL Library, *E-resources A to Z* and "E-resources by discipline", as well as "My Portal" under the heading "Databases".

UL offers the possibility to use subscribed electronic information resources (databases, e-book platforms) outside the UL computer network by connecting with LUIS's user name and password, in some cases with personal profile access data created while in the UL IP address.

To 31.01.2022. There are four individual e-editions that contain materials according to FS PMSMS available in the UL Library collection: the UL Library's subscribed e-journal *Nature*, the FPMO individually subscribed e-journals *The Physics Teacher* and *Magnetohydrodynamics*, the KF individually subscribed to *the Journal of Chemical Education*.

Subscribed e-resources in individual study fields, including materials for the purposes of "Physics, Material Science, Mathematics and Statistics"

Jurista Vārds – the largest recurring, specialised, legal issues in Latvia. *Available at the UL Library on Raiņa bulvāris.*

***Marketline*,** a statistical data database with statistical data available for more than 3,000 major cities in the world from a variety of social and macroeconomic statistical aspects. *Available at the UL Library on Aspazijas bulvāris.*

***ORBIS* -** The database provides statistical information about 300 million world companies, public and private companies. *Available at the UL Library on Aspazijas bulvāris.*

***Overleaf Common*,** an online LaTeX co-operation tool suitable for the work of representatives of the biology, chemistry, earth sciences, computer science and mathematics industries.

***Passport*,** the information resource of *Euromonitor International* in international business and marketing, economics, international relations, tourism and social sciences. *Available at the UL Library on Aspazijas bulvāris.*

Physical Review Journals - gives access to journals issued by *the American Physical Society (APS)* in the physics sector.

Multisectoral e-resources subscribed, including materials for the purposes of "Physics, Material Science, Mathematics and Statistics"

***Cambridge Journals Online* –** a multi-sectoral database of e-journals from Cambridge *University Press*, which offers the ability to search for information in more than 300 scientific journals as well as related Internet resources. The database contains full texts in study fields such as physics, mathematics, computer science, chemistry, biology, ecology, geology, medicine, etc. UL available e-resource archive until 31.12.2018.

EBSCO *Central & Eastern European Academic Source* – offers more than 400 full-texts of magazines in areas such as physics, mathematics, u. c. for the Central and Eastern European regions.

Emerald eJournals Premier - a multi-sectoral e-journal full-text database containing information in study fields such as statistics, mathematics, biology, computer science, medicine, economics, entrepreneurship, education, etc. *An e-resource archive available to UL up to 28.02.2020*

JSTOR – Journals, Books and sources Database, with issues from leading publishing houses: *Sage Publications, Springer, Taylor & Francis, Blackwell Publishing, Cambridge University Press, Oxford University Press, John Wiley & Sons*. c. The chronological coverage of issues extends to the beginning of their issuance. A number of extensive collections of materials are available under the UL subscription, including *the Life Sciences* Collection, which includes materials in technical sciences in general, mathematics, statistics.

Latvijas standarts - Document Set of the Latvian National Standardisation Institution. Access to the online reading room of Latvian standards for the UL Library provides more than 44 000 full-texts of Latvian standard documents in electronic format (national, adapted European (EN) and international (ISO, IEC) standards and their historical versions without prejudice to ICS groups). The standard item is updated and updated with pre-publishing standards, new versions, translations, amendments and adjustments.

LETA – News, Archives and Nozare.lv – offers the possibility of searching for operationally published news, photos, videos, press releases, articles from the Latvian press, statistics and other information.

***Lursoft* newspaper library NEWS.LV -** The Latvian electronic version library provides access to **more than 100** newspapers' current and archival articles.

Nature – one of the world's leading industry journals in an electronic environment, issued by *Springer Nature*. As part of the UL subscription, the latest full-text magazine numbers are available and the journal archives are available for the period 2017-2021.

The OECD *iLibrary*, a full-text database compiling books, articles, reports and statistics issued by the Organisation for Economic Cooperation and Development.

Oxford Journals Online – the collection provides access to more than 350 authoritative and leading *Oxford University Press* journals issued in collaboration with the world's most important scientific organisations. The database includes full-text journals with high quotation index scores in different science study fields: physics, optometry, data science, computer science, biology, mathematics, life sciences, physics, humanities and social sciences, etc.

Proquest Dissertations & Theses Global – the largest database of dissertations and masters works in the world – contains more than five million jobs in different industries: natural and medical sciences, humanities and social sciences.

***Proquest Ebook Central Academic Complete Collection*,** a collection of *ProQuest* electronic books available on *the ProQuest Ebook Central* platform. It has available around 211 296 e-books from major publishing houses in all study fields, including many university publishing houses.

SAGE *Journals* – the full-text journal database of the publishing company SAGE, which offers articles from more than 1100 journals. The database represents a variety of sciences, including material science, statistics, data science, biology, bioengineering, computer science, mathematics, etc.

Science, life sciences and medicine, and humanities and social sciences. The database contains information about several thousand journals and books issued *by Elsevier*. The full texts of around 2650 journals are available for UL, mainly from 2002 to the latest journal number, as well as more than 350 e-books.

Scopus, a database of bibliographical and quoting information from the publishing company *Elsevier*, containing records of over 21 000 journals, 86 000 e-books and 6.8 million conference materials, as well as 27 million patents. The database includes study fields such as material science, physics, chemistry, biology, computer science, mathematics, etc.

Springerlink Contemporary Journals – the full-text database of the company'*s Springer Nature* magazines, which offers access to more than 6 million articles from more than 3,400 journals, covering fields of science and social sciences.

Taylor & Francis Social Science & Humanities Library, a full-text database for humanities and social sciences journals, includes materials including sociology, statistics, mathematics, data science (available free resources to support FS FMS).

The WEB of Science – database contains the most significant scientific information about more than 12 000 journals, offering bibliography and quoting information, summaries and other information. Sectors such as physics, mathematics, chemistry, material science, biology, computer science, optometry, medicine, nature, social and humanities are included.

Wiley Online Library E-Journals Full Collection – more than 8 million full-text articles are available in over 1600 reviewed multisectoral journals, including mathematics, physics, biology, computer science, data science, etc.

E-books available in the UL Library, including information resources for the purposes of FS PMSMS

Vlebooks – e-books platform, which together makes available **145** UL Library e-books from the world's leading publishing houses, including materials for the “Physical, Material, Mathematics and Statistics” (e.g. *Wiley-Blackwell, Pearson, Routledge,* CRC *Press, Academic Press, Springer*, etc.), 44 of them covered between 2013 and 2016.

The Proquest Ebook Central Academic Complete Collection – the e-book platform *ProQuest eBook Central* subscribed to a collection of **23 316** subscribed expenses according to the “Physical, Material, Mathematics and Statistics”, of which **6155** were issued between 2013 and 2022. There are also separately purchased **73** e-books, according to the “Physics, Material Science, Mathematics and Statistics” study heading, from the world's leading publishing houses (e.g. CRC *Press, Springer International, Princeton University Press, John Wiley & Sons, Elsevier, Cambridge University Press,* u. c.), 57 of which were issued between 2013 and 2021.

Free-access resources, including information for the purposes of the heading “Physics, Material Science, Mathematics and Statistics”

ArXiv.org, Bookyards, Bookboon, Cogent OA, Cognitive Science Society's Journal Archive, Cogprints, *Digital Library of Information Science and Technology* (DLIST), *De Gruyter Open*, *Directory of Open Access Books* (DOAB), *Directory of Open Access Journals* (DOAJ), EBSCO *e-book Open Access Collection*, EBSCO *Open Dissertations, Encyclopedia for Life, Eu* DML*, Eurostat, Data F1000 Research, Git, Hub, Google Scholar, IEEE Open, Journals for* Free, LR Central Statistics Office Database, mdpi, oapen*, Open Research Europe Open Access Platform,* Optipedia, Periodika.lv*, Science Books Online,* ScienceOpen, spie. *Digital Library, Springer Open*, *Sw* MATH, *Wiley Open Science*, *Wolfram MathWorld*, *WordlWideScience.org*, ZbMATH *Open*, *Zenodo*.

Conclusions

Information and methodological provision of the FS include the physics and mathematics study fields and the information resources of their sub-study fields. The share of newly issued printed issues (from 01.01.2013) against printed issues received in the UL Library stock during the reporting period is 37% and 56,3% in the Science Building Library. Overall, printed issues entering the UL Library in Latvian and Russian accounts for 53%, 47% in English, 59% in English, 34% in Latvian, 7% in Russian.

The library's stock is generally in line with the implementation of studies and the development of scientific research, as it is complemented each year with the most up-to-date information resources in line with the informational needs of 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.

The UL Information Technology Department provides students and employees with the MS *Office* 365 application package, which is a cloud-technology solution. *Office* 365 provides students and employees with the best tools for contemporary studies, such as *Outlook*, *Forms*, *OneNote, Sway*, and *an Office* program package that includes *Word*, *Excel*, and *Powerpoint* programs.

In addition to MS *Office* 365 UL, students and employees are provided with software such as SPSS, *Question Pro*, *Autodesk*, *Mathworks*, *Mat* LAB, *Esri Arc*GIS.

Remote study and distance learning programs use one of *the Office* 365 online applications *Microsoft Teams*, which provides both online lecturing and online communication with students.

In addition to the MS *Teams* programme for a remote study process, UL offers its students and employees the UL information system *BigBlueButton* ("BBB system"), which is an online video conferencing system for the open code web. BBB provides UL to staff from the online organisation of events, including students and visitors to UL events, and can be used as an integrated solution, both in the e-study system (only the users registered in the course) and outside the e-study system, where the UL web conference server must be connected to the https://bbb.UL.lv web browser.

There are two e-education environments available in UL – estudijas.lu.lv and edu.lu.lv. The e-studies environment estudijas.lu.lv is intended for the provision and management of the study process and the e-education platform edu.lu.lv has been developed for e-education projects, activities and courses, as well as distance learning programmes.

Both e-education environments use the open-code e-learning environment MOODLE, a modular object-oriented dynamic learning environment, and currently not only the most methodically and pedagogically efficient but also the most cost-effective e-learning solution. IN MOODLE's e-study environment, courses have been established in which students have access to the necessary study materials and activities. It is possible for teaching staff to perform both student evaluation and to register a study visit.

For data storage in the study process, both students and employees in UL provide *the Office* 365 Cloud service *for OneDrive* 1TB. *OneDrive* is *a Microsoft* Cloud service that connects to all user files. This allows you to save and protect files, share files with other users, and access them from any location on all your devices.

For data transfer, UL offers its students and employees a bulk file transfer system in store.lu.lv. This system allows you to send files that cannot be sent by e-mail due to their size, but is not intended for long-term storage.

Computers with adequate software support, permanent and Wi-Fi internet connections, and the possibility of teleconferencing, are available in sufficient quantities in both libraries and teaching and scientific laboratories.

The staff of FS PMSMS (with the exception of junior colleagues) have long-standing experience of teaching higher physics and mathematics courses, while at the same time being open to modern learning of student-centred education. Employees have the required experience of using the e-learning Environment (MOODLE) to successfully create an e-study environment for each field of study. Teaching materials created by teachers are provided for the majority of study courses in the e-environment:

- original course notes,
- task kits,
- descriptions of the works of the laboratory.

in an e-study environment, it is possible to test the knowledge of students both in the form of tests and by requiring the submission of written materials (task solutions, laboratory work reports, etc.).

The exchange of experience between generations is provided by the process of class observation.

The “UL MOODLE Course Builders Guide 2019” is available for the development of e-learning materials, as well as

- issues and advice in e-studies,
- instructions, Internet resources,
- video teaching,
- Rules for the use of the Information System.

UL workshops are underway to analyse new teaching methods, contributing to their learning and implementation in the study process. In addition to existing materials, the development, burial and introduction of study materials IN the MOODLE environment is gradually underway. In addition, vocational development activities organised centrally in UL contribute to the development of teaching skills.

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* (available in section *Other attachment*s, available only in Latvian)
- *Procedures for the Recruitment of Unelected Teaching and Research Staff at the University of Latvia* (available in section *Other attachment*s)

There are three teaching groups in UL: elected teaching staff, teaching staff performing the duties of elected academic staff (also, guest teachers), and unelected academic staff.

In the case of elected academic positions, as well as performers of their duties, selection and recruitment take place in accordance with *Regulatory Enactments on Academic and Administrative Positions at the University of Latvia* (Only in Latvian). According to the Statute, UL has the following academic positions: Professor, associate professor, docent, leading researcher, lecturer, researcher, assistant, scientific assistant.

Decisions regarding the need for the establishment of certain posts is taken in faculty. Contests for elected academic positions are openly launched. Information on the competition, including job description is published on the UL website 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 complies with the requirements specified in *the Law on Higher Education Institutions* may apply for competition.

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, leading researchers, lecturers, and assistant professors (docents) – by the respective Faculty Council), however in the case of associate professors and professors – by the relevant Professors Council. Elections must take place within two months from the date of the call for applications. The personalia – docents, lecturers, assistants, leading (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 2nd 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 Statute, the minimum requirements for all applicants for academic positions are specified, i.e., the knowledge of the official language in accordance with the requirements of regulatory enactments, the knowledge of foreign languages at the level necessary for the fulfilment of academic duties and the continuous development of their academic and scientific qualifications. The other requirements are already different depending on the academic position in question, for example, in order to qualify for a docent post, as required by a doctoral degree, while associate professors have even higher requirements, i.e., there should be significant academic and pedagogical experience, a broad number of publications and experience in participation in scientific projects.

If, on a proposal from the department, the Senate decides not to declare the competition for office, a guest doctor may be recruited, while a teacher of hours is more relevant to the development plans and needs of the faculty, the teacher enter into a contract for a specified period (usually at the time of teaching). Decisions relating to the selection, address and recruitment of candidates is taken in these cases by departments, i.e., faculty. In these cases, only control is centralised, which ensures that the remuneration specified by the unit complies with internal and external regulatory enactments.

With the person elected to the academic position, the Rector enter into an employment contract for the entire election period.

The election of the teaching staff of FS PMSMS is in accordance with the procedure described above. For example, in order to ensure the development of the academic staff, the following teaching staff have been elected for the first time as professors and associate professors: I. Bula (Prof. Mat, 2013), J. Buls (Prof. Mat, 2013), S. Lācis (Assoc. Prof. in Physics, 2016), I. Uļjane (Assoc. Prof. Mat., 2016), J. Valeinis (Prof. Mat., 2017), Ģ. Barinovs (Assoc. Prof. in Physics, 2019), V. Kaščejevs (Prof. Physics, 2019), U. Strautiņš (Prof. Mat., 2019), A. Šarakovskis (Assoc. Prof. in Physics, 2019). A much longer list has those teaching staff who have become scientific assistants, lecturers and docents for the first time.

FS PMSMS has relatively many university teachers who have a working relationship with FPMO for a given term (one semester or all academic years, depending on teaching courses, but can be repeated several times). In general, teaching staff who have just expressed a desire for academic work or have a different place of basic employment become university teachers. In the second case, they are specialists in their own industry, and therefore they are also attracted to teaching courses to provide students with more practical skills and professional competence.

Through the projects of the specific support objective of the European Social Fund 8.2.2 “Reinforcing the academic staff of higher education institutions in areas of strategic specialisation”, a number of guest teachers (who have undergone a selection contest) were recruited in the study programmes between 2018 and 2022, two of whom have been elected to academic positions (J. Bajārs, A. Guļāns) and another of the guest lecturers is scheduled to be elected to an academic position in FPMO.

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 Development Strategy 2021-2027 stresses that development and excellence-oriented personnel policies aim to ensure the development, growth and renewal of academic and general staff, establish a performance-based staff management system that will also include competitive and motivating staff remuneration, develop career development opportunities for academic staff, establish local and foreign staff. national academic staff, as well as the new talent recruitment system, and promote international mobility.

Training staff in the field of study ensure and increase their qualifications by:

- implement professionalisation in accordance with Cabinet Regulation No 569 (Riga, 11 September 2018, i.e.. No 42, § 14) “Regulations regarding the Education and Procedures for the Development of Vocational Competences of Teachers and the Procedures for the Development of Vocational Competences of Teachers”, item 16;
- perform a mutual lesson observation;
- self-assessment is carried out annually;
- carry out scientific activities and participate in international conferences;
- undertake certified continuous education courses;
- developing the skills of applying a student-oriented learning approach to lectures and lessons;
- participate in the informal exchange of experience between science and mathematics teachers;
- participate in schools organised by the faculty for secondary pupils and in the formation and organisation of Latvian municipalities and National Physics and Mathematics Olympics, in reviewing, evaluating and organising research activities of pupils;
- improve English skills.

Further details for each action.

1) The vocational development of the academic staff of UL in UL is organised in accordance with the provisions of Regulation No 569 of the Cabinet of Ministers of the Republic of Latvia, *Regulations regarding the Education and the Procedures for the Development of Professional Qualifications and Vocational Competences of Teachers* (Only in Latvian), in which Paragraph 16 provides: “Educators of higher education and colleges, by the end of the term of election, acquire a vocational Development in academic capacity. Development programmes on innovation in higher education systems, higher education didactic or educational work management of 160 academic hours (including at least 60 contact hours). Professional development may include international mobility corresponding *to* the purpose of professional development and participation in conferences and seminars, as attested by the submitted documents, as well as Republic of Latvia Cabinet Regulation No. 129 Adopted 25 February 2021 *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*.

Qualification requirements and tasks of the academic staff of UL are included in *the* *Regulations on academic and administrative positions at the University of Latvia* (Only in Latvian), while the quality/performance of the work of the academic staff of UL is assessed in relation to *University Of Latvia academic remuneration regulations* (UL Senate 30.05.2016 Decision No 14) and *the Statute for determining the remuneration of the scientific staff of the University of Latvia* (UL Senate 27.1.1.1.0 Decision No 71 of 2020) (Only in Latvian).

2) in order to promote collegial learning and the identification of good practices in pedagogical work, the development and implementation of the continuing training programme “Promoting the Collegial learning experience of academic staff”, through which academic staff carries out collegial observations, thereby directly promoting the exchange of teaching experiences, as well as the UL learning development.

Lectures of the teaching staff are observed during each year of study. The observation process is planned on the basis of the UL FPMO observation arrangements, which are briefly described as follows.

1. For each academic year, a separate plan for the observation of courses and teachers in the

study programme is drawn up.
2. Following the conclusion of observations in a given academic year, an analysis of the observation process is carried out and proposals for further class observation are prepared.
3. The observation is carried out by two teaching staff, the observation is intended to be a mutual process of exchange of experience, with a view to organising constructive dialogue and feedback to the training industry for improving its teaching work and improving professional competence. Observation, as a process of pedagogical interaction and mutual enrichment, is useful for both sides, both for the practice enforcer and for the class-watcher.
4. Teaching staff:
    - the aim of the particular class and the results to be achieved is submitted in writing to the observers no later than 3 working days prior to the lesson
    - after the lesson, prepares a brief self-assessment of the course of the lesson by recording it in the observation report – what was achieved, what were the problems.
5. Observers:
    - after observation, write up their notes whether the objective of the lesson and the results have been achieved (with a short justification).
6. Observers, together with the teaching staff:
    - after the class, meet at a mutually agreed time and analyse the class by including the main findings in the observation report.
    - the final version of the observation report is supplemented by comments, the teacher's comments, if necessary.
7. In improving the observation arrangements, it is intended to develop a more precise methodology for assessing progress in the framework of cooperation between UL and the parties.
8. The report, prepared “docx” (*MS Word*), is submitted in e-mail to a designated person, such as a faculty secretary.

The conclusion of the observation is therefore a discussion and feedback is provided. Most importantly, judged during observation, is the relevance of the curriculum content to the program and a student-oriented learning approach that is suitable for STEM-area high-school students.

3) in addition to observation, the teachers receive, at the end of each course, an anonymous survey of students in different categories, the content of the course, the methodology and the organisation, as well as student comments. Raising their qualifications in continuing education courses on a student-oriented learning approach (see (5)), the teachers, on the basis of the knowledge and student feedback, supplement or improve his or her teaching methodology.

The Academic Department of UL, the UL Faculty of Education, Psychology and Arts (PPMF) Adult Educational Training Centre (PPIC) provides informational, consultative and methodical support to UL teaching students in the field of higher education didactics. UL PPMF PPIC offers academic staff to learn the vocational development programme “University Didactic: modern theories and practices”, as well as the pedagogical aspects of the development of study programmes in higher education”, “Professional development of the competence of the student curator”, etc.

Following the continuous education programme “Methodology for the formulation and evaluation of the results of studies”, programme directors and academic staff target the updating of their study courses and the mapping of the results of study programmes and study courses.

All programmes have been developed by analysing in advance the professional development needs of staff members 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 academic staff of UL, resulting in information on the ongoing professional development needs of all faculty teachers, as well as a number of teachers expressing their readiness to participate in the development and offering of further education content to their counterparts in line with professional and didactic development. needs for development.

After each programme has been implemented, a survey of its members and an evaluation of the results is carried out. Participation in continuing education programmes is a voluntary choice of staff members or a recommendation from the management of the faculty. It is typical that faculty also organise thematic seminars on topics for the development of staff members for their academic staff.

Activities for the development of the professional activities of the academic staff of the University of Latvia were included in the Plan for Development Measures of Academic Personnel of the University of Latvia for the years 2018-2020 and are included in the Plan for Development Measures of Academic Personnel of the University of Latvia for the years 2021-2023.

In order to identify the professional development needs of UL's academic staff in the field of pedagogical activity, the academic department of UL in 2017 and the Development and Management Programme for UL Studies in Q1 2020, as well as in spring 2021, conducted a survey of academic staff, including heads of study and directors of study programmes, the results of which have been taken into account, drawing up a training plan for the development of the competences of academic staff, including the "Growth and Employment" programme of the project, 8.2.2. In Round 1, "Renewal of Academic Personnel and Development of Competences at the University of Latvia", Round 2 - "Education, pedagogy and sport", motivated, modern and competitive academic staff and Round 3 "Strengthening of UL doctoral capacity under a new doctoral model", so that the increasing of the competences of the academic staff is planned effectively. Expected results to be achieved by December 2023:

- an improved system for recruitment and selection of academic staff in UL;
- a reduced average age and age structure of teaching staff is approaching the EU average (Eurydice Report: *Modernisation* of Higher Education in Europe: Academic Staff – 2017), reaching a rate of at least 1/3 of academic staff in the age group 35-49;
- improved scientific performance;
- developing and introducing a model for the renewal and succession of academic and scientific staff;
- a system for professional development of UL academic staff has been developed and implemented.

4) teachers perform scientific activities in conformity with the contract of employment, including publication in peer-reviewed journals and international conferences. It is the responsibility of the teacher to insert data on scientific and popular publications and participation in conferences in the university information system (LUIS), which makes it possible to assess the scientific performance of the teacher. Scientific activities are often carried out in micro-collectives, working on project execution, while teaching staff, who are not involved in any project at the given moment, are supported by from faculty resources. The resulting indicators on the scientific performance of teaching staff can be found in the CV and publication lists attached to the Annexes to this report.

5) teachers regularly supplement their knowledge and skills in certified continuous learning courses, including certified online courses. Depending on the field, the teacher chooses the appropriate courses. In the Methodology, teachers advise each other by sharing experience and embrace student-oriented teaching methods for high-school science students in effective online courses. For example, one of the most popular is the https://courses.edx.org/ "Learning through evidence-based STEM teaching on two levels: *"An Introduction to Evidence-Based Undergraduate STEM Teaching" and "Advancing Learning Through Evidence-Based STEM Teaching"*. These courses are repeated periodically, so every semester teachers learn them again. The course's requirement for participants, among other things, is to create groups of face-to-face discussions, so teachers share ideas, experiences and examples of methodological practices in the classroom.

In January 2020, several teachers attended the UL Library Training Seminar entitled “Reference Management Tools: A convenient solution for writing, quoting and preparing the table of authorities used”.

The funding of the European Union for the period 2018-2022 involves the implementation of a number of training programmes for staff members:

1. Development of online learning and digitisation of learning content (target group: academic staff);
2. Innovation to improve the quality of the learning process (target group: academic staff);
3. Academic integrity (target group: Directors of study directions and study programmes).

For the successful and uniform implementation of study programmes in UL, a special training programme was developed for field of study and programme directors, its implementation took place 12.10.2021. -28.10.2021, the training was conducted by an international accreditation expert from Poland and the Latvian Higher Education Quality Agency.

Young academic staff and doctoral candidates from various UL doctoral programmes, each spring semester, are increasingly using the possibility of learning the “Introduction to teach in higher education” programme. Teachers provide reports on learning this course in the UL information system.

Planning the development and restoring of the academic staff, UL pays attention to identifying capable students in the study programmes and motivating them to get involved in the academia (both teaching and research). In this context, LU has developed requirements and selection conditions for attracting new doctoral candidates under the “Growth and Employment” programme 8.2.2. Round 1, “Renewal of Academic Personnel and Development of Competences at the University of Latvia”, Round 2 - “Education, pedagogy and sport”, motivated, modern and competitive academic staff and Round 3 “Strengthening of UL doctoral capacity under a new doctoral model” (specific support objective “Stimulate academic staff of higher education institutions in areas of strategic specialisation "):

1. a doctoral candidate who is studying in the final year of an accredited doctoral study programme, as well as a doctoral candidate of Latvian nationality who studies in a doctoral study programme accredited outside Latvia, and a candidate for a scientific degree;
2. successfully acquired the number of credits required for the first two/three years of study/successful doctoral work for the applicant for a degree;
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 skills at least C1 level;
6. successful passing of the promotion examination in English;
7. positive feedback by the promoter on the doctoral candidate as a potential teacher;
8. leadership skills and interest in UL research and teaching courses.

In view of the renewal and development of foreign academic staff, UL has developed requirements and selection conditions for recruiting foreign academic staff:

1. persons employed in an academic capacity in one of the accredited foreign universities during the previous five years;
2. a doctoral degree in the relevant scientific sector or equivalent to a doctoral degree;

3. scientific and academic experience relevant to the post;
4. the ability to operate in the Internet environment of e-studies;
5. participation in at least three international conferences with presentation/report;
6. published monographs and scientific articles, including international issues with a calculated citation rate (at least three);
7. paricipation in research projects;
8. excellent knowledge of foreign languages, especially English, and the ability to use them in study and methodological work.

As a special target group for continuing training of teachers in UL, teachers working with freshman students are also offered a further training programme for “Advancing professional training with first-year students”.

6) when creating new study courses, courses is formed in conformity with modern science and manufacturing requirements, in addition to the objectives of the content of courses, methodological objectives determine a student-oriented learning approach. In order to do this, teachers increase their self-training skills by training in methodological courses (see (5) above)) or by learning the methods of the UL “*Entrance to future education (EFE)*” project. The department of UL FPMO Physics has launched a study on the understanding of the basic concepts of physics for bachelor's students. It is expected that appropriate tests for the measurement of basic concepts of physics for Masters’ courses will also be selected and used. Measurements allow the teacher to diagnose and refine the study course while working in the form of an active study. Teachers gradually learn the methodology for measuring the basic concepts of physics (*Concept Inventory*).

7) teachers in continuing education programmes highly value the possibility of modelling the study process, testing new learning methods, sharing experience. UL has created informal lessons and lessons for the “Teacher Club”, which takes place 2-3 times in the semester. Teachers present to each other their examples of feedback to students, the organisation of working groups, the use of working sheets – their structure, the differentiation of the degree of difficulty, the organisation of work, as well as the principles of drawing up tests, examples of IT use and other practical and methodical cases. The lessons are created by following suit and based on information about what is new in education and the latest on education studies. Information is selected for STEM field teachers, binding publications, etc. Both young teachers and teachers with many years of experience participate in these lessons.

8) in addition to the formal work of improving the quality of teachers, teachers develop their skills and have feedback from future students, while at the same time interesting in the field of STEM in the possibilities of study. In particular, the teachers' employment agreement provides and teachers are willing to engage in the “School of Young Physicists”, “Little Mathematics University” and “Professor Cypher’s Club”, “School of Science” (DU) activities, driving them or developing materials. In addition, teachers, together with students, form the tasks, practical works and demonstrations of school physics and mathematics in Latvia and the State Olympics. This enables teachers to see and identify the preparedness of pupils and potential students at the same time.

9) teachers acquire and develop English within the framework of the ESF SAM 8.2.2 project. The academic staff of UL has the possibility to supplement the English-language skills in the continuing training programme of the Centre for Applied linguistics of UL Humanities Faculty in “Developing the Scientific and Academic Capability of Academic Personnel”.

American Latvian businessman and professor Andris Zoltners has committed USD 120,000 to support the development of the mathematics sector at the University of Latvia by establishing the “A. M. Zoltners Scholars” programme. At the beginning of the 2021/2022 academic year, MD docent Dr. Math. Sergejs Smirnovs became the first recipient of the newly created A. M. Zoltner's excellence scholarships in mathematics.

In drawing up the field of study self-assessment report, information was gathered on the opportunities used by the participating academic staff to promote growth and raise qualifications during the reference period, the results of which are summarised in Table 2.3.6.1.

Table 2.3.6.1. Promoting the growth of teaching staff

(Assessment of improving didactic skills and raising qualifications)

No.	***Criteria/academic year***	2013	2014	2015	2016	2017	2018	2019	2020	2021
1.	**Improving language skills[1]**	2	1	1	1	1	2	6	31	22
2.	**University didactics[2]**	4		7	10	5	9	11	11	11
3.	**Visit to different summer schools**		4	1	2	3	3	13		9
4.	**Lecture and teaching courses in the framework of Erasmus and Erasmus + programmes**			1	2	1	2			
5.	**Participation in Erasmus or other staff development programmes**	1					2	1		
6.	**Attending international scientific conferences (listening)**	154	179	200	135	140	171	164	126	160
7.	**Attending national scientific conferences (listening)**	22	43	22	43	38	29	23	22	35
8.	**Participation in various seminars**	6	12	9	9	9	9	10	9	3
9.	**Participation in professional organisations (associations, societies)**	64	64	64	66	68	68	69	70	71
10.	**Participation in different working groups (improvement of regulatory enactments, etc.)**	1	1	1	2	3	2	3	3	4
11.	**Participation in and provision of continuous education**	9	11	12	15	14	13	18	13	26
12.	**Participation in various scientific editorial boards at international level**	9	6	7	9	7	9	8	11	13
13.	**Participation in different national scientific editorial boards**				1	1	2	1	1	1
14.	**Participation in various international organising committees**	18	15	21	19	24	32	29	23	22
15.	**Participation in different national organisation committees**	15	17	17	24	23	24	26	21	14
16.	**Opinions to the Central Election Commission and other institutions**				1	1		1	1	1

17.	**Other further training courses, vocational training courses, training, etc., other than those of higher education didactics**	3	2	5	13	8	9	11	43	24

[1] For example, learning foreign languages in courses, training.

[2] Vocational training courses, training, teaching, teaching, teaching, teaching, teaching, teaching, teaching, teaching, teaching, teaching, teaching, teaching.

Some concrete examples.

All new teaching staff who start teaching study courses have the opportunity to attend the further education courses "Introduction to the work of a lecturer" at the UL.

All teaching staff have the opportunity to participate in the hospitalization of other teaching staff's study courses. This is a feedback loop, as it is possible to suggest to colleagues how to do something better and at the same time to gain experience on how to do teaching better yourself; and it is also possible to be in a different role at the next hospitation. Hospitations are particularly important for new teachers. Improvements in the learning process can be detected through mid-semester and end-of-semester study course surveys.

In 2020 and 2021, all teaching staff are only given the opportunity to improve their knowledge of the English language. About 30 teaching staff used this opportunity. Knowledge of the English language is necessary for reading specialized literature, communicating with foreign colleagues, and preparing scientific articles. The latest scientific literature in physics and mathematics is only available in English. These activities enhance the qualifications of the teaching staff, which adds value to the courses they teach.

All teaching staff are given the opportunity to participate in methodological or scientific conferences of their field around the world. Each member of staff attends at least one conference per year. Participation fees and travel expenses are covered by UL. The conferences provide the most up-to-date information on developments in the field. This knowledge can be passed on to students, thus contributing to the quality of studies.

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.

Basic information on the teaching staff involved in the study field is set out in the Annexes (II Description of the Study Field - 2.3. Resources and Provision of the Study Field):

- basic information on the teaching staff involved in the study field – Annex 2.4;
- teaching activities (*Curriculum Vitae Europass* format) – Annex 2.5.

In 2021/2022, 108 teaching staff, 76 of which are the academic staff elected by UL, are involved in the field of study. In the 2023/2024 academic year, 121 teachers will be involved in the field of study (see Annex 2.4), of which 88 are academic staff elected by UL. 2.3.7.1 Table gives the number of teaching staff involved in the implementation of the field of study by post at the beginning of the reporting period (2013/2014 academic year), at the end of the reporting period (2021/2022 academic year), as well as the planned number of teaching staff in the new study programmes in the academic year 2023/2024. It should be noted that a part of the teaching staff holds a number of positions listed in the table, namely that staff members are active in research.

Of the number of university teachers (28 teachers) in Table 2.3.7.1 who will read courses in academic year 2023/2024, 18 are doctors of science, and almost all of them at the same time are researchers, leading researchers, associate professors or professors at other institutes, universities or colleges.

Table 2.3.7.1

Number of teaching staff involved in the implementation of PMSMS courses

Position	**Number of**		
Academic staff	13/14	21/22	23/24
Professor	12	12	19
Associate Professor	5	8	10
Docent	10	18	24
Lecturer	7	10	10
TOTAL	**34**	**48**	**63**
Leading researcher	1	12	20
Researcher		6	12
Scientific assistant		9	10
TOTAL	**1**	**28**	**42**
Other teaching staff			
Teacher	15	26	28
Acting Professor		3	2
Acting Associate Professor	2		
Acting Docent			1
Acting Lecturer	3	1	1
Guest asoc. professor		1	1
Guest docent		1	1
TOTAL	**20**	**32**	**34**

In the 2021/2022 academic year, 75 doctorate teachers, 31 with a master's degree, one with a bachelor's degree, are involved in the implementation of the field of study. In the 2023/2024 academic year, 90 PhD and 31 Master Degrees are expected to take part in the field of study.

Out of 2021/2022 academic year 108 teachers were involved in the field of study, 83 or 76.85% as in the main job and 25 or 23.15% as guest lecturers.

The teaching staff workloads include the following elements of academic work:

- study work, which includes the management of study courses, the management and review of graduation papers, advising students;
- methodological work involving the updating of study courses or the development of new courses (including e-learning), participation in methodological seminars or conferences, etc.;
- scientific work involving participation in scientific conferences, projects, preparation of publications, etc.;
- professional development, including participation in vocational development programmes, study of the latest scientific and methodological literature, etc.

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.).

Students of 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 throughout the study period. Academic support includes the implementation of the first year of study support programme, advice on the study process (content of study programme, choice of study courses, legal documents for the UL study process), information on counselling, advice and workshops on learning of study skills (making notes, reading of scientific literature, active listening, exam anxiety, time planning and use of libraries and Internet resources).

Academic support for students in academic matters is centrally provided by the UL Study Service Department and by the responsible person from the faculty: the director of the study programme, curator, mentor, clerk, academic staff, as well as the Council of Students and the Faculty Student Authority. Advice on the use of library and Internet resources is provided by the UL Library. Table 2.3.8.1. shows examples of the main tasks to be performed by the student support departments/staff.

Table 2.3.8.1

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

Departments/Personnel	Main tasks

Faculty student authority	FPMO student authority informs students about the topics in the faculty (both on the study process and outside the study process). Organise activities outside the study process. Helps to create the monitor system student groups. Organise mid-term surveys of courses. Report the problems of students to the directors of study programmes. Organise regular meetings with faculty management (dean, department heads, head of field of study) and control the performance of decisions taken.
Curator	Inform students of the developments in the study process, provides individual support to those students who have difficulties in incorporating the academic environment of UL and initiate adaptation and consolidation measures.
Staff member, study advisor	Provide study advice, assist in day-to-day issues related to the training process, organise study records, advise on the information system of the University of Latvia (LUIS).
Mentor	A senior student who helps freshman students adapt to the studio environment and share their experience.
Student Council (SP)	The purpose of the SP's activities is to represent UL students and to defend their rights and interests. The SP represents the interests of students in academic matters by electing students' representatives to the UL decision-making bodies, examining issues related to the study process and its development.
Director of the study programme	Organise and manage the development of a study programme in accordance with the requirements of the specific scientific or economic sector, cooperate with employers and places of practice in matters of the content of studies, evaluate and approve individual study modules and individual study plans chosen by students, etc.
Study Service Department	Organise the admissions process, advise faculty and students on mobility programmes, study, social and cultural issues, advise and organise training on career issues. Organise student adaptation activities, provide training for curators, mentors, organise cooperation with employers, etc.

The aim of career development support is to provide an individual with the support of a variety of services with the possibility to identify their interests, abilities, skills, experience throughout their life, with a view to making informed decisions on the choice of education and/or occupation, and to organise and manage their individual pathways of life in the fields of training, work and other areas. Career development support is provided by the Career Centre of the UL Department of Study Services in collaboration with faculty.

The Career Centre provides the following services to students:

- Individual counselling for future studies and careers, drawing 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 development (“Advancing 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/ and https://www.karjera.lu.lv/en/ provide up-to-date information on career planning issues, occupational information and the labour market;
- Electronic resource “E-karjera” https://e-karjera.lu.lv/login and https://e-karjera.lu.lv/lv/login, which enables short-term students to find their places of internship and employment by placing their personal CVs in a database and employers to find employees by placing vacancies in the database.

Psychological support is provided by the Service Department for Studies. A psychologist-consultant provides psychological support to students in addressing any personal and learning problems arising from studies (relationship issues, conflict resolution, emotional difficulties). A psychologist-adviser provides personal counselling and telephone counselling.

Special events are organised for students from abroad, in cooperation with the ESN (*Erasmus student network*), to meet local students, Latvian culture and traditions.

On the other hand, in cooperation with the Apeirons association, there has been an inversion of the infrastructure on accessibility for persons with special needs. The results obtained are taken into account both in the construction of the new infrastructure and in the provision of study programmes. It is possible to enter the House of Science through revolving doors, any floor can be reached by elevator, the doors have no thresholds, the movement on the stairs can be facilitated by Braille writing on the stair railings, the toilets are also intended for persons with special needs.

At the beginning of one of the studies programmes of FS PMSMS, first-year students are invited to the “Baldone” welcome camp. This event is organised by the FPMO student authority. The camp takes place for three days. At this time, young students learn their future colleagues, develop collective links, which are then a strong foundation in the study process. The transition from the school training system to university training poses great difficulties for many young people, so the peer's shoulder can be very useful.

The first year of study is the toughest. In the course of the first year, more than half of the pre-graduate students discontinues studies. In order to reduce the number of students who have fallen back, the Bachelor's 1st year has an additional course in mathematics. A system of curators has been established. Physicists have developed meta courses for each year of study, while mathematicians have started the course “Introduction to Mathematics” in year 1.

An important event for FPMO is *Fizmatdienas*, which takes place every year at the end of April. This event, with the support of FPMO management, is organised by the student authority. On the one hand, it is a set of entertaining events, but on the other it is a measure of cohesion for students and their teaching staff, as well as for the entire faculty as a whole.

The role of the directors of the study programmes of FS PMSMS, in cooperation with the monitor and curators of the groups, is to notice the causes of student discontent. For example, one of the teaching staff asks for many homework, but grading is done with great delays.

Significant support for students is financial support. Only a small number of students receive UL scholarships. In 2018-2020, FPMO developed a statute that provided financial support to one student from each year 1 FPMO master's program. Unfortunately, the faculty leadership decided not to support this funding in the future because it causes the faculty more losses than benefits. When applying to the UL Foundation and holding a competition for the Kaspars Ērglis Memorial

Scholarship (one-time support), a graduate of ABSPP may be eligible, but a Kārlis Kaufmanis memorial grant may be received by a bachelor's student who studies astronomy. In 2017, 4 finance AB issued three one-time scholarships to best PBSPMS graduates. The directors of study programmes may contribute to the creation of a scholarship fund in a specific science sector.

SV PMMS does not provide for part-time and distance learning forms of study, but AMSPMDS, AMSPP and DSPPPAT are designed for studies in English, therefore students from foreign countries are welcome. Students from foreign countries have the right to receive academic support, career development support and psychological support just like other students. In September 2022, UL received the Best Practice University certificate, which confirms that it fulfills the criteria set by good governance and ministries in responsible attraction of foreign students and provision of quality studies.

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).

According to UL Strategy 2021-2027, the UL mission is stated in its slogan “Science and the Homeland”. The basis for UL's international reputation and competitiveness is scientific achievements and their integration into studies. Basic and applied research in the field of studies is consistent with the objectives of UL and the level of scientific development. This is reflected in projects carried out by the teaching staff and researchers involved in the field of studies (see Annex 2.8) and in publications indexed *to the Web of Science* or *SCOPUS* (see Annex 2.9).

AS part of the FPMO, scientific activities are carried out in the departments of mathematics and physics and in other departments, such as the Laser Centre, the Institute for Numerical modelling, the Laboratory for Statistical Studies and Data Analysis, the Laboratory for Magnetic Soft Materials. In the fields of physics, material science and mathematics relevant to the field of studies, research is very extensive, thematically diverse and includes both fundamental and applied research. At the University of Latvia, seven UL institutes (AI, AXIS, ISSP, PI, GWGS, ICP, IMM) are closely associated with these areas, which include more than 300 scientists in total. In the 2019 International Assessment of Scientific Institutions, the UL ISSP acquired 4, while the remaining units as part of the UL Science cluster 3 out of 5 points in the overall assessment, while 4 out of 5 points in the scientific quality assessment. According to the valuation methodology, this indicates a very good quality of science and institutions as strong international players. From a wide range of topics, extensive studies of material communications (planned layers, new materials, micro and nano devices, batteries), UL ISSP, internationally recognised nanoelectronics theory studies PD, internationally unique magnetohydrodynamic studies UL PI and widely applied continuous environmental numerical modelling studies INM can be highlighted. These areas are also closely linked to a variety of knowledge-intensive companies (*Groglass*, *LightGuide*) and start-ups (CENOS, *Cellbox labs*) with a significant share of R & D activities. Cooperation with the international radio astronomy centre of Ventspils University College, which is a powerful institution in the field of astrophysics, complements the range of physics and astronomical themes represented by UL. It is also worth noting the participation of Latvia in the European Nuclear Research Organisation (CERN) and the European Space Agency (ESA), both closely linked to physics and astronomy.

The following are the fields of research involving academic staff:

- algebraic and topological structures and methods, their generalisations in the context of non-strict logic;
- discreet and continuous dynamic systems, their qualitative analysis;
- mathematical modelling in technical and natural sciences, with emphasis on analysis of fluid and gas movements and modelling of heat and transfer processes;
- mathematical statistics and other methods of data analysis;
- modern elementary mathematics;
- the didactics of physics and mathematics;
- nanoscale electronic device theory and quantum computing physics;
- photonics and its applications, including biophotonics;
- atomic physics, molecular spectroscopy;
- astronomy and astrophysics;
- solid-state physics and material science;
- magnetohydrodynamics, magnetism and soft environmental problems;
- nanophysics, nanotechnology, etc.

The topics of the studies are topical, relevant to the priority research axes and provide coverage of the subsectors of physics and mathematics needed to implement the study process.

FPMO organises a faculty plenary session and several sections within the framework of the UL Annual International Scientific Conference, including the participation of foreign scientists. A number of international scientific conferences were organised in Latvia, including the 20th International conference *Mathematical Modelling and Analysis* (MMA, 2015, Sigulda), the 47th International scientific conference *European Group on Atomic Systems* (EGAS, 2015, Riga), 10th international conference *Progress on Difference Equations* (PODE, 2016, Riga), 8. International Scientific Colloquium *Modelling for Materials Processing* (MMP, 2017, Riga), 10th International symposium *European Symposium on Computational Intelligence and Mathematics* (ESCIM, 2018, Rīga), 23rd International conference *Mathematical Modelling and* Analysis (MMA, 2018, Sigulda), International Workshop on Fuzzy and Rough Mathematical Structures (FARMS, 2019, Riga*), Workshop Magnetism and* Life (2019, Riga), 10th International Scientific Conference *Electromagnetic Processing of* Materials (EPM, 2021, Riga).

There are regular scientific seminars, four of them organised in the Mathematics Department: *Discrete mathematics and Algebra, Discrete mathematics and Continuous Dynamic Systems, Multivalued Mathematics Structures and their Applications, Statistical Studies and Data Analysis Laboratory Seminar*. Workshops also take place in the research groups of the Department of Physics (*Magnetic Soft Materials Laboratory Seminar*, *Physical Education Research* Department Seminar), Laser Centre, Numerical modelling Institute and other Physics-Related UL Institutes (e.g. ISSP UL/*Doctoral school "Functional Materials and nanotechnologies"* scientific Worksho*p*, UL AXIS Scientific Workshop U. c.). The participation of the faculty organizes a variety of research activities, such as the Annual Activities *of the Night of Researchers.*

The quality and quantity of research in the field of studies are sufficient to support doctoral studies. During the period under field of study, the doctoral studies programmes "Physics, Astronomy and Mechanics" and "Mathematics" were carried out, their quality being shown by the high level of doctoral theses, the conclusion of studies with publications included in the world's leading scientific databases, the academic performance of young science academic staff and the competitiveness of EU countries. in the labour market. Over the last two years, UL implemented the consolidation of doctoral programmes with other doctoral programmes that have existed in the field of studies, thereby ensuring a single, interdisciplinary approach in the preparation of new science dockets and promoting cooperation between scientific study fields. Despite the fact that the development of the new consolidated doctoral programmes “Natural Sciences” (with “Physics, astronomy and mechanics” sub-programme) and “Computer science and Mathematics” (with “Mathematics” sub-programme) are intended outside the “Physics, Material Science, Mathematics and Statistics” field of study, PhD studies in the field of science present a significant factor in assessing the research potential of the field of study .

The new UL and RTU joint doctoral study programme “Particle Physics and Accelerator Technologies” was created (License No. 2021/06K, 29.09.2021.), in close cooperation between universities and the recruitment of researchers from leading universities and research institutes in the Baltic States active in research programmes and CERN from the European nuclear research organisation. This cooperation was co-ordinated by CERN's Baltic Group Education Commission. CERN Baltic group includes Kaunas University of Technology (KTU) – Lithuania, National Institute of Chemical Physics and Biophysics (NICPB) – Estonia, Riga Stradiņš University (RSU) – Latvia, Riga Technical University (RTU) – Latvia, Tallinn University of Technology – Estonia, University of Latvia (UL) – Latvia, University of Tartu (UT) – Estonia, Vilnius University (UV) – Lithuania, Vytautas Magnus University (VMU) – Lithuania. Such cooperation ensured close links between the study programme and current research, not only in UL but in the Baltic region as a whole. One of the objectives of this study programme is to strengthen research towards high particle physics in Latvia.

Given the specific nature of high energy physics, the need for very expensive infrastructure, particle accelerators not only available at individual universities but often not available in individual countries, it is clear that the provision of research infrastructure in this study programme requires close cooperation with CERN. Currently, when Latvia has become an associated Member State of CERN and is on track to participate fully in CERN research programmes, access to CERN infrastructure is provided by cooperation agreements between UL and RTU with CERN departments providing for the experiments. Currently, UL and RTU are joint research with CERN, supported by full cooperation agreements with:

- Compact Muon Solenoid (CMS);
- Aegis (Antimatter Experiment: gravity, Interferometry, Spectroscopy).

The research groups of UL and RTU are also involved in CERN experiments:

- Innovation Fostering in Accelerator Science and Technology (IFAST);
- Heavy Ion Therapy Research Integration (HITRIplus);
- Next Ion Medical Machine Study (NYMS)
- Hybrid Exhaust Gas Cleaning Retrofit Technology for International Shipping (HERTIS);
- The Isotope mass Separator On-Line facility (ISOLDE);
- Medical Isotopes Collecated from ISOLDE (MEDICIS);
- The European medical isotope programme (PRISMAP).

Cooperation agreements provide the possibility for DSP “Particle Physics And Accelerator Technologies” students to engage in one of these experiments. In order to make this engagement as effective as possible, the study programme provides two advisers for doctoral candidates, one from the University of Latvia or Riga Technical University and the other from CERN's respective experiment. As part of the study programme, students will spend at least two out of four years in CERN. This ensures both full involvement in research at CERN and involvement in the training process provided by UL and RTU. Moreover, such a model for the implementation of the doctoral study programme furthers links between Latvia and CERN. In order to ensure the link between the courses read in the doctoral programme and the ongoing research, teaching staff from universities and research institutes belonging to CERN Baltic, as well as CERN, are attracted to teaching in the status of guest professors. The national research programme currently being carried out in Latvia in high energy physics and accelerator technologies, the aim of which, in cooperation with the European Organisation for Nuclear Research, CERN, is to strengthen the development of the Latvian scientific community in high energy physics and accelerator technologies, and its International Advisory Council constitutes additional support in ensuring the quality of the study programme, so that it complies with both the Latvian and European Union research technologies. priorities for research.

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.

Scientific and applied research in the field of studies is closely linked to the study process at all levels (bachelor, master and doctorate), supplementing and improving it. The teaching staff involved in the field of studies work in science in parallel to the study process and participate in the achievement of project results. The optional courses included in the study programmes are usually related to the fields of teaching staff research. Teaching staff then integrate their research experience, proven results and developed methods into study courses, thereby ensuring continuous learning of knowledge and skills for students. For example, Prof. Uldis Strautiņš and doc. Maksims Marinaki enriches the study courses “Mathematical modelling frameworks”, “Perturbation analysis” (at bachelor's level) and “Industrial mathematical modelling” (at master's level) with the models used in his research work; non-strict-logic mathematicians Prof. Svetlana Asmuss and Aleksandrs Šostaks in the teaching courses “Non-rigid sets and structures” (at bachelor's level) and “Non-rigid Logic-Based Bodies and Methods” (at Master's level), include designs and techniques developed in research projects.

According to UL Strategy, FPMO provides science-based studies using modern and competitive education technologies, as well as promoting the scientific performance of learners and staff. Access to databases for scientific publications enables the development of study courses using the latest research knowledge. In several study courses, teaching staff present scientific articles relevant to the content of study courses (see the section on periodicals in the course descriptions).

The Bachelor-level study programmes already include courses in which students are presented with the selection and analysis of special literature, the methods used in research, as well as the processing, presentation and presentation of study results. This has been achieved in individual study courses by including the preparation of essays or the execution of individual studies of a research nature (see course descriptions). In the Bachelor-level studies programmes, ABSPM and PBSPMS provide a course in which students are already selecting their research topics, using both the knowledge and skills acquired in the course of the development of the work, as well as the latest knowledge and methods, the analysis of scientific articles. The course work is presented and defended before the commission. In all study programmes, research is an integral part of graduation paper. All student graduation papers are advised by scientists, which can only be achieved through the extensive research capacity. Moreover, the majority of students are involved and also employed in research projects during the development of their works, thereby essentially gaining first work experience in the industry already during studies. For example, in the AMSPP study course “Research laboratory works”, students develop laboratory works in the environment of scientific laboratories, in direct contact with scientists and current research challenges. Such closer interaction allows for a better development of research skills for students. Doctors are also scientists who carry out studies in the scientific institutions mentioned. It provides a more sensible balance between scientific and academic work and enhances the expertise of academic staff. As a separate accent for linking research to the study process, studies in physics and mathematics education can be highlighted. Physics education studies have been focused on evaluating the effectiveness of the use of the selected teaching methods in the training of specific concepts of physics, for example through pre-tests and post-tests. This makes it possible to use and adapt the latest results of physics education studies to improve the study process while also raising its research capacity. The studies related to mathematical didactics are developed in the Department of Mathematics by A. Liepa’s Correspondence Mathematics School.

Other methods to promote the integration of students into the academic environment also are used in the study process. Students are invited to participate in scientific seminars. Students at Master and Doctor level should participate in the meetings of the relevant sections of the UL Annual Conference. For the involvement of students in the implementation of research projects, see section 2.4.5. The implementation of the field of study programmes in the new UL Science Building, one building together with many other UL research institutes, alongside the new UL Nature Building, where several research centres are also located, significantly expands the possibilities of students to integrate into the UL academic environment and research, greatly facilitates cross-disciplinary research, as well as the use of equipment and laboratory equipment needed for research. Academic practice contributes to research-related mobility within all academic bachelor's and master's level programmes, by offering students the opportunity to familiarise themselves with research activities in other collective groups.

The doctoral studies process is dominated by methods in which independent research of doctoral candidates is important. The doctoral programme should ensure excellence in research on the relevant topics of promotion work, the acquisition and successful use of the latest research methods, the skills of the research organisation, prepare specialists who are competitive in both the Latvian and EU labour markets in both the fields of research and the economy.

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.

Physics and mathematics studies are mainly international, except for the performance of contract work for the Latvian economy. This is due to the fact that there are no topics of local physics or mathematics, only studies that are innovative at global level can be competitive. This presupposes that successful research can only exist within the framework of international cooperation. Consequently, all scientific research groups cooperate with foreign counterparts.

In addition to the course of the studies, the special feature is that some teaching staff perform their research activities in the faculty of FPMO LC or FPMO INM, or in the UL institutes ISSP, IMCS, AI, IAPS, PI, ICP, IMM. In the field of astrophysics, cooperation with Ventspils University College is forming. In Table 2.4.3.1., funding can be seen at the disposal of FPMO. The budgets of PD and MD studies are comparable to the budget for foreign-origin research projects. It describes intensive and competitive international cooperation. Moreover, it describes international cooperation only within the framework of the faculty, and the overall international cooperation within scientific institutes is even greater.

Table 2.4.3.1

Budget of PD and MD studies total amount of faculty actions and foreign research projects

A year	PD studies, euro	MD studies, euro	Foreign research, euro
2017	339000	342300	249800
2018	370000	363000	553300
2019	412000	387700	219100
2020	418800	373000	603500
2021	493800	426400	379700
2022	497800	407900	244100

The benefits of international cooperation are for all fields of study, as scientific qualifications of teaching staff are provided, topics of scientific relevance are offered in the field of global trends and in the graduation papers. In particular, the international cooperation of the UL ISSP in the framework of the CAMART2 project resulted in a module of the AMSPP specialisation studies “Physics of Solid State and Materials (CAMART2 courses)” of 32 CP.

List of international projects FOR FPMO physics and mathematics in 2020:

1. NEWA: New European Wind Atlas (NEWA *Joint Programme*),
2. *Novel Materials Discovery* - (H2020-EINFRA CoE projects NoMaD),
3. *Fimar* software maintenance, support and data supply for 2016-2018,
4. Magnetism and microhydrodynamics, from steered transport to supply (H2020 MSCA-ITN project MAMI),
5. Determination of the structure and dynamic properties of bi-atomic alkali-metals molecules for quantum technologies,
6. Drift modelling in the Baltic Sea for pollution reduction and safety,
7. Pharmaceutical multicomponent phase crystalline engineering for more efficient crystalline design,
8. The physical aspects of quantum benefits in information and measurement technologies,
9. Single-electron quantum optics for quantum-enhanced measurements (EMPIR project SEQUOIA),
10. *Modelling of operational risk losses and deliver the results of the research to customer*,
11. *Simulation of carbon distribution in flooding zone grown crystals*,
12. *Development of an Optical Magnetic Sensing System for Security Checkpoints/MYP-Optical Magnetic Sensing System*,
13. *National Competence Centres in the framework of Euro* HPC-EUROCC,
14. Mixing of positions in alkali metal atoms and dimers in the outer magnetic field,
15. *Feasibility study of spacecraft magnetometers based on nitrogen-vacancy centres in*

diamond,

16. The Integrated Initiative of European Laser Research (LASER-EUROPE).

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.

According to the information available in *the Scopus* and *Web of Science* databases, a total of 1628 scientific publications have been indexed to the teaching staff involved in the field of studies during the period 2013-2021 (the number of publications of each teaching staff is listed in Annex 2.9, the list of publications is summarised in Table 2.4.4.1). Data show that the number of publications increased by 30% during the reporting period as the number of articles published in *Scopus* and *Web of Science* databases increased from 154 in 2013 to 201 in 2021. The teaching staff involved in the field of studies participate in the implementation of scientific projects at both international and national level (see Annex 2.8 and the CV of the teaching staff). The list of teaching staff reports involved in the implementation of the programme is impressive at international conferences and congresses (see Annex 2.8 and the CV of teaching staff, summarised in Table 2.4.4). When assessing the participation of teaching staff with a paper at scientific conferences in 2020 and 2021, it should be noted that the organisation of conferences over the last two years was difficult due to measures to limit the spread of Covid-19 (several conferences did not take place or had been transferred).

More than 300 scientists are associated with the physics industry, so a more significant challenge is to encourage scientific personnel to be involved in teaching rather than vice versa. It succeeds, and many courses related to specializations of physics are provided by scientists, typically teaching 1 or 2 courses as university teachers. Among them also part of the most productive scientists in Latvia (e.g. A. Kuzmins, L. Skuja, R. Ganeev). At the same time, the core of PD's academic staff is made up of academic staff with more load. In order to stimulate their international competitiveness, research engagement is promoted and supported by a number of mechanisms. Firstly, one of the conditions for the development of academic careers is the performance of scientific activities: publications, project writing, the creation and management of a research group. Secondly, the planning of the PD study process is welcome to changes related to research visits, conferences and other activities. Thirdly, additional resources and activities are available for the development and exchange of staff experience.

Among the articles of the academics in physics programs we have 1 publication in the most prestigious *Nature* and *Science* journals, 10 publications in *Nature Communications* and 2 *Science Advances*. Teachers are also active participants in international science networks, as demonstrated by the large number of conference theses and participation and organisation for various events. The scientific qualifications of PD's elected academic staff greatly exceed the requirements of Latvia, such as the Hirsch Index, for the vast majority of all 28 staff members, is above the minimum requirement for professors, without even comparing it with existing professors. Our academic staff are also successful in raising funds by mobilising more than EUR 80 000/year on average.

Among the teaching staff involved in the implementation of the field of studies are experts from the

Latvian Council of Science: 9 in the mathematics sciences sector, 18 in the science sector (physics and astronomy), as well as 4 in the engineering and technology sector (material science) (see teaching staff CVs).

The choice of fundamental and applied research courses is influenced by both the specialisation of teachers in the field of study and the ability to attract funding needed for research, which is largely linked to the focus of research themes and the relevance of scientific development priorities at both national and international level.

For example, in Mathematical Modelling (prof. Uldis Strautiņš, doc. Jānis Bajārs, doc. Maksims Marinaki), studies during the reporting period were related to the project “Gradual flows: modelling and use in energy engineering, design of new devices, obtaining new technical solutions and protecting the environment”, “Biomass combined combustion studies and electrodynamic management for clean and efficient energy production”, “Data-based non-linear wave modelling implementation”. Research work in non-rigid logic based mathematics (prof. Uldis Strautiņš, doc. Jānis Bajārs, doc. Maksims Marinaki) during the reporting period was related to the project “Applications for mathematical structures based on the principles of non-strict logic for the development of telecommunications networks design and resource management technologies”. “Development of non-rigid logic-based risk assessment technologies using relationship-based aggregation”, “Development of non-strict mathematical morphology for development of imaging techniques”. In the course of the study, teachers whose research is related to the Statistical Research and Data Analysis Laboratory participated in the implementation of a number of projects related to the analysis of data during the reporting period, such as the “Development of mathematical models to process road traffic events”, “Development of a public monitoring system for the quality and efficiency of health care”, “Assessment of the economic activity of the administrative areas of Latvia and the fluctuation of population activity using load data on the mobile network”, “Development of an operational risk forecasting model”, “Development of an algorithm for identifying and classifying anomalies”.

In the context of the development of academic staff involved in the field of study (see section 2.3.6), the renewal and succession of academic staff is highly important. The UL doctoral programmes play a particular role in the process of rebuilding academic staff. For example, three students working in the field of mathematics defended their doctoral theses in UL during the reporting period: Ravis Bēts “Recurrent words structure: resilience and closeness measure”, Maksims Marinaki “Parameter optimization and patern recognition for combustion and reaction kinetics models”, Māra Delesa-Vēliņa “Empirical confidence method for localisation parameter based on some robust evaluators”. Young scientists involved in the field of study use post-doctoral support measures. Three post-doctoral projects are implemented by students working in the field of mathematics: Jānis Bajārs, “Data-based non-linear wave modelling”, Raivis Bēts, “Non-strict pseudo-metric applications in word combination”, Olga Grigorenko “Non-strict Relations and Non-Strictly Metrics for client behaviour modelling and analysis”.

At university level, a professional development system for UL academic staff and a science excellence support programme have been developed and implemented, providing material support for publication in category Q1 according to the classification of the *Web of Science* database. At university level, material support has also been provided for the participation of UL academic staff in international conferences, but that cannot be considered sufficient. Participation of academic staff in international conferences and publication of research results at international level is supported at the level of faculty departments.

In the light of the above, it can be safely argued that the composition of the teaching staff involved in the pursuit of the direction provides for the acquisition of high-quality theoretical knowledge and research skills in the physics and mathematics sciences, which enables students to successfully engage in different research challenges.

Table 2.4.4.1

Summary of quantitative data of FS PMSMS on scientific and/or applied research activities during the reference period

criterion/Year		2013	2014	2015	2016	2017	2018	2019	2020	2021
1. Publications										
1.1.	International scientific publications indexed to *Scopus* and/or *Web of Science* databases	154	132	186	168	170	186	218	213	201
1.2.	International scientific publications not indexed to *Scopus* and/or *Web of Science* databases	15	7	6	9	4	2	6	2	7
1.3.	Scientific publications at national level	4	1	1	2	3	1	4	3	2
1.4.	Popular publications	4	5	11	4	7	9	15	13	8
2. Participation in scientific conferences with a paper										
2.1.	Participation in international scientific conferences with a paper	155	182	196	138	142	180	167	126	158
2.2.	Participation in national scientific conferences with a paper	17	35	19	44	31	30	18	23	34
3. Participation in projects										
3.1.	Participation in international scientific projects	36	41	43	39	39	41	43	46	49
3.2.	Participation in national scientific projects (including ESF and ERDF)	37	50	65	44	72	96	100	127	121
4. Patents										
	Patents	5	3	1	2	6	2	2	10	6

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.

All students in the physics sector develop their graduation papers in scientific institutions under the management of scientists, with individual exceptions in companies or in cooperation with undertakings. Most of the students also work in scientific institutions during the development of graduation papers, often starting the working relationship in ABSPP in year 2 and continuing their work, studying at AMSPP, then on to doctoral studies. For the most part, funding for student engagement comes from research projects (LZP FLPP and TNP, ERDF, etc.). The active and serious involvement is also evidenced by scientific publications in which students are co-authors or even first authors. For example, two graduates of AMSPP 2021, K. Buks and R. Sondors, at the end of the master's studies, were already among the authors of 7 and 4 publications.

It should be noted that there are more vacancies for students in research laboratories associated with physics than the available students, and therefore students from other study programmes (chemistry, mathematics, optometry) and universities are also involved. Table 2.4.5.1 shows the graduation papers of the 2021 ABSPP in physics and the corresponding departments where these works have been carried out.

Table 2.4.5.1

ABSPP Bachelor of Business Names 2020/2021

Ramana spectroscopy of diamond crystal synthesised by CSD method	ISSP
Magnetic field distribution exploration and optimization for periodically deployed permanent magnets	Institute of Physics
Luminescent properties of zinc oxide	ISSP
Research on actual efficiency of solar panels in Latvian climate	INM
Optical studies of diphensulfones and benzophenone derivatives for Generation 3 organic light emitting diodes	ISSP
Design and use OF CHGM resonators for the generation of optical frequency combs	IAPS
Effects of correlated non-occlusion on the locale phenomenon in single-dimensional close-link models	Theoretical physics department, NTG
Precision of asteroid regolith porosity calculations by comparing remote exploration methods and sample return missions	Astronomy Institute
Synthesis of gallium oxide-containing kernel-shell nanowire hetero-structures	ISSP

MHT-X: tracking non-direct-linked multiple hypotheses optimized with algorithm X	INM
Development of an IC-8 waveform optical gas sensor with optical lithography technique and characterisation of its optical properties	ISSP
Magnetic droplets as a tool to determine the temperature dependency of the properties of the phase-separated magnetic fluids.	Theoretical physics department, MMML
Bubble chain magnetohydrodynamic flow distribution in dynamic wake	INM
Electrocaloric effect in perovskite structure segnetoelectrics near a large electrical field	ISSP

The themes of the 2021 bachelor's theses are well in line with the research directions of the institutes involved in the implementation of the ABSPP programme.

2019 is the first year in which all bachelor theses have access to electronic catalogues (https://kopkatalogs.lv/, UL Graduation Papers, Latvian only). This year is well suited for deeper analysis as it is last year before Covid-19 limits. Of the 21 theses defended at ABSPP in 2019, 5 have been performed at ISSP UL, 4 UL Institute of Chemical Physics, 3 works at Physics, Mathematics and Optometrics Faculty Laser Centre, 3 works at UL Atomic Physics and Spectroscopy Institute, 3 works at UL Numeric Modelling Institute (VTPMML at that time), 2 theses at UL Physics Institute, 1 at UL's Astronomy Institute. The bachelor's theses were advised by 18 staff members of physics or chemistry and 4 masters of physics. According to the information available at the time the thesis is submitted, the results of the bachelor's thesis are published in 7 international reviewed publications and 35 conferences at different levels, most of which are international.

Similarly, in 2018, of 22 bachelor's theses, 5 at the UL Institute of Solid State Physics, 2 at UL Institute of Atomic Physics and Spectroscopy, 4 at UL Institute of Chemical Physics, 4 at Physics and Mathematics Faculty Laser Centre and Magnetic Soft Materials Laboratory, 3 in UL Environmental Technology Process mathematical modelling laboratory, 2 at UL Institute of Physics and 2 at UL Astronomy Institute.

Over the period 2013-2021, 112 Master Theses themes have been applied for and 108 works have been defended (assigned a master's degree in physics), in two cases not awarded a degree. The demand for the management of masters' theses is high, so virtually all masters are involved in the development of a research project that provides a focus on research topics in the sector and links to the labour market. Breakdown by institutes and laboratories where works are developed as follows: UL AI – 1, UL ASI – 15, UL ISSP – 43, UL PI – 7, FPMO PD – 11, UL ICP – 5, FPMO LC – 12, UL IMM - 3, FPMO INM – 14, Ventspils University College -1. The UL ISSP provides about a third of the graduation papers, with a slightly less than a third (37) of the graduation papers being developed in the FPMO departments. As has already been mentioned, all subjects of Master's works are related to scientific research in faculty and collaborative institutes. Links with active scientists ensure that work topics are linked to project development on topics of major importance in the world and Latvia, and work is managed by recognised researchers. This is confirmed by the data in Table 6.2.1, which shows that half of all works are managed by researchers who have at least 3 managed graduation papers during the reporting period, with a high number of publications and a Hirsch index.

Many students in the mathematics sector write their bachelor's and master's theses in connection with practical projects or job assignments in their workplaces. In the professional bachelor's programme, “Mathematician Statistician”, for example, let us look at the bachelor's theses of recent years (Table 2.4.5.2). It appears that bachelor's theses such as “Cluster Analysis in Non-Life Insurance”, “Hydrorological Data Analysis Methods”, “Follow-up of Unmatched Offset and Optimize Data Collection Strategy for Adaptive Sampling Survey”, “Real Estate Price Index Calculation and Forecasting”, “Online Customer segmentation via Clusters, “Methods of collaborative filtering in recommendation systems” have been produced by employers. Around 90-95% of students in a professional program remain in their jobs after completing their practice, and therefore theses are often written with this orientation.

Table 2.4.5.2

PBSPMS Bachelor Theses Titles 2020./2021.ak. g.

1.	Clustering analysis in non-life insurance
2.	Non-detailed games, Texas Holdem playing situations modelling
3.	Use AutoKers automated machine learning package for image classification
4.	Use of Markov circuits in the context of the Latvian dictionary
5.	Online customer segmentation using clustering methods
6.	Non-discriminatory function optimization issues
7.	Impacts and identification of confounders
8.	Browne-Robinson iterative method
9.	Stochastic approach to assessing the timing and costs of project execution
10.	Oligopoly in the context of game theory
11.	Collaborative filtering in recommendation systems
12.	Choosing the most appropriate penalty functions for different datasets in logistic regression models
13.	Stochastic scenario simulator with ARCH effect modelling
14.	Creating pseudo-event strings with linear offset register and decrypting them
15.	Methods of analysis of hydrological data
16.	Machine-learning-based service advising model
17.	Optimal choice of auxiliary variables to reduce non-responsiveness in sample surveys

18.	SIR Model Parameter Assessment using Bayesian Statistics
19.	Mass service system networks
20.	Themes for epidemiological studies
21.	Calculation and forecasting of real estate price indices
22.	Monitoring the non-response shift and optimizing the data collection strategy for adaptive sampling
23.	Paradoxes and false judgments in statistics

However, from Table 2.4.5.2, we can see that there are other types of works, such as “Oligopoly in the context of game theory”, “Creating pseudo-event strings with linear offset register and decrypting them”, “SIR Model Parameter Assessment using Bayesian Statistics”, “Problems of optimization of non-discriminatory functions”, “Paradoxes and false judgments in statistics”, etc., advised by teaching staff. At the bachelor's level, only a few of the best students are officially involved in projects as employees.

Mathematics students are enrolled in applied and fundamental projects 1) at the University of Latvia's Institute of Mathematics and Computer Science, and 2) in the various departments of the mathematics department: Laboratory of Statistical Research and Data Analysis (SPDAL), UL A.Liepa’s Correspondence Mathematics School (NMS). It should be noted separately the LZP project, which is being carried out by the MD Differentials and approximated methods department (DTMK), a leading researcher and a docent, Jānis Bajārs, who has recently returned from abroad to Latvia, under whose leadership many students are developing their bachelor's and master's theses. Students of mathematics are also involved in scientific activities in a variety of physics institutes and departments: Laser Centre (LC), INM, ISSP, etc. (the involvement of students in recent years can be seen in Table 2.4.5.3). The UL Institute of Mathematics and Computer Science (UL IMCS) plays an important role in the scientific activities of students, since many people in the mathematics department are involved in this institute as researchers or leading researchers. Under their leadership, various LZP, ESF, ERDF and other projects, where students are also actively involved.

Table 2.4.5.3

Number of students in mathematics programmes in different projects in different departments

departments	2019	2020	2021	2022
MD NMS	3	3	4	3
MD SPDAL	3	4	3	2
MD DTMK	0	1	3	1
FPMO INM	1	1	1	1
FPMO LC	1	1	1	1

IMCS UL	3	3	5	2
UL PI	0	1	1	1

A look at the ABSPM graduation papers (Table 2.4.5.4) shows that many of the works are written in the field of modelling and differentials ("parallel numerical methods at the time", "modelling of natural convection with the final volume method", "Study and use of the dynamism method of dissolving particles", "Top and Bottom functions" the use of second-round border prevention research, "Algorithms for solving Hamilton's systems and maintaining learning structures"), are also separate works in functional analysis and discreet mathematics.

Table 2.4.5.4

ABSPM bachelor's theses titles 2020/2021

1.	Mathematical morphology operator applications for image processing
2.	Time parallel numerical methods
3.	Topology optimization for rod system models
4.	Hamilton systems resolution and learning structures retaining algorithms
5.	Study of the essential characteristics of mathematical morphology operators
6.	An in-depth insight into some concepts and tasks of a functional analysis course
7.	Exploration and use of the hydrodynamic method of the precipitating particles
8.	Application of the upper and lower function method to study second-order border problems
9.	Natural convection modelling with final volume method

Finally, we should mention the works of the masters of AMSPM (AMSPMDS) (Table 2.4.5.5), of which 4 are written in more mathematical statistics and data science, 2 in the modelling direction and the other 3 in the pure mathematics sector. Although the number of students in the master has declined in recent years, the quality of the works is high and many of the masters are involved in both pedagogical work and scientific projects. For example, the Master's Thesis on "Real-Time Timeseries analysis for forecasting and anomalies detection" is based on a project in the Statistical Studies and Data Analysis (SPDAL) laboratory. Similarly, the Master's "Empirical Confidence Method for Two Favorite Dependant Data" was written by a student named Reinis Alksnis, who already works as a teacher in the Department of Mathematics and developed his work in the framework of a special scholarship that was awarded for a year in the PHMOF faculty in support of science-excellent students and works.

Table 2.4.5.5

AMSPM (AMSPMDZ) *Master's titles 2019/2020 and 2020/2021*

1.	Real-time time series analysis for forecasting and detection of anomalies
2.	Mathematical model of thermal decomposition of biomass
3.	Functional dependency based on an orthodox set
4.	Fuzzy mathematics morphology operators: theory bases and operator sales for specific conjunctor-implicator couples
5.	Study of linear partial differential equations systems
6.	Empirical confidence method for two samples for poorly dependent data
7.	modelling of heat generation and transfer processes in graphs
8.	Empirical confidence function for kernel ironing methods
9.	Methods for evaluating the parameters of diffusion processes

In the Department of Mathematics both at bachelor's and master level and doctoral students are actively involved in different sections of the UL annual conference: 1) Mathematical statistics; 2) Differential singles and differential equations; 3) Non-strict logical mathematical structures and their uses; 4) Discrete Mathematics; 5) Modern elementary mathematics and mathematics teaching.

Special scholarship: For several consecutive years, a competition for a scientific assistant was organised at UL FPMO in order to support freshman master students in scientific activity:

- (1) ASPM student Elina Kresse; (2) ASPM student Guna Brenda Pogule;
- (1) AMSPP student Valts Krūmiņš; (2) PMSP “Optometry” student Zane Agarelova; (3) AMSPM student Saiva Vilne;
- (1) AMSPP student Jānis Užulis; (2) PMSP “Optometry” student Linda Krauze; (3) AMSPM student Reinis Alksnis.

Several of the winners of the scholarship have successfully joined the ranks of the FPMO departments: for example, Reinis Alksnis is a doctoral candidate and a scientific assistant in the SPDAL laboratory and has been involved in teaching practical works of various courses. Guna Brenda Pogule is involved in NMS, works on the realisation of various projects, and studies in Master year 2. Jānis Užulis is a scientific assistant at the Department of Theoretic Physics. These examples show that the scholarship created by the FPMO has played an important role in the faculty.

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.

During the reference period, the innovations applied to the implementation of the FS FMS can be classified as: organisational innovation, marketing innovation, infrastructure innovation, learning process innovation, information technology innovation.

- Organisational innovation

During the reference period, the transition from the sectoral study programme boards to the field of study boards has taken place. As a result, in the field of studies, “Physics, Material Science, Mathematics and Statistics”, closer cooperation is underway between physics and mathematics programmes. Analysis of the content of study courses has been entrusted to the boards of the departments of physics and mathematics.

Organisational innovation also includes the active transition of UL to electronic documentation, which takes place within the framework OF the existing information system LUIS.

Bachelor's level freshman students have a renewed system of curators. The so-called metaphors of the e-study environment are used to inform and inform students.

- Marketing innovation

The marketing innovation of study programs is led by the UL Department of Communications. As part of the field of study, close coordination of activities is taking place to make the process more efficient, and the promotion of study programmes takes place in cooperation with other specific UL study programmes. Cooperation is improved by being in the academic centre of the UL Tornakalns.

- Infrastructure innovation

The main innovation in infrastructure development is the creation of the UL Tornakalns academic centre, which currently houses Nature and Sciences, is expected to join the Writers' house within two years. UL is also actively working on other ideas: Technology Home, Sports Home, etc. In addition to modern, “European level” spaces, the modernisation of training and research infrastructure at plant level has also been implemented.

- Innovation in the learning process

In the last two years, the Covid-19 situation stimulated the acquisition of an active remote study process and the development of teaching materials, including the creation of video recordings of lectures. Continuing the process of student-oriented studies through the development of teaching staff in the remote courses of the EdX platform “*An Introduction to Evidence-Based Undergraduate* STEM *Teaching*” and “*Advancing Learning Through Evidence-Based* STEM *Teaching*”, as well as the organisation OF FPMO internal teaching experience exchange seminars. UL has offered teaching staff the opportunity to improve both English and the skills of using different IT tools. UL continues to improve the e-environmental capabilities of studies (MOODLE). It is connected to *Microsoft Teams*.

Each of the study programmes has its own individual innovations as described in the sections of the characteristics of the study programmes.

- Information Technology Innovation

These innovations include the development of LUIS, the extensive use of electronic documents and the associated use of e-signature, e-studio environmental innovation, its linkage to MS *Teams*. As important IT innovations are joint provision of separate software across UL (*Microsoft Office* 365, SPSS*, Autodesk,* ANSYS*, Gaussian, MathWorks Mat* LAB*, Esri Arc* GIS*, Wolfram Mathematica, Thomson Reuters EndNote, Question Pro*). FPMO-level innovation is the transition to computer programming environments (languages) *Python* and *R*.

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.

First of all, let us note that there are two joint study programmes between FS PMSMS study programmes – ABSPP is shared with Daugavpils University (DU), while DSPDFPT is shared with Riga Technical University (RTU). These universities have a good logistical base and experienced teaching staff. Specialists at Ventspils University College are also involved in the provision of certain study courses. And it is also the other way around, the teaching staff of FS PMSMS lead study courses at Riga Technical University, Latvian Agricultural University, Novikontas Naval College.

The most important criteria for choosing partners are their scope and competence, while the types of cooperation can be divided into program implementation (e.g. joint programs, teaching staff, practice) and development (opinion, new teaching staff), as well as competence dissemination (schools, society, associations) and in development (teaching staff). Attracting partners takes place by following the development trends of the fields, the interest of students, the employment of graduates, as well as cooperation offers from companies or associations.

All studies programmes of FS PMSMS, with the exception OF DSPDFPT, include practices. the practice OF PBSPMS has existed since the creation of a study programme in 1997; as a professional programme, the duration of the practice is the highest (20 credits), the duration of the practice in the other academic programmes is limited (2-6 credits). In order to successfully implement the practice and to achieve the results of its professional activities, FS PMSMS has concluded a total of 17 practice assurance contracts (Annex 2) with the following companies: UL Mathematical and informatics Institute, TNS *Latvia*, AS *4 finance*, *Accenture Oy*, *Creamfinance Latvia*, *Dukascopy Bank* SA, Central Statistical Bureau, *Gamhanger Audio* Ltd., *SIA Light Guide Optics* International, Electronics and Computer Science Institute, *SIA* Hackmotion, RTU Institute of Mechanics and Mechanical Engineering, Department of Theoretic Mechanics and Materials Resistance, Ventspils University College, Riga Secondary School 41, UL Institute of Solid State Physics, UL Astronomy Institute, SIA *RAA Consulting*. Students can also find a place of practice regardless of contracts concluded, so the number of companies working with to ensure practices is much higher. In the field of studies, potential places providers are invited to tell students about their business in order to give students an idea of job opportunities in their own industry, and to allow them to choose a place of practice first and then possibly a place of work.

For many students, the practice site becomes the first workplace, especially it can be said about PBSPMS students. In academic programs, practice can be passed through a scientific institute, which means that a student gains real scientific experience while working with real data from experiments and observations. At the end of practice, the students receive a review and assessment of the institution of practice. These reviews are like feedback showing how many students have been knowledgeable, skilled and able in their places of practice. There are also placement employees who can find out what knowledge students need to gain at university. The results of an employers' survey carried out in 2021 show that employers are satisfied with the graduates of FS PMSMS and that, in general, they were able to carry out their duties after a short period of training/entry at work.

In seeking places in which students acquire not only professional experience but also new theoretical knowledge, there has been good cooperation with many UL institutes. This is particularly the case for institutes in the physics sector, such as the Astronomy Institute, the Institute of Physics, the Institute of Material Mechanics, the Institute for Atomic physics and Spectroscopy, the Institute for Chemical Physics, the Institute for Solid State Physics. Many institute staff are attracted as university teachers in physics research programmes, as well as a number of teaching staff in the FS PMSMS perform scientific activities in one of these institutes. In Latvia, however, in the only mathematics-related institute, the UL Institute of Mathematics and Computer Science, the scientific activity is carried out by a large proportion of the teaching staff of the sector. Cooperation with the institutes facilitates the involvement of students in scientific projects, thereby providing students with real scientific experience.

The teaching staff of FS PMSMS certify their professional participation by acting in both professional and non-governmental organisations, such as the Latvian Astronomy Society, the Latvian Physics Society, the Latvian Association of Mathematics Teachers, the Latvian Association of Statisticians, the Latvian Association of Actuaries, the Latvian Association of Physics Teachers, Association of New Scientists, Association of Latvian University Professors. Not only do they bring together members of interest, they are also educated, organising scientific and professional readings and seminars, and organising conferences.

The teaching staff of FS PMSMS are involved in cooperation with Latvian schools. There are individual teaching staff who have chosen work as a side-by-side in the school (for example, Riga State Gymnasium 1). Not only UL teaching staff (e.g. A. Cibulis, A. Zīlīte u. c.), but also senior students, tend to teach maths in schools. To attract potential students, FPMO organises lessons throughout the entire school year at the New Physicist School (JFS) and Little Mathematics University (MMU). In these classes, active participation is taken by students, showing and telling them exciting physics and mathematics issues. Information on these events is sent to Latvian schools; physics and mathematics teachers organise and interest pupils to participate in the JFS and MMU classes. There are also those who prepare pupils for international Olympiads in physics and mathematics.

The education of the Latvian public regarding the physics and mathematics spotlights takes place through a variety of measures. One such popular event is the Night of Scientists.

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.

UL has concluded 23 cooperation agreements with foreign universities on Erasmus+ studies in physics and/or mathematics (Table 2.5.2.1.). Contracts are regularly updated. AT the beginning of each semester, FPMO has been consulted with students on the possibility of participating in the Erasmus + mobility programme. The debate covers partner universities, scholarships and general conditions, as well as student success stories that have already participated in Erasmus +. The information is also provided in e-mail format. Interested students are asked to send a letter of motivation and form of application. The application criterion is a weighted average mark for the final semester, it must be at least 7 points. Upon receipt of the applications, a vote of the FPMO commission is organised in which each member of the commission votes in favour of/against each applicant. Approved nominations are directed to mobility.

New cooperation partners (higher education institutions) are sought through the scientific contacts of the faculty staff, and offers of cooperation from other universities are accepted if the relevant faculty of that university meets the criteria of the FMOF of the University of Latvia. For example, in February 2022 an agreement was concluded with AGH University of Science and Technology (Poland). The most important criteria for selecting foreign partners are also scope and competence, as well as mutual interest.

New co-operation partners (higher education institutions) are sought through scientific contacts of faculty employees, as well as other university co-operation offers are accepted, if the relevant faculty of such higher education meets the criteria of the University of Latvia. For example, in February 2022 an agreement was concluded with AGH *University of Science and Technology* (Poland).

In the spring semester of the 2021/2022 academic year, three students in the Department of Mathematics and one student in the Department of Physics are studying in partner universities under the Erasmus+ programme, as well as one student from *Kocaeli University* (Turkey) in the UL Department of Mathematics. In the autumn semester of 2022/2023 academic year, three students in the Department of Mathematics and one student in the Department of Physics will study in partner universities under the Erasmus+ programme.

Table 2.5.2.1

FS PMSMS Erasmus + Contract List

Erasmus + contracts		
1.	*University of Ostrava* (Czech Republic)	*Erasmus +, mathematics*
2.	*Universität Bremen* (Germany)	*Erasmus +, Physics, Mathematics*
3.	*Gottfried Wilhelm Leibniz Universität Hannover* (Germany)	*Erasmus +, physics*
4.	*Technische Universität Kaiserslautern* (Germany)	*Erasmus +, Physics, Mathematics*
5.	*Universität Rostock* (Germany)	*Erasmus +, physics*
6.	*University of Tartu* (Estonia)	*Erasmus +, mathematics*
7.	*University of Helsinki* (Finland)	*Erasmus +, Physics, Mathematics*
8.	*Universitat de les Illes Balears* (Iceland)	*Erasmus +, mathematics*
9.	*University of Oulu* (Finland)	*Erasmus +, physics*

10.	*Grenoble INP Institute of Engineering and Management* (France)	*Erasmus +, physics*
11.	*Sorbonne Université* (France)	*Erasmus +, physics*
12.	*Universitė Jean Monnet* (France)	*Erasmus +, physics*
13.	*University of Patras* (Greece)	*Erasmus +, physics*
14.	*Vilnius University* (Lithuania)	*Erasmus +, physics*
15.	*Utrecht University* (Netherlands)	*Erasmus +, Physics, Mathematics*
16.	*Pedagogical University of Cracow* (Poland)	*Erasmus +, physics (practice)*
17.	*Umeå Universitet* (Sweden)	*Erasmus +, physics*
18.	*University of Ljubljana* (Slovenia)	*Erasmus +, mathematics*
19.	*Izmir Institute of Technology* (Turkey)	*Erasmus +, Physics, Mathematics*
20.	*Kocaeli University* (Turkey)	*Erasmus +, mathematics*
21.	*AGH University of Science and Technology* (Poland)	*Erasmus +, mathematics*
22.	*University of Łódź* (Poland)	*Erasmus +, physics*
23.	*KTH Royal Institute of Technology* (Sweden)	*Erasmus +, physics*

UL is a partner in of the FORTHEM (*Fostering Outreach within European Regions, Transnational Higher Education and Mobility*, European Regional Cooperation, Promoting Transnational Higher Education and Mobility) Alliance for Partner Schools. All higher education establishments signed a multilaterial contract at the end of December. In Table 2.5.2.2, you can see universities that offer the opportunity for UL students to learn physics or mathematics. In the spring semester of the 2021/2022 academic year, a student from the University of Palermo (Italy) will visit the Mathematics Department as part of the FORTHEM programme.

Table 2.5.2.2

FORTHEM Contract List

FORTHEM partner universities		
1.	*Johannes Gutenberg University Mainz* (Germany)	*FORTHEM, Mathematics*
2.	*University of Valencia* (Spain)	*FORTHEM, physics*
3.	*University of Burgundy* (France)	*FORTHEM, physics*
4.	*Universidad de estudios de Palermo* (Italy)	*FORTHEM, physics*

5.	*University of Jyväskylä* (Finland)	*FORTHEM, physics, mathematics*
6.	*Universitetet i Agder* (Norway)	*FORTHEM, physics, mathematics*

Students may choose a place of practice abroad within the framework of the PBSPMS (20 CP). For example, one student spent the autumn 2019 semester at *Smartwatt* (Portugal), but these are exceptional cases.

In cooperation with the Merseburg Technical University in Germany, an annual exchange of ABSP Physics 2 students (up to 10 students on each side) for the development of experimental laboratory work on experimental facilities available only at the university to which the student visit is organised. UL's student visit to Merseburg takes place in the summer. During the visit, in addition to job development, students participate in training tours in the region's scientific laboratories and businesses. Students are accompanied by one or more academic faculty who lead a lecture during the visit or speak with a workshop for a wider audience. At the end of the visit, students defend the laboratory works developed, obtain an assessment of them and obtain the right to include the course learned ABSP Physics in Part B of the programme at 2 CP.

International cooperation for the teaching staff is also part of the organisation of school curricula. Teaching staff can be found annually between the heads of Latvian international Olympiad teams, but in 2019, thanks largely to the competence of the teaching staff of FS PMSMS and the responsiveness of students in Riga, European Physics Olympiad (EuPhO 2019) was successfully organised.

There are no co-operation agreements between the faculty and foreign institutions. But that doesn't mean there are no cooperation partners abroad. Many teaching staff have visited foreign universities for both shorter and longer periods (see Annex 2.5 with teaching staff CVs); many are on editorial boards of scientific journals; many are reviewers of scientific journals.

There are many international associations and organisations involving teaching staff, such as

- *European Society for Fuzzy Logic and Technology* (S. Asmuss, O. Grigorenko, A. Sostak, I. Uljane),
- *American Physical Society* (M. Auzins, A. Ceber),
- *European Physical Society* (M. Auzins),
- *International Group for Mathematical Creativity and Giftedness* (M. Avotina, A. Zilite),
- *The European Society of Magnetohydrodynamics* (M. Birjukov),
- *Daad-alumni-Verein Lettland* (I. Bula),
- *International Society of Difference Equations* (I. Bula),
- *European Magnetism Association* (A. Ceber),
- *International Biometric Society* (M. Delesa-Velina, J. Valeinis),
- *European Association for Astronomy Education* (I. Dudareva),
- *Actuarial Association of Europe* (I. Helmane),
- *International Union of Geodesy and Geophysics* (T. Sile),
- *European Network of Crystal Growth* (J. Virbulis),
- *International Association of Meteorology and Atmospheric Sciences* (T. Sile) etc.

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.

Certain measures to attract foreign students to FPMO have so far not been taken since UL has a separate department dedicated to recruiting students. The main and most widely used mechanism for attracting foreign students is cooperation with recruitment agencies abroad working in the countries concerned. The faculty makes informational materials, maintains a faculty home page in English that contains information about study opportunities, the application procedure, and all issues of interest to foreign students.

The recruitment of foreign students and foreign teachers during the reporting period has been very small (Annex 2.10). Overall, over the period considered, there were 37 foreign students (Table 2.5.3.1), of whom 19 have been in Erasmus+ internship. As studies have so far been conducted in Latvian, interest in the study programmes of FS PMSMS on the foreign side has been very small. Engagement has been through Erasmus + mobility so far. However, as a result of the accreditation process, both master's programmes and, of course, the doctoral programme will also provide the study in English, so an increase in the number of foreign students is expected.

Table 2.5.3.1

Number of students from abroad

	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022
Total in the field	**3**	**5**	**2**	**3**	**10**	**10**	**1**	**1**	**2**
For a degree, qualification	2	1	1	1	0	0	0	0	0
In the exchange programme	1	4	1	2	10	10	1	1	2

The analysis of the outgoing mobility of students in the reporting period (Table 2.5.3.2) leads to the conclusion that the number has decreased over time. This could be explained by the fact that students do not go to study abroad in the first years, but when it would be time to do so, there has been a working relationship in parallel with studies which, for financial reasons, it would not be desirable to terminate.

Table 2.5.3.2

Outgoing mobility of students

	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022
Total in direction	10	5	12	9	1	2	5	2	4

Analysing the incoming and outgoing mobility of the teaching staff of FS PMSMS, it can be concluded that these were mainly short-term visits.

Table 2.5.3.3

Incoming and outgoing mobility of the teaching staff

	2013/ 2014	2014/ 2015	2015/ 2016	2016 / 2017	2017/ 2018	2018 / 2019	2019 / 2020	2020 / 2021	2021 / 2022
incoming	11	13	14	6	20	8	10	1	3
outgoing	16	13	12	13	11	14	1	0	15

To realise the ESF specific aid target 8.2.2 “Strengthening the academic staff of higher education institutions in areas of strategic specialisation” projects “Renewal of academic staff and capacity building at the University of Latvia” between 2018 and 2022 attracted a number of foreign trainers, two of whom have been elected to academic positions. As studies take place in Latvian, there have been problems in providing guests with study courses that would be suitable for reading in English.

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.

In previous accreditation of the field of study, the recommendations provided by experts for the development of the field of study have been implemented as far as possible. Annex 3 gives a full overview of the implementation and enforcement of the recommendations made by experts, with 5 key recommendations being highlighted here.

Experts have recommended setting up stricter admission conditions in bachelor's-level programs because the number of dropout students is too large, especially after the 1st year. The recommendation for the first half on reinforcing the admission conditions cannot be accepted, since there has been virtually no contest for the announced admission to the budget places until now. Stricter admission requirements can scare off potential students in all field of study and create problems with completing the full number of students scheduled for year 1 in the budget. The most serious problem is reducing the number of missing students. Several steps have been taken to reduce the number of students who have fallen back: at the beginning of the study, there is a student camp event; in the 1 st year of study at bachelor's level there is an additional training course in mathematics; a system of mentors and curators has been set up; in order to better focus the study process, physicists have created a metacourse for each of the years, but mathematicians have started the course “Introduction to Mathematics Studies” in year 1.

An important recommendation is on English literacy: 1) to focus more attention on the development of personnel English skills. (2) It is recommended that the courses be given in English, as students are very interested in such an alternative. Staff English skills have grown considerably compared to 2013, but FPMO has also offered staff a chance to attend English courses. Between January 2020 and June 2021, the English language courses were attended and the knowledge was improved by 25 study-related teaching staff. For the second half of the recommendation, students from both the Mathematics and Physics Master have been offered study courses in English. AMSPP and AMSPMDS studies directed to accreditation are also intended in English. If this is done successfully, it will also be possible for those students who have planned their studies in Latvian to study in English.

The critical remark that academic staff do not use e-studies effectively has been re-evaluated and repeated. In the surveys conducted by UL on the courses to be completed by students at the end of each semester, the question “The materials available in e-Course helped in learning the course” on the 7-point scale should be answered. When reviewing the 2021 Spring and Autumn semester surveys, you can see that score 7 has been received by a number of study courses and overall these scores are very high (above 5.5), but unfortunately there are 2 study courses with a score of 3.67 and 3.86. The Covid-19 pandemic in the past two years has forced all faculty to review and recreate teaching materials that are deployed in e-studies. Over the past two years, tests in various forms (tests of different types or the submission of written solutions) have taken place through e-studies in virtually all study courses. Test job ratings are entered in the corresponding e-study rating books of study courses. The recommendation has been completed, but the possibilities for improving the environment for e-studies have not stopped.

Experts have made two recommendations regarding the evaluation of the quality of study programmes: FPMO student authority and FPMO management (dean, department leaders, head of field of study) regularly organise monthly meetings where different issues are discussed, including the results of study courses surveys. The content of the study programmes is discussed in the meetings of the Board of Physical and Mathematical Divisions, in which student representatives participate. Much has been debated about creating specialisation of study programmes, how this will affect the interests of students, the quality of dropouts and studies in general. the results of AMSPP's first years show the right choice. A very important decision was taken by the Mathematical Division, scheduling to reduce the duration of ABSPM studies from 4 years to 3 years in the accreditation process. Practically all students of the ABSPM were involved in the adoption of this decision, as each should have expressed their views. This is not an unequivocal decision, the earliest of its consequences will be seen in 2024.

In the internal evaluation of the results of study programmes, it is much more difficult to involve other academic staff of Latvian universities and foreign study institutions than to discuss with students studying in faculty. The creation of a joint AMSPP with the University of Daugavpils has discussed and evaluated not only the content of the specific Master's degree programme but also the content of the Bachelor-level ABSPP. AMSPP has also been evaluated internationally before obtaining the licence. The Council of Mathematics Professors is involved in the work of the RTU and DU teaching staff, and the RTU teaching staff participate in the final commission of the PBSPMS. Mathematicians have discussed the study programmes and the methods of teaching individual courses at the annual international conferences “*Teaching mathematics: retrospective and perspectives*” (2013-2018).

In 2012, when documents were drawn up for previous accreditation, ESF projects played an important role in financial support for FPMO, the development of the study process depended on some large ESF projects and was one of the conclusions of experts that there was a need for dependency on ESF projects. Over time, the situation has changed. Although 2/3 of the FPMO budget consist of research funding, they are no longer a few large projects (see Annex 2.8). A large part of teachers are successful in attracting and implementing the funding of various research projects, and a part of teachers' scientific activities are also carried out in the UL institutes. The EU Structural Funds has also managed to raise funds for the development of individual study 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, two study programmes have received a licence for IU PMSMS. One of these is the joint with Daugavpils University (DU) Academic Master's Study Programme “Physics” (AMSPP), created by reorganising the UL Academic Master's Study Programme “Physics”, the other is the joint doctoral study programme with the Riga Technical University (RTU) “particle physics and Accelerator Technologies” (DSPDFPT).. As part of the authorisation OF AMSPP, the performance of the recommendations provided by experts is described in Table 2.6.2.1, while the performance of the recommendations made by experts in the framework of the licensing OF DSPDFPT is described in Table 2.6.2.2.

Table 2.6.2.1

Follow-up to the recommendations provided by experts AMSP “Physics”

No.	Recommendation	Activities	Due Date
Short-term recommendations			
1.	Develop an algorithm for financial and academic affairs when a student admitted to a single university nevertheless chooses to specialize in a second university.	Develop a clear algorithm for how high schools act in a situation where a student enrolled in one higher education chooses courses in the other higher education to specify remote learning opportunities for study courses.	Until the beginning of the study programme
2.	Make changes to the study contract, including information on the declared place of life of the student.	The necessary changes have been made to the study contract of the other party.	Executed
3.	Consider the system, the choice of the size of the high selection courses (57 study courses) (e.g., what is the intended assembly of courses for students, what would be the amount of specialisation).	Review the system for offering limited-choice courses, if necessary, define additional conditions, inform students about the assembly of specialisation courses and their choice.	Until the beginning of the study programme

No.	Recommendation	Activities	Due Date
Long-term recommendations			
1.	Develop an active applicant attraction activity with a view to increasing the number of students.	Set up a joint plan for UL-DU reflex engagement activities and implement according to available resources. Review this plan annually with a view to improving it.	Until the accreditation of the field of study
2.	In annual student surveys and in the process of day-to-day studies, focus on ensuring equal opportunities for UL and DU students in the partner school in the relevant study programme in order to identify and address problems in time.	Jointly analyse annual surveys of UL and DU students, focusing on ensuring equal opportunities. Identify and fix problems. Inform students of study programmes and student self-governments of the measures identified in the surveys and taken to address problems.	Until the accreditation of the field of study
3.	Raise students' awareness of mobility opportunities (e.g. ERASMUS+) and develop a more favourable environment to promote this and reduce barriers to the transfer of study courses acquired abroad.	Inform students about mobility opportunities when starting studies. Organise annual joint UL- DU seminars on student mobility, collect student experience on ERASMUS + in specific universities and make this information available to students.	Until the accreditation of the field of study
4.	To find additional alternatives in partner schools, which would be able to provide the possibility for studies to continue to specialise in the study programme, as the programme might even say that the programme is not applicable at Latvian level, it is possible to develop cooperation at Baltic level.	To survey Baltic universities on the possibility of ensuring the continuation of studies if the implementation of the study programme in UL and DU is terminated. If necessary and possible, enter into inter-university contracts.	Complete the survey in the next 3 years
5.	Improving the cross-university communication system by focusing directly on communication between teaching staff, avoiding fragmentation of study courses.	Organise annual seminars on the content of the study programme and its development.	Until the accreditation of the field of study

No.	Recommendation	Activities	Due Date
6.	Improving the overall quality management system of the study programme, focusing on aspects that could lead to potential risks and challenges in the long term, such as providing students with a full minimum share and selecting courses for both UL and DU, the analysis and marketing capabilities of these challenges have not been analysed and evaluated.	1. Look through and develop a common quality management system, together with the UL Academic Department, the DU Studies section and the DU Studies Quality Assessment Centre, to address potential risks and adapt to new challenges that may be encountered. 2. Improving the implementation of study courses in order to enable students, regardless of the site of imatriculation (UL or DU), to ensure a comfortable learning of the minimum share, as well as a realistic possibility of selecting specialisation courses in both UL and DU.	Until the accreditation of the field of study

Impact of the recommendations on the quality and development of studies

Short-term recommendations. Clarity on the distribution of student funding between HEIs (No.1) and increased student awareness of the elective part of the course offer (No.3), as well as the need to plan a full set of Part B electives.

Long-term recommendations.

Initiate annual joint refugee recruitment activities, coordinating the activities of the two universities (No.1).

Another ERASMUS+ student information seminar was held, also involving DU students (No.3).

Regular communication between the programme directors of the two sides, establishment of a Joint Programme Board,

meetings are held as necessary (No.5).

The way of delivering the compulsory part of the courses has been improved by providing remote access to lectures (No.6), the need for such measures in specialisation courses has not yet arisen.

Remark. Questions related to the analysis of students' opinions will be possible after the first survey results are available, thus from February 2023. Currently, the programme has only 1st semester students.

Table 2.6.2.2

Performance of the recommendations provided by experts in the DSP Particle Physics and Accelerator Technologies

No.	Recommendation	Activities	Due Date
Short-term recommendations			

1	To identify and supplement study courses with newer sources of literature by the beginning of the study programme	The gold standard teaching materials of the study course “The Theory of particle Physics” are still based on the teaching materials created in the 60 s of the last century, in the 70 s and in the 80 s. However, in order to ensure a more modern learning approach, the training process for this course will also use the available free access training materials, formed in recent years, including David Tong Cambridge lecture series materials (https://www.damtp.cam.ac.uk/user/tong/teaching.html) and materials from STFC summer schools (https://stfc.ukri.org/research/particle-physics-and-particle-astrophysics/hep-summer-school/past-schools/). The training materials will be updated and updated annually. In addition, students are advised to study and learn the content of specific scientific articles to ensure the understanding of the individual subject of each student's work.	N/a
2	Establish and describe or regulate a quality assurance system for the specific doctoral programme (DSP) prior to the commencement of the implementation of the study programme	The quality assurance mechanisms specific to the DSP is developed, improved, renewed and modified by the DSP Board, the establishment and duties of which is determined by the implementation of the bilateral cooperation agreement on the joint doctoral study programme “particle physics and accelerator technologies” concluded on 15 January 2021.	Executed
3	Until the meeting of the Study Quality Commission, include in the RTU study contract the credentials, an indication that the joint DSP will be implemented and a reference to the agreement with UL. Add to the Annexes a model agreement with UL.	Adjusted forms of the RTU study contract that contain credential information in the property part. We are informed that point 1.2 will include information on the implementation of the common DSP and the reference to the Treaty. The Annex adds a correct UL contract for studies in the joint study programme for students imatriculated in partner high school.	Executed
Long-term recommendations			
4	Establishment of research laboratories relevant to the direction of the study programme in one of the partner institutions of the DSP, which will contribute not only to the acquisition of practical skills and exchange of experience among students of the DSP, but also to the training of students in the master and bachelor's programmes.	This Recommendation is fully taken into account and the setting-up of relevant laboratories will be included in the rewind plan of the study programme and related research activities.	2025
5	Develop an appropriate master's training programme to attract and prepare graduates for doctoral studies.	This recommendation is fully taken into account and the development of the relevant master's programme is included in the CERN Baltic Group priority list. In January 2022, a project application *for the Erasmus Mundus Designe Measures* project competition for the creation of a new international study programme was drawn up and submitted.	Autumn 2025
6	Include in the materials of the publication of the study programme information that applicants want good English knowledge while also studying in Latvian.	The publication materials of the study programme include information that doctoral candidates should have good knowledge of English.	Executed
7	To specify study programmes in both universities in which students would be admitted if the DSP is not licensed or loses a licence.	The implementation of the bilateral cooperation agreement on the joint doctoral study programme “Particle physics and Accelerator Technologies”, concluded on 15 January 2021, will be supplemented with 7.4. Point.	Up to the accreditation of the field of study
8	Include teaching practices of the DSP as part of the compulsory study process	This recommendation is taken into account and will provide such practices where it will not result in negative side effects incompatible with quality studies and high-quality promotion.	N/a

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	1.1.annex_List of the main internal normative acts and regulations of the University of Latvia.docx	1.1.piel_Saraksts ar galvenajiem augstskolas iekšējiem normatīvajiem aktiem un regulējumiem.docx
The management structure of the higher education institution/ college	1.2.annex_The management structure of UL.jpg	1.2.piel_LU pārvaldības struktūra.jpeg
II - Description of the Study Field - 2.1. Management of the Study Field		
Plan for the development of the study field (if applicable)	2.1.annex_Plan for the development of the study field.docx	2.1.piel_Studiju virziena attīstības plāns.docx
The management structure of the study field	2.12.annex_The management structure of the study field.jpeg	2.12.piel_Studiju virziena pārvaldības struktūra.jpeg
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.	2.2.annex_Oportunities to continue their education in another study programme.zip	2.2.piel_Apliecinājumi par iespēju turpināt izglītības ieguvi citā studiju programmā.zip
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.	2.3.annex_Compensations.zip	2.3.piel_Apliecinājumi par zaudējumu kompensāciju.zip
Standard sample of study agreement	annex_Standard sample of study agreement.zip	piel_Studiju līgumu tipveida paraugi.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	2.11.annex_Analysis of the results of surveys of students, graduates and employers.docx	2.11.piel_Studējošo, absolventu un darba devēju aptauju rezultātu analīze.doc
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	2.4.annex_Basic information on the teaching staff involved in the study field.xlsx	2.4.piel_Pamatinformācija par studiju virziena īstenošanā iesaistītajiem mācībspēkiem.xlsx
Biographies of the teaching staff members (Curriculum Vitae in Europass format)	2.5.annex_Biographies of the teaching staff members (CV).pdf	2.5.piel_Mācībspēku 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.	2.6.annex_Declarations of the state language.zip	2.6.piel_Apliecinājumi par mācībspēku valsts valodas zināšanām.zip
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)	2.7.annex_Declarations on the respective foreign language skills.zip	2.7.piel_Apliecinājumi par mācībspēku angļu valodas prasmi.zip
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.	2.8.annex_Summary of quantitative data on scientific research.docx	2.8.piel_Kvantitatīvo datu apkopojums par zinātniskās pētniecības aktivitātēm.docx
List of the publications, patents, and artistic creations of the teaching staff over the reporting period.	2.9.annex_List of the publications of the teaching staff.docx	2.9.piel_Mācībspēku publikāciju saraksts.docx
II - Description of the Study Field - 2.5. Cooperation and Internationalisation		
List of cooperation agreements, including the agreements for providing internship	2.annex_List of cooperation agreements.docx	2.piel_Sadarbības līgumu saraksts ar citām institūcijām.docx
Statistical data on the teaching staff and the students from abroad	2.10.1.annex_Statistical data on foreign students and teaching staff.docx	2.10.1.piel_Statistikas dati par ārvalstu studējošajiem un mācībspēkiem.docx
Statistical data on the incoming and outgoing mobility of students (by specifying the study programmes)	2.10.annex_Statistics on student mobility by study programmes.docx	2.10.piel_Statistikas dati par studējošo izejošo un ienākošo mobilitāti (norādot studiju programmas).docx
Statistical data on the incoming and outgoing mobility of the teaching staff	2.10.2.annex_Statistical data on the incoming and outgoing mobility of teaching staff.docx	2.10.2.piel_Statistikas dati par mācībspēku 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.	3.annex_Report on the implementation of the recommendations.docx	3.piel_Rekomendāciju izpildes pārskats.docx
An application for the evaluation of the study field signed with a secure electronic signature	SF_FMMS_Application for the Assessment of the Study Direction.docx	Iesniegums AIC studiju virziena "Fizika, materiālzinātne, matemātika un statistika" novērtēšanai (I.Bula).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)	5.9.annex_ABSPM_The curriculum of the study programme.docx	3.9.pielikums_PBSPMS_StudijuPlani.docx
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
Pāsvērtējuma ziņojumā lietotie apzīmējumi	Pielikums_Pašvērtējuma ziņojumā lietotie apzīmējumi.pdf
Abbreviations used in the self-evaluation report	Annex_Abbreviations used in the self-evaluation report.pdf
Atsauksmes par studiju programmām	AtsauksmesParStudijuProgrammam.zip
References about study programs	ReferencesAboutStudyProgramms.zip
Kvalitātes vadības rokasgrāmata	Kvalitātes_vadības_rokasgrāmata_14_10_2022.zip
Quality Management Handbook	Quality Management Handbook_14_10_2022.zip
Kārtība par nevēlēto mācībspēku un zinātnieku pieņemšanu darbā	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
Latvijas Universitātes profesoru padomes nolikums	Latvijas Universitātes profesoru padomes nolikums.doc
Uzņēmuma BALTIC3D atsauksme par fizikas bakalaura un maģistra programmām	Uzņēmuma BALTIC3D atsauksme par fizikas bakalaura un maģistra programmām.pdf

Mathematics (43460)

Study field	*Physics, Material Science, Mathematics, and Statistics*
ProcedureStudyProgram.Name	*Mathematics*
Education classification code	*43460*
Type of the study programme	*Academic bachelor study programme*
Name of the study programme director	*Uldis*
Surname of the study programme director	*Strautiņš*
E-mail of the study programme director	*uldis.strautins@lu.lv*
Title of the study programme director	*profesors, Dr.math.*
Phone of the study programme director	*22141797*
Goal of the study programme	*To provide students with high-quality academic education in mathematical science, preparing them for further studies in Master of Mathematics or other related Master's programmes in Latvia and worldwide, for work in industry, education or other fields, developing their abilities to implement achievements of mathematical science in innovative solutions of scientific, technological and economic problems.*
Tasks of the study programme	*• Provide students with theoretical and practical background knowledge in all sub-fields of mathematics. • Prepare specialists who can independently and creatively learn the latest developments in mathematical science and apply them effectively in practice. • Provide the necessary academic knowledge base for the preparation of high-skilled professionals for mathematics applications in the economy (mathematical modelling, mathematical statistics), science and mathematical education. • Promote the development of the student as an intelligent, creative and responsible person and to make him/her competitive in future academic or professional studies.*

Results of the study programme	*Knowledge:* *1. Knowledge of the basic academic material at university level: understanding the axiomatic architecture of mathematics, theoretical results and algorithms included in programme courses, key proof techniques;* *2. Understands the course materials, interdisciplinary subjects and IT technologies.* *Skills:* *3. Applies the theoretical knowledge acquired in the program to solve standard problems, proves results with proof techniques used in programme courses, uses IT technologies proficiently to solve problems;* *4. Applies mathematical and IT techniques to solve problems in the chosen economic, mathematical or industrial specialization.* *Competence:* *5. Under the guidance of a supervisor, carries out independent scientific research, works with scientific literature, formulates and analyses hypotheses, draws conclusions, presents the results obtained in written and oral form at a high academic level;* *6. performs critical analysis of scientific literature, and of methods and techniques to select suitable ones for specific problems, interprets the results, evaluates the accuracy of the methods applied, changes the approach to the task if necessary;* *7. works both individually and within a group to address problems, communicates clearly and accurately, both verbally and in writing on the themes of mathematics and selected specialisation, managing at least one foreign language at a sufficient level to communicate on the issues of mathematics and chosen specialisation;* *8. is aware of their knowledge and skills and the limits thereof, adheres to the principles of academic integrity.*
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 school education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor’s degree of Natural Sciences in Mathematics*
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

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.

In accordance with the decision of the UL FPMO Department of Mathematics, it was decided to change the amount of ABSPM from 160 credit points to 120 credit points and the duration of full-time studies from 4 years to 3 years, by changing the content of the programme, trying to maintain the content of the study programme as much as possible and complying with the requirements of *Cabinet rule No 240 (13.05.2014). Rules regarding the requirements of the state's academic education standard* (only in Latvian). Therefore, in the ABSPM study plan submitted for accreditation, changes have been made in the scope of study courses in compulsory Part A, restricted elective Part B and free elective Part C, as shown in Table 5.1.1.1.

In order to provide students with the knowledge, skills and competences over three years of study that were previously available over four years, it was decided to divide them into specializations after the third semester. Hearing the views of employers and students, four specialisation directions are offered: pure mathematics, mathematical technologies, business mathematics and modern elementary mathematics. The programme is thus still able to offer courses traditionally taught at the ABSPM.

A number of new courses have been added to the programme as a result of the new specialisations: "Introduction to Abstract Algebra, Introduction to Topology, Fundamentals of Mathematical Modelling, Microeconomics, Macroeconomics. In order to ensure the offer of study courses of the Modern Elementary Mathematics specialisation, the programme includes the study courses "Elementary methods for solving extreme problems", "Elements of modern elementary algebra and geometry", "Methodology of Mathematics I", " Methodology of Mathematics II", "Classical problems of elementary mathematics", "Fundamentals of geometry", "Charming proofs", "Elementary mathematics methods". The course "Introduction to Mathematics Studies" has also been newly created.

A series of study courses are removed from the ABSPM by replacing some of them with new courses, others being moved to a master's degree programme; changes have been made with the following courses: “Elements of Mathematical Logic and Set Theory”, “Abstract Algebra”, “Analytical Solutions”, “Mathematical Foundations of Econometric Analysis”, “Fuzzy Sets and Structures I”, “Stochastic Processes”, “Introduction to Algorithm Theory”, “Introduction to Number Theory”, “Selected Chapters in Numerical Analysis of Difference Schemes using MATLAB and MAPLE”, “Principles of Mathematical modelling”, “Nonlinear boundary value problems in applications”, “Perturbation Analysis”, “Mathematical Models of Processes in Porous Media”, “Solution of Boundary Problems in Layered Media”, “Seminar of Mathematical Software and of Data Processing for Continuous Processes”, “Applications of Numerical Methods for Solutions of Mathematical Physics and Hydrodynamics Problems”, “Splines and their Applications”, “Topology I”, “Topology II”.

During the reporting period, the courses "Mathematical Analysis I", "Mathematical Analysis II", "Mathematical Analysis III" were changed from 8+8+8 credits to 6+6+4 credits in order to include the required courses "Academic Practice", "Civil Protection" and "Environmental Protection" in the programme. The programme submitted for this accreditation has also changed the content of other courses: 'Numerical Methods I', 'Numerical Methods II': from 2 credits to 4 credits, 'Functional Analysis' and 'Complex Variable Function Theory': from 3 credits to 4 credits.

In 2012, ABSPM didn't include a study course on “Academic Practice.” Such a course of 8 credits was included in the study program and took place for the first time in the spring semester of 2021. In the new study plan, the volume of the study course “Academic Practice” is reduced to 4 credit points.

Since the previous accreditation period, the place of implementation of the study programme has changed. By January 2018, the ABSPM was implemented in the Zeļļu Street 25 (numbering changed from 8), Riga. Beginning with the spring semester of 2018, studies take place at the UL Sciences Building, Jelgava Street 3, Riga.

Table 5.1.1.1

Changes to Part A and Part B courses in the ABSPM studies

Study courses	2013./2014.	2023./2024.
Part A	91	86
Compulsory courses	81	72
Academic practice	0	4
Final examination	10	10
Part B, Restricted elective courses	61	32
Part C, Free elective courses	8	2
Total	**160**	**120**

Following an analysis of demand, a decision has been taken to offer the ABSPM only in full-time studies, by forgoing offers of part-time study forms.

The discussions at the meetings of the FS Council decided to change the objective of the ABSPM, on the grounds that the ABSPM programme is intended to prepare students for the labour market or for further studies, rather than for immediate involvement in science.

During the reporting period, taking into account the regulations of Cabinet Regulation No 322. (13.06.2017) on the *Classification of Latvian education* (only in Latvian), outcomes of the ABSPM were also changed, separately describing the knowledge, skills and competencies to be achieved by the graduates of the programme. The outcomes were described according to the new structure. More emphasis is placed on the skills needed in the labour market, while maintaining the learning outcomes aimed at preparing graduates for further studies at Master's level. A new outcome has been added on academic and professional ethics.

The above changes in the parameters of the study programme were made with the aim of improving the quality of the study programme, for example in the following aspects. The newly created specialisations were selected and approved at the meetings of the study field council, by analysing the labour market (studying the employment of graduates of recent years), as well as by conducting student surveys, thus ensuring the scientific relevance of the study programme and the conformity of study results with the knowledge, skills and competence required by the labour market. The development of new study courses provides an opportunity to incorporate the latest scientific results and developments in mathematics education, especially in courses that emphasise the applications of mathematics in other fields, such as "Fundamentals of Mathematical Modelling". Synergies between the ABSPM and the professional bachelor study programme "Mathematician Statistician" were improved, for example by allowing the lectures of the Mathematical Analysis course series to be delivered simultaneously to students of both programmes, thus saving resources.

The changes are also in line with the objectives of the study programme. The possibility to choose a specialisation improves the opportunities for students to engage in individualised, student-centred learning. The specialisation directions - both pure mathematics and modern elementary mathematics, as well as the "interdisciplinary" specialisations of pure mathematics and mathematical technology - encourage the development of academic excellence and collaboration with specialists from other disciplines. The results of the study process both during the studies (coursework, bachelor’s thesis, academic practice) and after graduation in the labour market will add to the positive contribution of the field of study to the whole society of Latvia.

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.

Since estabilishing the field of study all programmes related to mathematics and physics have been included in the field of study; this estabilishes the relevance of the Academic Bachelor's study programme "Mathematics" to the field of study. The relevance of the degrees to be granted and the parameters of the study programme in achieving the results of the specified study programme are governed by external standards, i.e. Cabinet of Ministers Regulation No 240 (13.05.2014) *Regulations regarding the national academic education standard* (only in Latvian) and Cabinet of Ministers Regulations No. 322. (13.06.2017) *Regulations regarding the classification of Latvian education* (only in Latvian).

ABSPM code 43460 according to Cabinet of Ministers Regulations No. 322. (13.06.2017) *Regulations regarding the classification of Latvian education* (only in Latvian) means:

1) first digit 4 - the higher education study programme;

2) the first two digits together 43 - academic higher education (bachelor's degree), Latvian education qualification level 6, duration of full-time studies three to four years;

3) the third digit 4 - the subject group of education is "Natural sciences, mathematics and information technology";

4) the third and fourth digits together 46 - the subject area of education is 'Mathematics and

Statistics';

5) the third, fourth and fifth digits together 460 - the subject group of the educational programme is 'Mathematics and Statistics'.

The scope of the study programme, the duration of implementation, the parts of the study programme and their scope, the compulsory content, the basic principles and procedures of assessment, the principles of implementation, etc. are regulated by Cabinet of Ministers Regulation No 240 (13.05.2014) *Regulations regarding the national academic education standard* (only in Latvian) and comply with the requirements set out in the Regulations.

The content of the study programme consists of study courses of 120 CP (Cabinet of Ministers Regulation No.240 (only in Latvian)); no less than 25 CP shall be devoted to the acquisition of the guidelines, principles, structure and methodology of the relevant branch or sub-branch of science (covered by the blocks of algebra, analytical geometry and mathematical analysis included in the compulsory part, totalling 36 CP); no less than 10 CP shall be devoted to the acquisition of the history of development and current problems in the field; this requirement is fulfilled by a block of Part B specialisation courses of 24 CP; a further minimum of 15 CP must be devoted to the interdisciplinary aspect of the field, provided by the courses "Programming and Computers I", "Programming and Computers II", "Oral and Written Communication in English for Mathematicians" (12 CP in total). For all majors, at least one of the interdisciplinary courses Physics for Mathematicians (4 CP), Microeconomics (4 CP), Methodology of Mathematics I, Methodology of Mathematics II (2+2 CP), which together with the 12 CP mentioned above, gives no less than 16 CP of interdisciplinary courses for the restricted elective part.

The objectives and results of studies defined by the study programme are interlinked with the results of study courses, as demonstrated by the mapping carried out (Annex 5.8).

The aim and objectives of the ABSPM have already been mentioned in the programme application.

The admission to ABSPM have been developed in accordance with the objectives of the study programme. In order to be able to start at ABSPM, the applicant must have obtained secondary education. The competition for places of study take place on the basis of the results of the centralised examinations or on the marks of persons who have obtained secondary education by 2004, who are exempt from from the centralised examinations or have obtained secondary education abroad. As a result of the competition, applicants are ranked according to the points obtained. Applicants acquire points, taking into account the results of the centralised examinations in Latvian, foreign language (English or French or German) and mathematics, while in addition 100 points are obtained regarding the attendance of the UL Little Mathematics University (MMU) in the corresponding year of study and benefits are given in the Latvian State or international mathematics, physics or IT (programming) winners of grades 1-3 and recognition diplomas in the past three years; winners of grades 1-3 of the National School Education Conference in the past three years; winners of Open Physics or Mathematics Olympiads 1-3 in the last three years. As a result of the competition, it is expected that students who have good knowledge of the level of secondary education in mathematics and who are familiar with the official language and one foreign language will start their studies.

Upon successful completion of the academic Bachelor's degree programme in Mathematics, the Bachelor's degree in Mathematics is awarded.

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

The growing demand for mathematics specialists is driven by the fact that mathematics forms the basis for exact sciences, engineering, computer science, and is seen as a technology that enables innovation in the economy, and is therefore included in the STEM subjects; the need to increase the share of graduates is repeatedly mentioned in the *National Development Plan of Latvia for 2021-2027* (Goals 156, 163, 167).

The "*Informative Report on Medium and Long-Term Labour Market Forecasts*" issued by the Ministry of Economy indicates that the most significant labour shortages in the medium term (i.e. until 2027) are likely to occur in science and engineering professions, including mathematics. The shortage of mathematics specialists is evidenced by the fact that the profession "Mathematician" is among those professions (it is No 47 on the list) mentioned in Cabinet of Ministers Regulation No 108 (20.02.2018) *Specialities (professions) in which a significant shortage of workforce is forecast and in which foreigners may be invited to work in the Republic of Latvia* (only in Latvian).

Only the University of Latvia and Daugavpils University offer academic bachelor's degrees in mathematics, but in terms of the number of students, the number of highly qualified teaching staff and the number and breadth of courses offered, ABSPM occupies a unique position in the Latvian higher education system.

To improve the link between studies and the labour market, an academic internship of 4 CP has been an essential part of the ABSPM since 2018. In 2021, ABSPM third year students successfully completed internships of 8 KPs in such institutions and companies as Accenture, Process Analysis and Research Centre, 4*finance*, Institute of Mathematics and Informatics of the University of Latvia, APPLY.

More than half of final year students combine their studies with work during their studies. Analysing the employment of graduates, it can be seen that practically all graduates who do not continue their studies in higher level study programmes (master's and then doctoral studies) are employed in Latvian and foreign institutions and companies. The job titles of graduates are: researcher, research assistant, data analyst, analyst, business informatics consultant, manager, blockchain developer, lead programmer, advertising specialist, guest lecturer, mathematics teacher. A Bachelor's degree in Mathematics demonstrates advanced logical thinking, process modelling and analysis skills, and digital literacy, which are in demand in the labour market.

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.

The dynamics of the number of ABSPM students are given in Table 5.1.4.1 for the period 2011 to the end of 2021.

Table 5.1.4.1

Number of students ABSPM

Data on 1st October of the reference year	Number of students in Year 1	Number of students by year of study				Total students	Including paying	Number of graduates	Number of drop-outs
		1	2	3	4				
2011	32	33	11	12	13	69	6	13	28
2012	34	34	7	12	7	60	2	13	31
2013	25	25	13	8	10	56	2	7	26
2014	24	25	11	10	11	57	2	9	18
2015	30	32	5	12	9	58	4	11	23
2016	32	38	7	6	11	62	8	8	19
2017	33	35	15	4	9	63	8	7	23
2018	29	31	17	9	4	61	7	6	22
2019	34	25	9	12	8	54	8	2	28
2020	30	24	9	7	11	51	5	5	25
2021	28	28	12	7	8	55	4	9	14

Analysing the dynamics of the number of students, we can see that the study programme is not large in terms of the number of students. Therefore, the dynamics of the number of students and graduates cannot be considered statistically significant and conclusions about the trends in the dynamics of the number of students should be drawn with caution. The number of students enrolled in the first year varies between 24 and 38. Each year there is a tendency for slightly more than half of first-year students to drop out after the first year (see Figure 5.1.4.1). In the following years, the drop-out rate is relatively low. Several measures have been put in place to support students, especially in the first year: students are supported by a dedicated tutor who monitors their progress and helps them to deal with various problematic situations. In order to reduce the difficulties related to knowledge gaps after secondary school mathematics courses, a Levelling Mathematics Course has been introduced for students who have not reached a certain score threshold in the centralised examination. Although the majority of students say that these measures help their studies, the drop-out rate has not decreased significantly. However, a similar trend can be observed in mathematics degree programmes in many parts of the world.

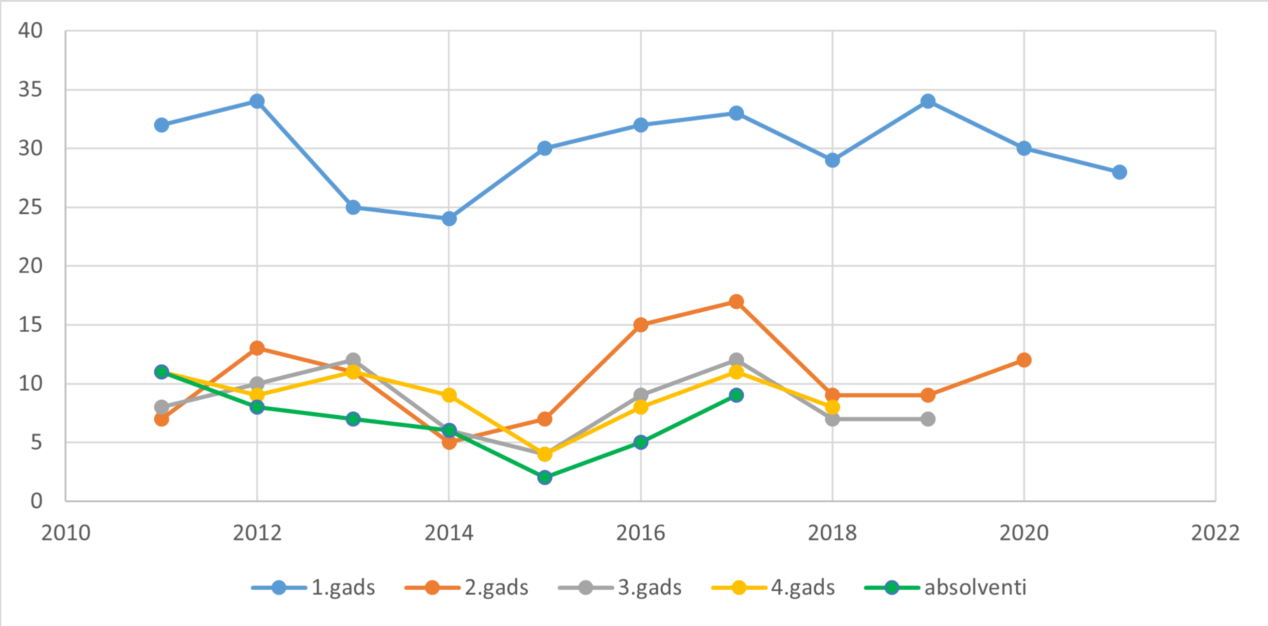


Figure 5.1.4.1. Dynamism by year of study, tracking students after year of joining (1.gads-1st year, 2. gads-2nd year, 3.gads-3rd year, 4. gads - 4th year, absolventi-graduates)

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 ABSPM study content consists of 28-30 study courses, including term paper, academic practice and bachelor's thesis. The content of the ABSPM study programme is based on the following external and internal laws and regulations:

- *The Law on Higher Education Institutions* of the Republic of Latvia;
- Cabinet of Ministers Regulation No 240 (13.05.2014) *Regulations regarding the national academic education standard* (only in Latvian);

- *Regulations on University of Latvia study and continuing education programmes*.

According to the Cabinet Regulation No 240 (13.05.2014) *The rules on* the mandatory content of the ABSPM of national academic education standards (see also 5.6. Annex):

According to the Cabinet of Ministers Regulation No 240 (13.05.2014) *Regulations regarding the national academic education standard* (only in Latvian) the mandatory content of the ABSPM consists of (see also Appendix 5.6):

- mandatory part courses (not less than 50 CP);
- restricted free elective courses (not less than 20 CP);
- free elective courses.

Required to include:

- bachelor's thesis (not less than 10 CP).

The courses included in the compulsory and restricted elective part must provide knowledge, skills and competences in the following areas:

- framework, principles, structure and methodology of the relevant discipline or sub-discipline (not less than 25 CP);
- history and current problems in the development of the discipline or sub-discipline (not less than 10 CP);
- characteristics and problems of the scientific field or sub-field from an interdisciplinary perspective (not less than 15 CP).

The *Regulations on University of Latvia study and continuing education programmes* require that the compulsory courses of study include also

- the acquisition of academic or other practices in UL or outside UL (not less than 2 CP);
- “Civil Protection” and “Environmental Protection” study courses for a total of not less than 2 CP.

From the mapping of the study courses included in the programme (Annex 5.8) it can be concluded how the study courses ensure the achievement of the study outcomes of the study programme. The study courses are designed in such a way that there is no duplication of content. The course mapping (Annex 5.9) is designed to ensure continuity and increasing level of complexity. The course mapping (Annex 5.8) shows that the ABSPM course outcomes cover all the intended learning outcomes of the programme.

The course plan provides for a gradual increase in the level of complexity of the material to be covered during the study period. Continuity of courses is very important in the study of mathematics, as many courses use concepts and theorems learned in other courses as prerequisites, e.g. students must learn the basics of algebra and mathematical analysis before studying functional analysis and the theory of functions of complex variable. Other examples of course continuity are the course cycles in mathematical analysis (4 courses), algebra (2 courses), "Programming and Computers" (3 courses). After the course "Mathematical Analysis II", the courses "Differential Equations" (I and II) can be taken, followed by the course "Equations of Mathematical Physics". The course "Mathematical Statistics" can be taken after successful completion of the course "Probability Theory". The continuity of the courses of study is represented by the prerequisites required to take a particular course.

The mapping of courses of study (Annex 5.8) shows that the planned outcomes of the courses included in the programme of study are in line with the expected outcomes of the programme of study. It can therefore be concluded that the student will have achieved all the expected learning outcomes of the ABSPM upon graduation.

All courses of study are updated every three years with the latest literature and developments in the field. At the beginning of each semester, the courses are regularly modified to reflect the current developments in the field.

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.

Oral, written, as well as combined study and assessment methods are used during the study courses and examinations.

A variety of methods are used to acquire and consolidate knowledge, such as introductory lectures, interactive lectures, summary lectures, problem-oriented lectures, seminars. In several study courses ("Mathematical Analysis I", "Mathematical Analysis II", "Algebra I", "Analytical Geometry", "Mathematical Statistics"), lectures are given by one lecturer and tutorials by another. Lectures are usually given by a more experienced lecturer, while the tutorial is carried out by new lecturers and PhD students. For a course to be successful, there needs to be consistency: the tutorial sessions should cover the same topics as the lectures, and the notation system needs to be harmonised. Practical exercises, seminars, individual, pair and group work, discussions and project work are used extensively.

In order to foster the development of students' research competence, students have the opportunity to analyse and study in depth problems of interest to them in the field in successive, mora advanced courses.

In seminars, students' speaking, presentation and discussion skills are promoted. This is particularly promoted in the three courses "Fundamentals of Mathematical Modelling," "Course project in mathematics," "Academic Practice in Mathematics".

The physical environment of the study is also gradually changing: classrooms can be easily converted for group work, individual work and students can use digital technologies. Lecturers mostly use methods that encourage students' active participation, critical thinking and reflection. The e-learning environment is used to support the learning process and independent study. For each course of study, an e-learning environment (MOODLE) has been created, where students have access to course materials, assignment descriptions, additional learning materials related to the course topics, as well as study assignments (tests, forums, seminars, conferences, etc.). All mid-term and final examinations, with the reasons for the mark, are recorded and made available to students in the e-learning environment.

The student-centred approach is followed when updating study programmes and their courses of study, with particular attention being paid to the meaningful formulation of learning outcomes in order to promote dialogue between lecturers and students on study content, forms of organisation and methods. Correctly formulated learning outcomes, in turn, promote students' understanding and ownership of their own learning, self-assessment and understanding of the assessment received. In the study process, lecturers use methods, forms of examination and assessment criteria that are appropriate to the aim of the study and the planned study outcomes.

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

The principles of student-centred learning encourage student mobility (recognition of learning outcomes), students to engage in research initiated by academic staff and social activities in the community, thus gaining meaningful experience of applying what they have learned in their studies in practice. Through the internal quality assurance policy, study programmes are implemented in such a way that students are encouraged to actively participate in the development of the study process. Policies and procedures are in place for the submission of student suggestions and complaints and for the handling of student appeals. The results of student surveys are evaluated and taken into account in the development of the study process. Students willingly express their suggestions for the improvement of study programmes and the process in discussions with lecturers, programme directors.

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).

The duration of the academic practice of ABSPM is 4 weeks (4 credits) and is 160 hours. The scheduled duration of the practice is the 6th semester of study (the first four weeks of the semester of study). ABSPM practices are governed by:

1. *Regulations on University of Latvia study and continuing education programmes* (Decision No 102 of the Senate of UL, 24.04.2017.),
2. *Principles and procedures for student placement at the University of Latvia* (Order No 1/417 of UL 25.11.2019.),
3. The Statute of the academic practice of UL ABSPM,
4. Description of the study course “Academic Practice” (4 credit points) and the corresponding e-study course.

Practice objectives

- Familiarity with mathematics applications in practice.
- Acquire, develop and strengthen the necessary competences in the working environment.
- Gain research skills.
- Prepare students for the Bachelor's thesis.

Objectives of practice

The specific objectives of practice depend on the specific nature of the objectives identified by the place of practice, which are put forward by the practice managers. Examples of practice are listed below:

- data processing and analysis,
- mathematical modelling of processes,
- scientific computing,
- development of software that requires in-depth knowledge of mathematics.

Place of practice

The practice place may be any institution outside the Department of Mathematics of the Faculty of Physics, Mathematics and Optometry (hereinafter, FPMO) of the University of Latvia, where the knowledge and skills acquired in the Bachelor of Mathematics study programme can be applied in practice.

The organiser of the practice of the Bachelor of Mathematics study programme offers the student a practice place (internship) in accordance with the cooperation agreements that the faculty has concluded with the practice institutions.

The student is also entitled to offer another place of practice. The organisers of the internship shall assess its compliance with the requirements of the study programme. In this case, a tripartite agreement shall be concluded between the FMOF, the placement institution and the student, stipulating the obligations and responsibilities of all parties (Annex 3 to the arrangements for organising the practice of UL students, 16.04.2007 UL Order No 1/86).

Duration and extent of practice

The practice duration is 4 weeks, amounting to 4 credits. The practice is scheduled at the beginning of the 6th semester.

Organiser of the programme practice, practice manager and head of the institution's practice

On the UL side, the practice is supervised by by:

- The Director of the Bachelor of Mathematics programme and/or a lecturer designated by the Department of Mathematics, whose duties are to organise the provision of internships, the conclusion of contracts and cooperation with internships, to supervise the internships of students registered in the programme and to coordinate the work of internship supervisors.
- Internship supervisor - a faculty representative (usually a lecturer of the Department of Mathematics of the Faculty of Mathematics) who supervises the internship at the institution and advises the student on specific mathematical issues related to the internship, advises on the formatting of the internship report.

At the institution where the internship takes place practice shall be managed by an employee appointed by its head (hereafter: the head of practice from the institution) who has practical experience. The responsibilities of the Head of practice from the institution include familiarising the student with the institution and its tasks, advising the student on the tasks of the internship, negotiating with the student a specific task related to the place of practice, monitoring the progress of the work, writing a comprehensive description of the trainee and his/her work during the practice.

Conduct of practice

When going to the place of practice, the student receives a cover letter from the UL practice organizer indicating what type of tasks would be expected to be performed at the institution of practice. In practice, the students familiarise themselves with the structure of the particular institution, the organisation of work and the tasks involving mathematical content performed at that institution. The student must agree with the head of practice on one concrete problem to be solved during the practice. The day-to-day tasks of the institution of practice should address the above-mentioned problem, the development of which will have to be described in the practice report and presented orally in the defence of the practice. In practice, the student consults a practice manager from UL oon the development of mathematical models, the use of mathematical tools and other mathematical-theoretical aspects, and consults on the drawing up of a practice report. In the event of conflict, the student must refer to the programme director or the specially designated practice organizer.

At the end of practice, the student must be able to prepare a practice report and presentation in which they

- present the institution of practice, indicating the tasks to be carried out;
- define the problems that they have dealt with in practice,
- formulate the specific task that has been addressed by the student in the course of practice,
- describe the means by which problems are addressed,
- make an analysis of the results, give appropriate conclusions.

Procedures for the Evaluation of Practice

The student is required to write a report on the completion of the practice task. The head of practice writes a reference (description) from the institution regarding the work of the student during the practice and signs the report prepared by the student on the documentary sheet (see Annex 1). The reference shall reflect the quality of the student's work and the discipline of the work, as well as the assessment of the practice (on a 10-point scale). The practice reports together with the reference shall be submitted to the practice organizer on the UL side (the programme director or the specially designated practice organiser) on the day of the defence of the practice, together with the feedback (characterisation) of the practice manager.

Defending the practice report takes place within one week of the last day of the practice.

Specific times are specified by the Director of the Bachelor of Mathematics Studies Programme. Defending the practice report and evaluation of the practice are performed by a committee approved by the Director of the Bachelor of Mathematics Studies Programme, which is made up of teaching staff of the Department of Mathematics. The Commitee's meeting calls for the participation of all student practice managers from the institutions (in view of objective circumstances (if it prevents the manager from exercising of his or her direct duties), it is permitted that he/she may also not participate personally but delegate another person from the place of practice).

During the defence - presentation (up to 10 minutes), the student informs the committee about the main results of the internship, illustrating them with various presentation materials.

When assessing the practice report with a mark (on a 10-point scale), the commission shall take into account the following factors:

- the content of the practice report, including the extent to which the mathematical apparatus acquired during studies has been used;
- reference (description) and oral and/or written comments from the head of practice;
- the design of the practice report;
- the presentation by the student;
- the student's answers to questions from members of the committee.

The practice assessment mark shall be entered in the relevant Examination Protocol.

Practice reports shall be stored in the Department of Mathematics.

Table 5.2.4.1 shows the places of practice and the titles of reports developed in the spring semester of ABSPM 2021.

Table 5.2.4.1

ABSPM 2021 autumn semester practice places and practice report titles

Place of practice	Practice Report Title
SIA APPLY	Introducing and exploring metrics for statistical analysis of segmentation networks
Processing Analysis and Research Centre Ltd	Development of hydrological models
UL Institute of Mathematics and Computer Science	Pairing algorithm for images and descriptions
Accenture	Data analysis in marketing and sales of a pharmacological company
AS 4 finance	Applications of Markov chains in credit loss analysis

We see that the list of internships and topics correlates well with the actual employment of graduates - we see jobs in research institutions, in companies operating in the financial market, and in consultancies working with clients in industry.

Currently the study programme has valid cooperation agreements with the Institute of Mathematics and Computer Science of the University of Latvia and RAA Consulting. In the near future it is planned to expand the range of companies and institutes with which cooperation agreements have been signed.

The results of studies in the course “Academic Practice” fully cover the study outcomes (see Annex 5.8 on the mapping of study courses).

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.

A bachelor's thesis is the main qualification for the ABSPM, and is an independent piece of research on a specific mathematical topic of scientific or practical importance. The individual topic and specific tasks of the bachelor thesis are formulated for each student by a supervisor qualified to supervise bachelor theses. The aim of the bachelor thesis is to apply, systematise and extend the theoretical knowledge and practical skills acquired during the studies, to apply them in carrying out independent research of scientific or practical significance, as well as to summarise and analyse the results obtained, draw conclusions and formulate recommendations for further work.

Students choose the topic of their final ABSPM thesis - bachelor thesis - according to the study programme content and chosen specialisation. Before starting the bachelor thesis, students are informed about the bachelor thesis process. The reasons for the choice of the topic are based on the chosen specialisation, relevance to the field of mathematical science, as well as the student's interests, scientific background, internship or professional experience.

A total of 57 bachelor's theses have been defended during the reference period from 2013/2014 to 2020/2021. The topics of the Bachelor's thesis of ABSPM students has been based on pure and applied mathematics. For example, in the year 2020/2021, 9 bachelor's theses were defended, their titles are given in Table 3.2.6.1.

Table 5.2.6.1

ABSPM bachelor's theses titles 2020/2021

1.	Applications of mathematical morphology operators in image processing
2.	Time-parallel numerical methods
3.	Topology optimisation for rod system models
4.	Algorithms for solving Hamilton systems and structure preserving learning
5.	Exploring the basic properties of mathematical morphology operators
6.	A deeper insight into some concepts and problems of functional analysis course
7.	Analyisis and application of smoothed particle hydrodynamics method
8.	Application of the upper and lower function method to the study of the solvability of second order boundary value problems
9.	Modelling natural convection with the finite volume method

The evaluation of the final examinations are carried out by the final examination committee, which, on a proposal from the FPMO Council, is approved by the Vice-Rector of the relevant field. In evaluating the Bachelor's thesis, attention is paid not only to the content of the bachelor's thesis and to the requirements of the final thesis, but also to the ability to present the results of the bachelor's thesis and to the answers to the questions raised by the reviewer and members of the final examination committee. Evaluations of bachelor's theses for the period from 2014/2015 to 2020/2021 show that students are able to demonstrate a high level of knowledge, skills and competence, in line with the requirements of bachelor's thesis (see Table 5.2.6.2 and Figure 5.2.6.1).

Table 5.2.6.2

ABSPM Bachelor of Business Ratings from 2014/2015 to 2020/2021

	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
assessment	number %	number %	number %	number %	number %	number %	number %
10	4 – 33%			1 – 17%	1 – 50%		4 – 44%
9	2 – 17%	4 – 50%	4 – 57%	3 – 50%		2 – 40%	3 – 33%
8	2 – 17%	1 – 12%	3 – 43%	1 – 17%	1 – 50%	1 – 20%	2 – 22%
7	1 – 8%	1 – 12%		1 – 17%		2 – 40%	
6	1 – 8%	1 – 12%					
5		1 – 12%					
4							
total	12	8	7	5	2	5	9

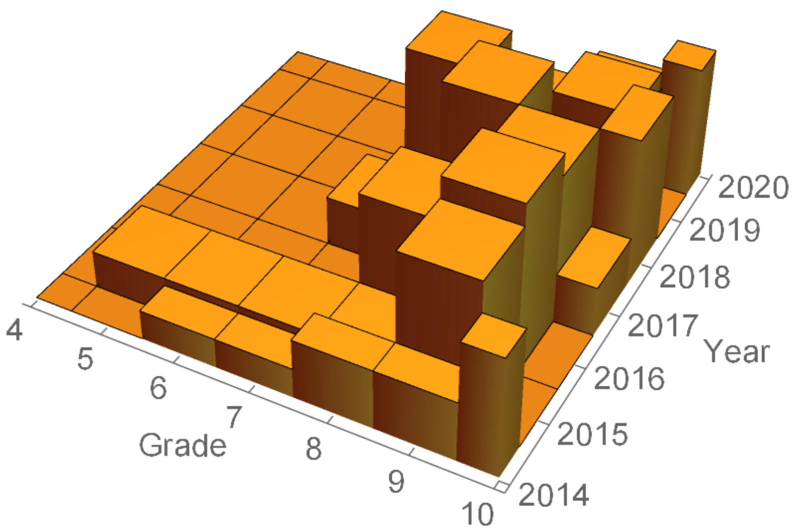


Figure 5.2.6.1. ABSPM Bachelor of Business Ratings from 2014/2015 to 2020/2021

We see that 83% of successfully defended theses are graded "very good," "excellent" or "outstanding".

A significant proportion of the final theses produced are related to current research projects. The theses "Algorithms for solving Hamilton systems and structure preserving learning" and "Time-parallel numerical methods" prepared the student for a later involvement in a research project. The thesis "Modelling natural convection with the finite volume method" contains an original implementation of the Navier-Stokes and heat conduction equation system in Matlab, which can be used in simulations of heat and mass transfer processes relevant to both science and applications. The work entitled “Analysis and application of smoothed particle hydrodynamics method” addresses a closely related system of equations; the numerical method developed and implemented in this work for simulations of the combustion of a mixture of gases is completely original and has the potential to make a scientific contribution. The topics of the latter two bachelor theses were inspired by a scientific project carried out by the Institute of Mathematics and Computer Science of the University of Latvia in collaboration with the Institute of Physics of the University of Latvia.

In general, it can be concluded that the topics of the ABSPM final theses are relevant to the title and content of the study programme, the results of the studies carried out by students are up to date in the field of mathematics; students receive high grades in defence of final theses and demonstrate the knowledge, skills and competence acquired during their studies.

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.

All resources at the disposal of UL and FPMO are available for the implementation of ABSPM. Both the information base (including the library) and the material technical base, as well as the methodological provision, comply with the conditions for the implementation of the study programme, create preconditions for achieving the results of studies and demonstrate the possibility of ensuring the quality study process to continue.

The implementation of the ABSPM in UL is the responsibility of the programme director under the direct authority of the Department of Mathematics. FPMO support for the planning and implementation of the study process is provided by:

- the senior methodologist, common to FPMO study programs, administer student affairs, provides students with services that are the responsibility of the faculty,
- the mathematics department's specific study issues are sorted out by the senior secretary,
- the Science Building two computer network administrators.

Classes scheduling is performed by the senior secretary of the Department of Mathematics.

ABSPM courses are conducted mainly by teachers from the Faculty of Physics, Mathematics and Optometry (FPMO), while individual courses are run by academical staff from the Faculty of Chemistry (“Civil Protection”), Faculty of Computing (“Programming and Computers I”), Faculty of Business, Management and Economics (“Microeconomics”, “Macroeconomics”), Faculty of Humanities (“Spoken and Written Communication in English for Mathematicians”) and Faculty of

Geography and Earth Sciences (“Environmental Protection”).

The teaching of mathematics and statistical courses is provided by the FPMO Department of Mathematics, composed of 3 Chairs (Chair of Differential Equations and Approximation Methods, Chair of Mathematical Analysis and Chair of General Mathematics),as well as the Laboratory of Statistical Research and Data Analysis and the A.Liepa's Correspondence Mathematics School.

Material technical provision covering all course of study programmes is described in Part II, point 2.3.2, and the resources of the UL Library are described in Part II, point 2.3.3.

The Sciences Building has been commissioned in 2019. The total indoor area is 20018 m2, with a total of 15 auditoriums, 8 workshop rooms, 78 scientific and teaching laboratories and 430 places for scientific and academic staff. These resources are shared by two UL Faculties (Faculty of Physics, Mathematics and Optometry and Faculty of Medicine) and 6 scientific institutes. A wireless computer network is available in all rooms. The rooms are modern, the technical provision is sufficient. During the Covid-19 pandemic, the rooms were equipped with webcams to allow online or hybrid teaching (in which some students participate in person and others remotely). It is planned to use these facilities after the pandemic to hold joint seminars with faculty and researchers from other universities.

The library offers information resources according to study programmes and research fields. The Library provides acquisition of information resources on the orders of the academic staff of the Faculty, on the proposal of the student self-government or on the proposals of the Library staff, which are entered in LUIS and approved by the Executive Director of the Faculty. For more information on the resources available at the LU Library, see Part II, Section 2.3.3.

The rooms of the Science Building Library, in which the collection of the physics and mathematics sector is located, are open to students at a comfortable time of 24 hours a day for 7 days a week. A free-access section is available for users. The Science Building Library is located on the 2nd floor of the building alongside auditoriums, computer classrooms and the Information Centre in rooms with a total area of 533 m^2. There are 110 places available to users in the Science Building Library. The user can use any workplace in the building to work with a portable computer.

The library's collection is adequate for the implementation of studies and the development of scientific research, as it is updated every year with the most up-to-date information resources in accordance with the information needs of academic staff and students.

There is no need for significant investment in infrastructure in the foreseeable future. There is a need for the maintenance and modernisation of technical provision on a regular and scheduled basis, in line with technical developments and changes in the content of studies.

In general, material-technical provision is considered to be very good.

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).

Revenue of the Programme

For the implementation of the ABSPM, UL use:

- a State budget grant from the Ministry of Education and Science determined for academic year 2021/2022EUR 2445.17 for full-time studies;
- tuition fees, taking into account all the factors referred to in the heading “Financial security” identified for academic year 2021/2022: for full-time studies, EUR 2000 per year.

In the light of the above, the overall budget for the study programme is expected to be EUR 146265.03 per year, the transcript is shown in Table 5.3.3.1.

Table 5.3.3.1

Budget of the study programme, EUR

Transcript of the budget	Budget, EUR
Tuition fee revenue	2000
State budget grant	144265.03
Total	146265.03

Program income

Table 5.3.3.2

Estimated annual income of the programme, EUR

Type of study	Number of students	Study fees/State grant	Total income
Full-time (budget)	59	2445.17	144265.03
Full-time (fee)	1	2000	2000
Total			**146265.03**

Programme costs

In order to estimate the amount of funds needed for financial provision, UL study programmes calculate costs based on a methodology developed by UL that takes into account the costs of providing the study process described in the section “Financial security for the SF” and information on the study programme plan, the academic staff involved, the planned number of students, etc., thereby ensuring the reliability of the forecasts.

Full - time costs *of the programme*

For calculating, ABSPM implementers use the student data of 2021/2022 academic year: 55 students, the existing study programme plan, and the existing academic staff structure. In the light of the above, the full-time cost of the programme per student is estimated at EUR 2360 per year and the total cost of the programme at EUR 136513.90 per year. A more detailed percentage of costs is shown in Table 5.3.3.3.

Table 5.3.3.3.

Percentage of costs in the study programme

Heading of expenditure	**% of total**
Teaching staff costs	47.39%
General staff	9%
Other costs	0.00%
Infrastructure expenditure	8.25%
Property and services	2.14%
Indirect costs	32.21%
TOTAL COSTS	**100%**

Figure 5.3.3.1 illustrates the cost of the study programme, depending on the number of students, and the comparison with the proposed study fee and the State budget grant.

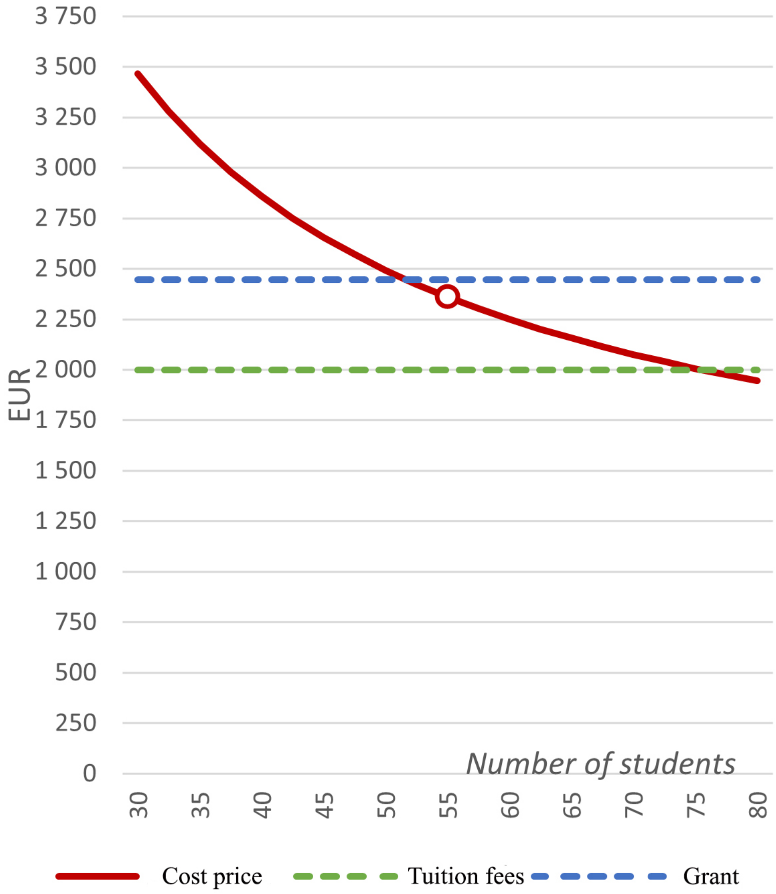


Figure 5.3.3.1. ABSPM cost from student count

Based on the calculation, it is apparent that for the programme to be cost-effective and the students to have a high-quality study process, the number of students in the programme (all courses together) should be at least 75 (red (cost) and the intersection of green (study fee) lines projected to x axis). On the other hand, if there were only budget students in the programme, the number should reach 52 students.

Summary of revenue and costs of the programme

Table 5.3.3.4 summarises the revenue of the programme on the basis of the number of students, government grants and study fees, and the expenditure of the programme at that number of students.

Table 5.3.3.4

Outcome of the programme

Type of study	Number of students	Study fees/State grant	**Total income**	**Total cost**
Full-time (budget)	59	2445.17	**144265,03**	**134032**
Full-time (fee)	1	2000	2000	2482.07
Total	**60**		**146265.03**	**136513.9**

The data presented in the table shows that UL has sufficient resources to implement the study programme and to ensure its further development. In addition, the development of the programme may be financed from revenue received from lifelong learning services and from financial resources accruing from the departments. Faculty also receive financial support for the development of programmes from the UL Study Quality Development 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.

The implementation of the ABSPM is intended to involve 27 teaching staff (see Table 5.4.1.1). Among faculty are 7 professors and 1 associate professor, as well as more than half (16) have a doctor’s degree. The current rights of LZP expert (to 01.06.2022.) are 7 teaching staff: Svetlana Asmuss, Jānis Bajārs, Inese Bula, Sergejs Smirnovs, Uldis Strautiņš, Ingrīda Uļjane and Jānis Valeinis. Accordingly, the requirements regarding the number and qualifications of teaching staff specified in Section 55, Paragraph one, Paragraph three of the Law on Higher Education have been fulfilled. The vast majority of teaching staff are involved in scientific research, as scientific assistants, researchers and leading researchers. The qualifications of the teaching staff are sufficient to ensure all courses provided for in the ABSPM study plan, to provide knowledge, skills and competence relevant to the results of studies in the study programme.

Table 5.4.1.1.

List of teaching staff involved in the ABSPM

	Last Name Name	Academic/doctoral degree	The position of UL, elsewhere	study courses
1.	Asmuss Svetlana	*Dr. math.*	FPMO professor, leading researcher of UL IMCS	Mathematical analysis I, Mathematical analysis II, Mathematical analysis III, Mathematical analysis IV, Operations research, Complex variable function theory
2.	Avotiņa Maruta	*Mg. math.*	FPMO lecturer, NMS researcher, Centre Manager	Elements of modern elementary algebra and geometry, Fundamentals of geometry
3.	Āboltiņa Baiba	*Mg. math.*	FPMO lecturer	Algebra I, Algebra II

4.	Bajārs Jānis	*Dr. math.*	FPMO docent, FPMO leading researcher	Numerical methods III
5.	Bēts Raivis	*Dr. math.*	FPMO docent, UL IMCS researcher	Classical cryptography
6.	Bula Inese	*Dr. math.*	FPMO professor, UL IMCS leading researcher	Optimization methods, Strategic game theory, Chaos
7.	Buliņa Elīna	*Mg. math.*	FPMO lecturer, scientific assistant	Mathematical analysis I, Mathematical analysis II
8.	Buls Jānis	*Dr. math.*	FPMO emeritus professor, acting leading researcher	Introduction to mathematics studies, Introduction to abstract algebra
9.	Cibulis Andrejs	*Dr. math.*	FPMO professor, UL IMCS leading researcher	Functional analysis, Elementary methods for solving extreme problems, Evolution of the concept of proof in mathematics
10.	Cīmurs Jānis	*Dr. phys.*	FPMO docent	Physics for mathematicians
11.	Delesa-Vēliņa Māra	*Dr. math.*	FPMO docent, researcher	Mathematical foundations of econometric analysis
12.	Dobkeviča Linda	*Dr. chem.*	UL Faculty of Geography and Earth Sciences researcher	Environment protection
13.	Dzenis Māris Gunārs	*Mg. math.*	FPMO lecturer, scientific assistant	Mathematical analysis I, Mathematical analysis II
14.	Grigorenko Olga	*Dr. math.*	FPMO docent, UL IMCS researcher	Mathematical analysis I, Mathematical analysis II, Mathematical analysis III, Introduction to complex analysis
15.	Jēkabsone Sandra	*Dr. oec.*	UL Faculty of Business, Management and Economics professor	Microeconomics, Macroeconomics
16.	Kalugins Emīls	*Bc. math.*	FPMO scientific assistant	Algebra I
17.	Kumerdanka Aira	*Mg. math.* *Mg. paed.*	FPMO university teacher	Methodology of mathematics I, Methodology of mathematics II, Methodology of mathematics III
18.	Lapa Lauma Terēze	*Mg. philol.*	UL FH lecturer	Spoken and Written Communication in English for Mathematicians

19.	Marinaki Maksims	*Dr. math.*	FPMO docent, UL IMCS researcher, Novikonta Naval College lecturer	Numerical methods I, Numerical methods II
20.	Pahirko Leonora	*Mg. math.*	FPMO lecturer; scientific assistant	Probability theory
21.	Parasiga-Parasiņa Kristīne	*Mg. chem.*	UL FC lecturer	Civil protection
22.	Smirnovs Sergejs	*Dr. math.*	FPMO docent, UL IMCS leading researcher	Differential equations I, Differential equations II
23.	Strautiņš Uldis	*Dr. math.*	FPMO professor, UL IMCS leading researcher	Academic practice in mathematics, Course paper, Bachelor's thesis, Equations of mathematical physics. Fundamentals of mathematical modelling
24.	Uļjane Ingrīda	*Dr. math.*	FPMO associate professor, UL IMCS leading researcher	Introduction to topology
25.	Valeinis Jānis	*Dr. math.*	FPMO professor, leading researcher	Mathematical statistics
26.	Vēzis Viesturs	*Dr. sc. comp.*	UL Faculty of Computing docent, leading researcher	Programming and computers I, Programming and computers II, Programming and computers III
27.	Zīlīte Agnese	*Mg. math.*	FPMO lecturer, researcher	Analytical geometry, Discrete mathematics, Classical problems of elementary mathematics, Fundamentals of geometry, Elementary mathematics methods

Annex 2.5 contains biographies of all teaching staff (CV).

The knowledge of the state language of the academic staff employed in the study programme comply with the *Regulations Regarding the Extent of the Knowledge of the Official Language, the Procedures for Examining the Proficiency in the Official Language and the State Fee for Examining the Proficiency in the Official Language* (Cabinet Regulation No 733, 07.07.2009), which allows the teaching of study courses in the state language.

The scientific qualifications of the academic staff ensure the high level of knowledge in the field necessary for the development and teaching of study courses of the programme. The active participation of academic staff in scientific projects promotes the knowledge of state of art in research in the field as well as familiarity with the latest technologies and the ability to integrate them into the study process.

In the light of the above, it can be argued that the staff members involved in the implementation of the programme ensure the acquisition of high-quality theoretical knowledge and the development of professional skills in mathematics.

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.

The changes in the composition of teaching staff during the reporting period are illustrated by the comparison between tables 5.4.2.1. and 5.4.2.2.

Table 5.4.2.1

ABSPM teaching staff and their capacity in 2013/2014

Position	Number of	CP, on average	CP, total
Professor	7	6	42
Associate Professor	6	5,8	35
Docent	4	7,7	31
Lecturer	2	4	8
University teacher	2	2,5	5

Table 5.4.2.2.

ABSPM teaching staff and their capacity 2021/2022 (parentheses show changes to 2013/2014)

Position	Number of	CP, on average	CP, total
Professor	7 (0)	6 (0)	42 (0)
Associate Professor	1 (-5)	2 (-3,8)	2 (-33)
Docent	6 (-2)	5,8 (-1,9)	35 (-4)
Lecturer	6 (+4)	4,7 (+0,7)	28 (+20)
University teacher	7 (+5)	3,1 (+0,6)	22 (+17)

The tables show that the number of docents, associate professors, professors has decreased, but the number of lecturers and especially university teachers has increased. This is due to the fact that the Department of Mathematics has replaced generations of teaching staff during the reporting period, as demonstrated by Table 5.4.2.3.

Table 5.4.2.3

Teaching staff	2013/2014	2021/2022
Asmuss Svetlana	professor	professor
Āboltiņa Baiba	lecturer	lecturer
Belovs Mihails	professor	-
Bērziņa Inese	acting lecturer	-
Buiķe Margarita	docent	-
Bula Inese	associate professor	professor
Buligins Leonids	professor	-
Buls Jānis	associate professor	acting professor
Cepītis Jānis	associate professor	-
Cibulis Andrejs	professor	professor
Dāme Lidija	university teacher	-
Delesa-Vēliņa Māra	teacher	teacher
Gultniece Iveta	lecturer	-
Kalis Harijs	professor	-
Lapa Lauma Terēze	lecturer	lecturer
Lapiņa Halina	lecturer	-
Lietuvietis Ojārs	associate professor	-
Reinfelds Andrejs	professor	acting professor
Smotrovs Jānis	lecturer	university teacher
Strautiņš Uldis	docent	professor
Šostaks Aleksandrs	professor	acting professor
Uļjane Ingrīda	docent	associate professor
Valeinis Jānis	docent	professor

Vēzis Viesturs	associate professor	docent

Comparing the situation in 2013 at the level of specific teaching staff (Table 5.4.2.3.), 10 teaching staff out of 24 are no longer teaching courses in ABSPM. Most of them have exceeded retirement age. The changes have succeeded in compensating young members of staff with good knowledge in the fields of study and skills in dealing with practical challenges, which opens up a sustainable view in the future.

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).

There are four levels of cooperation between the teaching staff for the development of the ABSPM:

- personal contacts,
- inter-branch cooperation (meetings of the Chairs),
- cooperation at MD level (meeting of the MD Board),
- between institutional cooperation, organised by the Director of the study programme and the Head of the MD.

The main organiser of the cooperation is the director of the study programme (responsible for the content), with the support of the Head of the MD (planned financial resources).

Cooperation among the faculty members of the ABSPM is ongoing. Formal events, such as meetings of Department of Mathematics, Meetings of Study Field and Chairs, and informal events, are organised, in which lecturers who teach related courses coordinate their curricula. The meetings, among other relevant topics, discuss the possibilities for improving study courses, the environment for e-learning, promoting cooperation between lecturers, discussing student proposals to improve the learning process, offering opportunities for the lecturers to improve their qualifications.

In several study courses (e.g. “Algebra I”, “Mathematical Analysis I”, “Mathematical Analysis II” and “Mathematical Statistics”), the lectures are given by a more experienced lecturer, while the tuorials (practical part) is conducted by a PhD student, scientific assistant or less experienced lecturer. The two faculty members must mutually agree on the content of the course and the continuity in the presentation of the material.

Following the creation of the study field system, the Mathematical Studies Programme Board, which took control of the content of the study courses, lost its role. At present, the council of study field has entrusted the content control functions of study courses to the MD Board. The Board of Governors of MD review the content of all new and substantially altered study courses.

Lecturers regularly update the content of study courses, adapting them to new requirements and trends. The quality of course descriptions is maintained by adhering to academic standards in the development of all course descriptions and by being aware of the importance of the information contained therein in ensuring a quality study process.

A total of 27 lecturers delivered ABSPM classes to 55 students in the academic year 2020/2021, which means that the average number of students per lecturer was 2.04. The low student-teacher ratio contributes to the implementation of the principles of student-centred education by providing ample opportunities for individual student-teacher consultations.

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	annex_ABSPM_Sample of the diploma and its supplement.pdf	piel_ABSPM_Diploma un tā pielikumu paraugs.pdf
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)	annex_Opinion of the Council of Higher Education.docx	piel_Augstākās izglītības padomes atzinums.docx
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	5.5.annex_ABSPM_Statistics on the students in the reporting period.docx	5.5.piel_ABSPM_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	5.6.annex_ABSPM_Compliance with the study programme with the State Education Standard.docx	5.6.piel_ABSPM_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	5.8.annex_ABSPM_Mapping of the study courses.docx	5.8.piel_ABSPM_Studiju kursu kartējums.docx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	5.9.annex_ABSPM_The curriculum of the study programme.docx	5.9.piel_ABSPM_Studiju programmas plāns.docx
Descriptions of the study courses/ modules	5.10.annex_ABSPM_Descriptions of the study courses.docx	5.10.piel_ABSPM_Studiju kursu apraksti.docx
Description of the organisation of the internship of the students (if applicable)	5.11.annex_ABSPM_Description of the organisation of the internship of the students.docx	5.11.piel_ABSPM_Studējošo prakses organizācijas apraksts.doc
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)	annex_ABSPM_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher Educ.docx	piel_ABSPM_Apliecinājums par akadēmiskā personāla atbilstību Augstskolu likuma 55. panta 1.d. 3.p.pdf

Mathematics and Data Science (45460)

Study field	*Physics, Material Science, Mathematics, and Statistics*
ProcedureStudyProgram.Name	*Mathematics and Data Science*
Education classification code	*45460*
Type of the study programme	*Academic master study programme*
Name of the study programme director	*Jānis*
Surname of the study programme director	*Valeinis*
E-mail of the study programme director	*janis.valeinis@lu.lv*
Title of the study programme director	*profesors, Dr. math.*
Phone of the study programme director	*+371 22017445*
Goal of the study programme	*Providing innovative and technology-oriented higher education, preparing top-level specialists with broad competences in mathematics and data science to work in industry, finance, data management, statistics and high-technology companies, as well as in universities, institutes and research centres in Latvia and abroad.*
Tasks of the study programme	*• Develop the skills and competences of students required for carrying out independent research work, including those related to the planning of scientific research. • Develop students' ability to understand, immerse and critically analyze scientific literature. • Select and apply an appropriate research method, compile and analyse the results by evaluating the results against the results and general findings of other authors, formulating conclusions in line with the objectives and results of the work, formulating the practical relevance and proposals of the results, as well as possible further research directions and limitations. • Present and defend the Master's thesis.*

Results of the study programme	*Knowledge:* *1. demonstrate advanced knowledge in the field of data science, which includes relevant theoretical mathematics, mathematical statistics, statistical learning and machine learning, IT tools and knowledge of the programming languages Python and R;* *2. demonstrate an advanced knowledge of technology mathematics, including general knowledge of theoretical mathematics, industrial and engineering modelling principles, advanced and emerging technologies based on data-driven systems, neural networks and numerical methods.* *3. demonstrate a thorough knowledge of pure mathematics, which includes both general knowledge of theoretical mathematical methods and programming languages and specific knowledge of mathematical structures such as topology, fuzzy sets, abstract algebra, analytical methods, mathematics for quantum computing and computer science.* *Skills:* *4. process and analyse data in depth, solve complex and original real data problems by building regression, classification and machine learning models, perform statistical tests, clustering, visualise data and data analysis results, work with IT technologies, version control systems, databases and data warehouses.* *5. analyse complex processes related to state-of-the-art technology and natural sciences, build mathematical models of complex systems, solve mathematical problems of optimisation, approximation, system control, differential and integral equations and apply numerical algorithms using modern IT technologies.* *6. prove and justify complex mathematical results, methods and formulae, describe theoretical mathematical methods in a clear and concise manner, justify theoretically obtained and proven results by carrying out simulations and using IT technologies.* *Competence:* *7. Carry out independent research work, selecting appropriate complex and innovative methodologies, creating original mathematical, modelling, algorithmic and statistical methods and knowledge, being aware of the principles of academic integrity and the potential impact of research results on the environment and society, critically interpret the results obtained, summarise them in the form of publications.* *8. Qualitatively oriented in the development trends and latest achievements of modern mathematics, able to solve complex practical problems in the fields of industry, data science and mathematical statistics, lead and implement interdisciplinary applied and fundamental research projects, make a unique contribution to the national economy by contributing to the creation of new products and technologies.*
Final examination upon the completion of the study programme	*Master's 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)	*Bachelor's degree or a second-level professional higher education (or equivalent higher education) in mathematics or bachelor's degree or a second-level professional higher education (or equivalent higher education) in natural sciences or engineering and technologies, or in social sciences and successful completion of study courses in mathematics (at least 8 credits) attested by a diploma or other educational document.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master’s degree of Natural Sciences in Mathematics*
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	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor's degree or a second-level professional higher education (or equivalent higher education) in mathematics or bachelor's degree or a second-level professional higher education (or equivalent higher education) in natural sciences or engineering and technologies, or in social sciences and successful completion of study courses in mathematics (at least 8 credits) attested by a diploma or other educational document. Studies in English require English language skills at least at B2 level.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master’s degree of Natural Sciences in Mathematics*
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

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 period, the place of implementation of the study programme has changed. By January 2018, the AMSPMDS was implemented at the Zeļļu Street 25 (numbering changed, from 8), in Riga. Beginning with the spring semester of 2018, studies take place at the UL Sciences Building, Jelgava Street 3, Riga.

The title of the study program has been changed. The title in the reporting period was “Mathematics”, the programme’s name submitted to accreditation — “Mathematics and Data Science”. The new title reflects the changes in the content of the study programme and the created sub-programmes.

The three sub-programmes containing three Fields/Specialisation were established for the new accreditation: 1) Data Science; 2) Technology Mathematics and 3) Pure Mathematics. It should be noted that a similar master's structure is being implemented at UL's Computer Sciences Faculty (Computer sciences — Master's Programme, https://www.lu.lv/en/studies/faculties/faculty-of-computing/graduate-studies/computer-science/).

The nature of the sub-programmes is similar to that of specialisations, but the idea is a little different: the student chooses one of the three sub-programmes when he joins, although the admission is to the whole of the programme. The sub-programmes are governed by the paragraph 30 of *Regulations on University of Latvia Study and Continuing Education Programmes* (approved by the decision No 102 of the Senate on 24.04.2017).

In comparison with the previous period, in future, the study programme will also be offered in English. A group for studies in English will be completed at a sufficient number of applicants. The director of the study program has identified the ability of teaching staff to implement the study program in English. All the teaching staff of the faculty have either an approval certificate of the level of English proficiency, either the study/work experience abroad or the participation in international fundamental and applied sector projects.

The plan submitted for the accreditation has changed the amount of the study courses in the mandatory part A and the limited choices in parts B and C, shown in Table 3.1.1.1.

Table 7.1.1.1.1

Changes in study courses in Parts A, B and C

Study courses	2023/2024	2013/2014
Part A	56	44
Total Part A	20	24

Part A of the corresponding sub-programme	14	0
Academic practice	2	0
Master's thesis	20	20
Part B	22	36
Part C	2	0
Total	**80**	**80**

It is also important to note that, on a mandatory basis, “Academic Practice” was added in Part B (2 CP) and that part C was added to 2 CP, which was not previously in the Master's programme.

A structural comparison with the previously accredited programme. One of the main reasons for a relatively serious change in the programme is the reduction in the number of students in recent years, as analysed in Chapter 3.1.2.

The previous accreditation report highlights only 4 directions:

1. Differential equations and mathematical modelling;
2. Modern elementary mathematics and mathematical didactics;
3. Probability theory and mathematical statistics;
4. Topology, algebra and discrete mathematics.

On the other hand, the new Master's sub-programme structure includes 3 sub-programmes:

1) Data science;

2) Technology mathematics;

3) Pure mathematics.

The data science sub-programme includes the specialisation of the Probability Theory and mathematics statistics included in the previous programme. Following the today's global trends, this sub-programme is accompanied by the computer science courses (e.g. “Modern statistics and data science”, “Deep learning”, “Selected Topics about Data Warehouses ”, etc.), as well as the courses from the financial sphere (“Risk analysis”, “Selected Chapters of Financial Mathematics ”, “Life Insurance Mathematics ”, etc.). This sub-programme therefore includes the previous specialisation and allows the acquisition of expertise in the current data science. It is composed of two modules under the sub-programme: statistical module and data analyst module.

The Technology Mathematics sub-programme includes the previous Master's Specialisation Differential equations and mathematical modelling. Historically, this direction is known in Latvia by professors such as A. Buiķis, U. Raitums, A. Reinfelds and J. Cepītis. There has also been a good communication with the TU Kaiserslautern, where Professor A. Buiķis, and Professor A. Zemītis have read lectures in the field of Technomathematics. For many years TU Kaiserslautern has been hosting UL masters, giving Latvia's best students grants, as well as offering *Erasmus+* opportunities. The examples of this communication include the pioneer of mathematical statistics and data science, professor J. Valeinis, and the promoter of technological mathematics, Professor U. Strautins, both of whom studied at the University of Kaiserslautern. The new sub-programme contains not only differential equations and modelling in the classical sense, but also offers subjects related to newer technologies ("Data-driven numerical algorithms", "Mathematical Foundations of Neural Networks ", "Big Data Technologies", etc.). This includes both machine-learning techniques and mathematical bases for neural networks and modern data-driven dynamic systems. The sub-programme is divided into two modules: Applied Mathematics Module and Numerical Mathematics Module. This direction will be chosen by students who have already shown the interest in mathematical/industrial modelling and want to continue their studies in this direction.

The Pure Mathematics sub-programme includes the previous Master's Specialisation Topology, Algebra and Discrete Mathematics. It sets up two modules: Mathematical Structures and Analytical Methods. The teaching staff, such as Professor A. Šostaks, is known in the world for topology and non-strict (fuzzy) mathematics. However, in order to make this theoretical mathematics direction more attractive to students and to combine the knowledge and innovation of the best mathematicians in Latvia, a Quantum computing and computer science mathematics module is offered. It should be noted that Professor A. Ambainis, who works at UL Computer Sciences Faculty, is not only a widely known scientist in Latvia, but also a world-wide scientist in quantum computing. The subjects of this sub-programme have been selected from both the possibilities of professors themselves and from the practice of other European universities.

Finally, it should be noted that the fourth module: Modern elementary mathematics and mathematical dydactics will no longer be offered at the master's level. The reason is simple: many pedagogy programmes have been merged in Latvia and a master's program has been created directly for pedagogy students.

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 relevance of the Master's degree programme "Mathematics and Data Science" to the study field has been determined since the development of the study field, which includes mathematics and physics-related study programmes. The name of the study programme, the degree to be granted, the professional qualifications to be granted, as well as the conformity of the parameters of the study programme in the achievement of the results of the specified study programme are governed by external standards, i.e. Cabinet of Ministers Regulation No 240 (13.05.2014) *Regulations regarding the national academic education standard* (only in Latvian), Cabinet of Ministers Regulations No. 322 (13.06.2017) *Regulations regarding the classification of Latvian education* (only in Latvian).

Code 45460 of the academic master's study programme "Mathematics and Data Science" according to the Cabinet regulation 322 (13.06.2017.) *The regulations regarding the classification of Latvian education* (only in Latvian) means:

1) first digit 4 - higher education study programme;

2) the first two digits 45 - academic education (master's degree), are implemented after the acquisition of a bachelor's or professional bachelor's degree. The duration of studies in full-time

studies is one to two years. The total duration of full-time studies is at least five years.

3) third digit 4 - the thematic group on education is “Science, mathematics and information technologies”;

4) the third and fourth digits in total 46 – the thematic area of education is “Mathematics and statistics”;

5) the third, fourth and fifth digits together 460 – the education programme group is “Mathematics and statistics”.

The scope, duration of implementation, modules of the study programme and their size, mandatory part, master's degree, basic principles and procedures for evaluation, implementation principles, etc. are governed by the provisions of the Cabinet No 240 *Regulations regarding the national academic education standard* (only in Latvian). AMSPMDS meets the requirements laid down in the rules.

The content of the study programme consists of the courses of 80 CP: Common Master programme courses, selected sub-programme courses, academic practice and Master's thesis are 56 CP (Part A) of the programme, 22 CP are limited choice courses (Part B) and 2 CP are free choice courses (Part C). These courses include teaching theoretical and applied mathematics courses, as well as IT courses to the extent that academic practices can be performed, creating the Master's thesis in each sub-programme.

The study programme will also be offered in English. There are 30 state budget places for the Latvian language stream, but no budget places for the English language stream. Therefore, the study programme will be implemented first for the Latvian language stream. In addition to the Latvian stream, the programme may also be offered in English if there are sufficient applicants. The benefits of such a programme would be both student mobility - Erasmus students would have the opportunity to attend lectures in English - and attracting foreign students and funding.

The AMSPMDS **aim** is to provide innovative and technology-oriented higher education, preparing top-level specialists with broad competences in mathematics and data science to work in industry, finance, data management, statistics and high-technology companies, as well as in universities, institutes and research centres in Latvia and abroad.

AMSPMT **objectives**:

- Develop the skills and competences of students required for carrying out independent research work, including those related to the planning of scientific research.
- Develop students' ability to understand, immerse and critically analyze scientific literature.
- Select and apply an appropriate research method, compile and analyse the results by evaluating the results against the results and general findings of other authors, formulating conclusions in line with the objectives and results of the work, formulating the practical relevance and proposals of the results, as well as possible further research directions and limitations.
- Present and defend the Master's thesis.

The following results of the studies to be achieved are planned for successful learning.

Knowledge:

- demonstrate in-depth knowledge in the field of data science, which includes relevant theoretical knowledge of mathematics, mathematical statistics, statistical learning and machine learning, the IT tools and programming languages Python and R;
- demonstrate in-depth knowledge of technology mathematics, including general theoretical

mathematics, industrial and engineering modelling principles, modern and new technologies based on data-driven systems, neural networks and numerical techniques;
- demonstrate in-depth knowledge of pure mathematics, which includes both general knowledge of theoretical mathematical methods and programming languages and specific knowledge of mathematical structures, such as topology, fuzzy clusters, abstract algebra, as well as analytical methods, quantum computing and mathematics of computer science.

Skills:

- process and analyse data in depth, solve complex and original real data problems by building regression, classification and machine learning models, perform statistical tests, clustering, visualise data and data analysis results, work with IT technologies, version control systems, databases and data warehouses;
- analyse complex processes related to state-of-the-art technology and natural sciences, build mathematical models of complex systems, solve mathematical problems of optimisation, approximation, system control, differential and integral equations and apply numerical algorithms using modern IT technologies;
- prove and justify complex mathematical results, methods and formulae, describe theoretical mathematical methods in a clear and concise manner, justify theoretically obtained and proven results by carrying out simulations and using IT technologies.

Competence:

- carry out independent research work, selecting appropriate complex and innovative methodologies, creating original mathematical, modelling, algorithmic and statistical methods and knowledge, being aware of the principles of academic integrity and the potential impact of research results on the environment and society, critically interpret the results obtained, summarise them in the form of publications;
- qualitatively oriented in the development trends and latest achievements of modern mathematics, able to solve complex practical problems in the fields of industry, data science and mathematical statistics, lead and implement interdisciplinary applied and fundamental research projects, make a unique contribution to the national economy by contributing to the creation of new products and technologies.

The defined aims, objectives and learning outcomes of the study programme are interlinked with the outcomes of the courses, as shown by the mapping exercise (Annex 7.8). When developing or updating course descriptions, teaching staff shall take into account the overall objectives of the study programme and the learning outcomes to be achieved. Thus, the achievement of the learning outcomes for each specific course contributes to the achievement of the overall programme learning outcomes. Course descriptions shall be drafted by the responsible course lecturer or other lecturer in the programme of study whose name appears as the author of the course description. In developing the course outcomes, the teacher is more focused on achieving the specific objectives of the course, while keeping in mind the overall objectives of the study programme. The Director of the Study programme checks the prepared course descriptions and their learning outcomes against the learning outcomes of the whole programme, as shown in the programme mapping.

Table 7.1.2.1

Example of the mapping of the learning outcomes of the programme of study.

Planned results of study courses	Learning outcomes of the study programme							
	Knowledge			Skills			Competence	
	1	2	3	4	5	6	7	8
Modern statistics and data science								
Demonstrate a thorough knowledge of mathematical statistical methods	X	X	X	X	X	X		
Demonstrate knowledge of data science problems and methods	X	X	X	X	X	X		
Practical knowledge of statistical methods in R and Python	X		X	X		X		
classify data problems by solving them with the different methods learned in the lecture course				X		X		
use programming languages to solve practical statistical problems and perform Monte Carlo simulations				X	X	X		
select and apply an appropriate set of methods (both statistical and algorithmic) to complex data problems				X	X	X		
competently select IT technologies - be able to critically evaluate and interpret the results of data analysis and simulations							X	X

The analysis of the study courses of the study programme AMSPMDZ (see Annex 7.8) shows that their outcomes ensure the achievement of the study programme outcomes. For example, the course "Modern Statistics and Data Science" in Table 7.1.2.1 provides knowledge, skills and competences in the sub-programme Data Science, which in turn contribute to the overall knowledge, skills and objectives of the whole programme.

Admission requirements at AMSPMDS

Previous education: A bachelor's degree or a level 2 vocational higher education (or equivalent to higher education) in mathematics; or a bachelor's degree or a level 2 vocational higher education (or equivalent to higher education) in science, computer science, engineering or economics, and an educational activity requiring an assessment of subjects in the mathematics sector (not less than 8 credits).

Studies in English require English proficiency in accordance with the applicable laws and regulations (for aliens, English proficiency at least level B2).

Formula for calculating the admission rating: weighted average mark (60%) and total mark of final tests (40%).

Eligibility for admission outside competition: for graduates of the corresponding academic year UL academic bachelor's degree programme “Mathematics ” and the professional bachelor's degree programme “Mathematician statistician ” for whom the weighted average grade in basic studies is not lower than 8 (very good) and the bachelor's thesis mark is not lower than 8 (very good).

Additional condition: Negotiations that assess whether the prior education and working experience of the applicant provide successful studies in the programme. Individuals who have identified shortcomings in mathematics knowledge and skills should further undertake the necessary courses of the Bachelor of Mathematics programme during the Master's degree programme.

Note: The study programme includes the following sub-programmes: "Data science", "Technology mathematics"and "Pure mathematics". When applying for studies, one must specify a sub-programme. The results of the competition are determined by the master study programme as a whole.

A master's degree in mathematics is awarded according to the terms of the academic programme, following the acquisition of the “Mathematics and Data Science”. The master's diploma has an attachment with the transcript (marks) of the sub-programme chosen accordingly.

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

It is expected that the demand of AMSPMDS specialists in the relevant scientific sector, as well as in the labour market in Latvia and the world will only increase. In support of the implementation of the programme in English, it can also be mentioned that, according to a study by the American Bureau of Labour Statistics, the world’s demand for mathematicians and statisticians will grow rapidly by 30% between 2020 and 2030 (*U.S. Bureau of Labor Statistics, Employment Projections program*, https://www.bls.gov/emp/tables/fastest-growing-occupations.htm). For many years, the data scientist is one of the most popular, well-paid occupations in America and elsewhere in the world (https://www.bls.gov/opub/btn/volume-7/big-data-adds-up.htm).

The information report of the Ministry of Economics on *the medium and long-term labour market forecasts* (27.08.2020) indicates that the most significant labour shortage in the medium term (i.e. by 2027) could develop in science and engineering, including the professions of mathematicians, statisticians and actuaries. The lack of mathematics professionals has been demonstrated by the fact that the professions Statistician mathematician and Mathematician are among those professions (on the list they are no. 46 and 47) referred to in Cabinet Regulation No. 108 of 20 February 2018 *Specialities (professions), in which significant labour shortages are forecasted and in which foreign nationals may be invited to work in the Republic of Latvia* (only in Latvian).

According to the *National Development Plan of Latvia for 2021-2027* (confirmed by Saeima 02.07.202020.), the proportion of graduates in science, mathematics and information technologies is to be increased from 6.8% in 2018 to 12% from the total number of graduates in higher education in 2027. According to the surveys carried out, the employment of students and graduates of the Master's degree programme in the relevant specializations is high.

Most students during their studies are already employed in industry, financial and other companies, as well as universities, institutes and research centres in Latvia. Among the most frequently selected employers are the UL Institute of Mathematics and Computer Science, the Institute of Numerical Modelling and other Physics institutes, IT *Accenture*, Central Statistical Bureau, *Kantar* TNS *Latvia*, *Tet*, credit institutions (Aizdevums.lv, *Creamfinance*, 4 *finance*), insurance institutions (Balta, BTA), banks (Swedbanka, SEB).

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.

Table 7.1.4.1

Number of students

Data on 1 October of the reference year	Number of students enrolled in Year 1	Number of students by year of study		Students total	Including paying	Number of graduates	Number of drop-outs
		1	**2**				
2011	31	31	22	53	2	17	18
2012	25	26	21	47	1	19	14
2013	21	20	19	39	1	16	13
2014	16	17	16	33	1	15	9
2015	25	29	10	39	4	15	5
2016	15	15	15	30	0	10	14
2017	21	21	9	30	0	12	9
2018	20	20	8	28	1	8	14
2019	15	16	10	26	2	5	9
2020	13	12	6	18	2	4	17
2021	11	11	5	16	0	5	10

The dynamics of the number of students is given in Table 7.1.4.1 for the period 2011 to the end of 2021. The data from the table show that the number of students has declined significantly in recent years. This trend has been around for many previous years. Figure 7.1.4.2 shows the dynamics of students by year, following students after the year of enrolment.

The number of budget places in the mathematics master studies is 30. The number of students enrolled by 2018 appeared to be around 20. However, in the last three to four years, the number of students has decreased to 11. This is the main reason why specialisation has been introduced to accreditation in the study programme, following modern trends in the world and bringing together Latvia's best experts and teaching staff in the 3 sub-programmes proposed: data science, technology mathematics and pure mathematics.

One of the reasons for the decline in the number of students in the AMSPM is the fact that over the last five years (2017-2022) the number of students in Latvian higher education institutions has decreased by 6.7% and since 2010, the number of graduates of Latvian universities has shrunk almost twice, according to data compiled by the Central Statistical Office (https://stat.gov.lv/lv/statistikas-temas/izglitiba-kultura-zinatne/augstaka-izglitiba/preses-relizes/8215-aktualais?themeCode=IG , Latvian only).

Another reason is that graduates of FMOF's Mathematics Department's bachelor's degree programs often choose to continue their studies in the field of computer science or economics at both LU and RTU. More theoretical Master's programmes are not as attractive as those oriented towards specific specialisations, as shown by graduate surveys (in point 3.2.1). In contrast, the upgraded AMSPMDZ programme provides for three specialisation sub-programmes, where, according to the student survey, 90% of our students could potentially come (see Table 7.2.1.3).

It is clear from the alumni surveys that students want to see more practical oriented courses, as well as the participation of industry in lecturing. However, some students who are oriented towards fundamental or pure mathematics are not interested in applied courses. Master's degree programme in mathematics had already, during the previous accreditation period, distinguished several streams: 1) Probability theory and mathematical statistics; 2) Modern elementary mathematics and didactics; 3) Differential equations and mathematical modelling; 4) Topology, algebra and discrete mathematics. However, due to the small number of students, students had to attend joint lectures regardless of the streams. This was probably one of the reasons for the decrease in the number of students.

It should be noted that the FMOF master's studies in Mathematics is the only place in Latvia where high-level mathematicians who can become University lecturers or researchers are trained. Therefore, the "Pure mathematics" sub-programme is not expected to have a large number of students, but it is important for Latvia that young mathematicians of high calibre are produced.

Figure 7.1.4.3 shows the proportion of graduating students relative to the number of admitted students. The trend is also shown here: less than 50% of students complete their master's programmes over the past four years.

In 2021, 11 students enrolled in the Masters, none of which was PBSPMS graduate. The surveys show that for students, the master's degree seems too theoretical and remote from practice. PBSPMS students usually find a job during internship. After graduating a professional bachelor's program, students prefer to work or seek master’s study programs with a specific sector orientation or specialisation.

The surveys of students and employers show that the three sub-programmes created are attractive mainly for specialisation and mathematical excellence. The data scientists in Europe and around the world are prepared mainly in mathematics master's degree programmes. It is one of the most paid and demanding professions of today. The surveys conducted by PBSPMS students suggest that nearly 90% of them are prepared to go to the newly created sub-programmes by selecting the data science sub-programme in the first place. Also, the surveys of ABSPM students show that students are also equally interested in pure and technology mathematics programs.

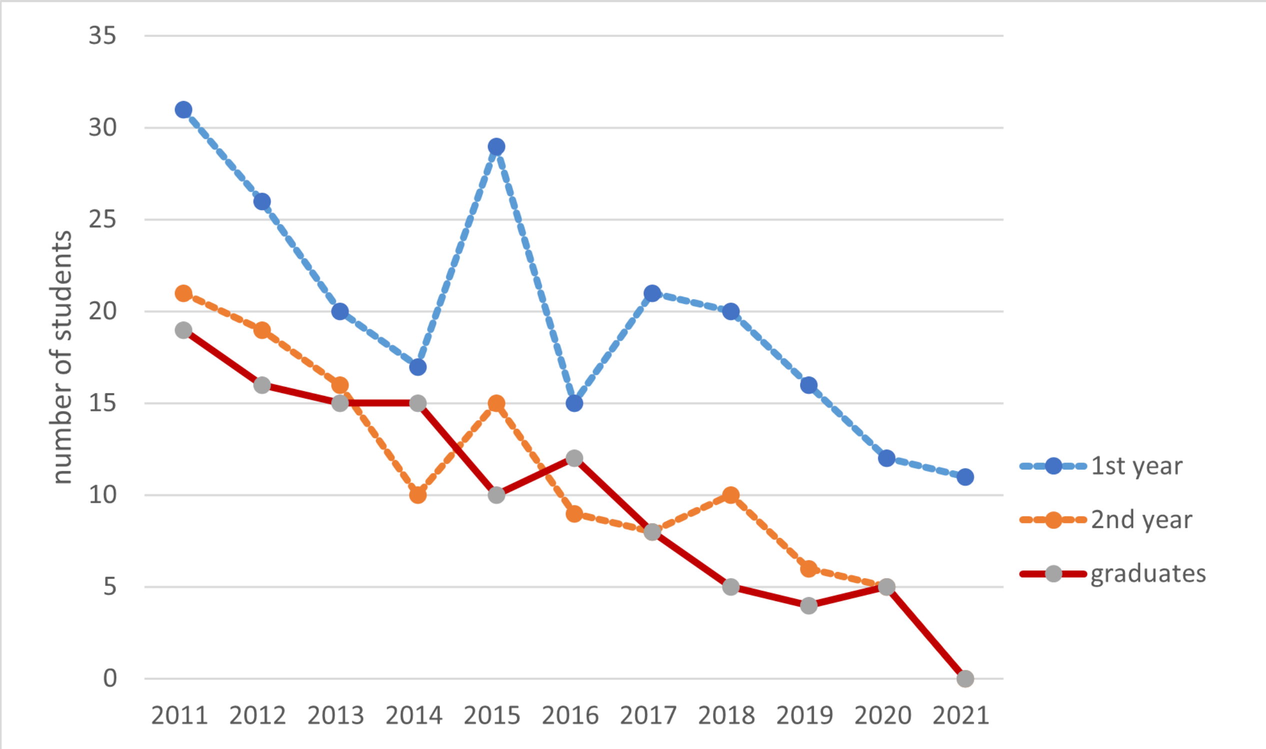


Figure 7.1.4.2. Year-to-year dynamics of students tracking a student after year of joining

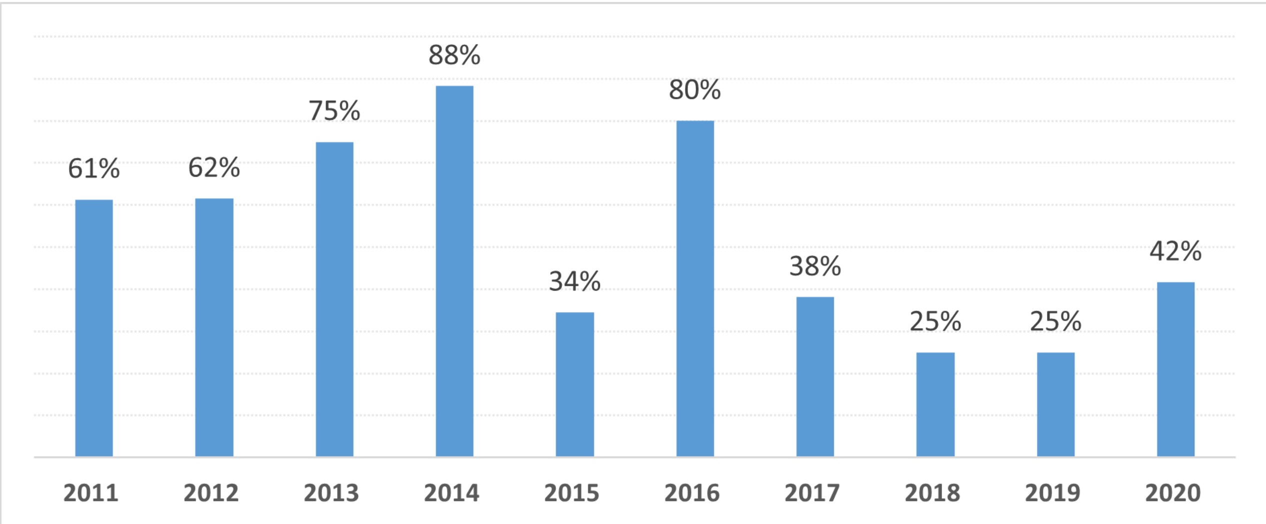


Figure 7.1.4.3. Graduation rate (% of 1st year students)

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 content of the study programme is designed and planned according to the above-mentioned economic and social background, which indicates trends in the labour market as well as by identifying the content of studies of similar programmes from foreign universities. The study programme is also developed in close cooperation with labour market and industry.

In the data science sub-programme, the content of the study course programme was developed by Professor Jānis Valeinis and the doctoral candidates and other staff of the Statistical Research and Data Analysis Laboratory (SPDAL), which he chairs. The development of the programme involved, for example, the Department of Mathematics doctoral student and the SPDAL staff member Dace Pētersone, who has worked for 6 years as a data scientist in one of the largest technology and consulting companies *Accenture*, and the doctoral students and data scientists Jānis Gredzens and Artis Alksnis, whose professional activities are linked to *Evolution* and *Scandic Fusion*.

In the Technology mathematics sub-programme, the major contributions to the course content were made by the leading researcher and docent Jānis Bajārs and Professor Uldis Strautiņš, including the scientific and academic staff of the Chair of Differential Equations and Approximate Methods of the Department of Mathematics. The staff of the chair are active at the Institute of Mathematics and Computer Science of University of Latvia (IMCS UL). In addition, cooperation with UL and other institutes (Institute of Numeric Modelling, Institute of Physics, Institute of Electrical and Computer Sciences, etc.) is being carried out, well aware of the specificities and demands of the latest technology, computing techniques and engineering industries. The department develops applied mathematics research in mathematical modelling, numerical calculations, development of new algorithms, dynamic systems, including the latest data-driven and machine-learning techniques. The main developers of this programme have obtained a doctorate, including the work experience in foreign universities and Latvia as the leading specialists in their field.

The creation of the Pure Mathematics sub-programme was greatly contributed by professors from the Mathematics Department as well as by the leading researchers who pursue a variety of fundamental projects in the mathematics sector. The main motivation for this sub-programme is to provide the only master's degree in pure mathematics in Latvia, thereby raising scientists, academic stuff and future professors in the field of mathematics. As Latvian academic staff is more known internationally for quantum computing, topology, fuzzy sets and mathematical structures, sub-modules were created with the relevant courses. Student job opportunities include various trans-national projects, continued doctoral studies, participation in academic work.

The content of the AMSPMDS consists of 52 study courses, academic practice and state examination (Master's thesis). The content of the AMSPMDS study programme is based on the following external and internal laws and regulations:

- *The Law on Higher Education Institutions* of the Republic of Latvia;
- Cabinet Rules No 240 (13.05.2014) *Regulations regarding the national academic education*

standard (only in Latvian);

- *Regulations on University of Latvia Study and Continuing Education Programmes* (Decision No 102 of the Senate of UL, 24.04.2017.);

In accordance with the Cabinet Regulation No 240: the mandatory part of the master's study programme, excluding the development of the Master's thesis, include a study of theoretical knowledge of the selected area of the science sector or sub-sector, and a theory study of the fields selected, in terms of the current problems the science sector or sub-sector, of not less than 12 CP where the scope of the Master's study programme is 40 CP, and not less than 24 CP in the case of a Master's degree programme of 80 CP.

AMSPMDS contains:

- total madatory part A courses: 20 CP;
- the madatory part A courses of the sub-programme: 14 CP;
- limited-choice Part B courses: 22 CP;
- free-choice Part C courses: 2 CP;
- academic practice: 2 CP;
- Master's thesis: 20 CP.

According to *Regulations on University of Latvia Study and Continuing Education Programmes*, the study courses are divided into 56 CP for mandatory part (A) courses, 22 CP in Part B and 2 CP for free selection (C).

From the mapping of study courses included in the programme (Annex 7.8), it can be concluded how study courses ensure the achievement of the results of study programmes. Study courses are designed in such a way as not to duplicate their content. The plan of study courses (Annex 7.9) is designed to ensure the continuity of study courses and an increase in the level of complexity. The study course mapping (Annex 7.8) shows that the results of the AMSPMDS courses cover all the planned results of studies in the study programme (Table 7.1.1 gives a summary of the mapping).

Table 7.2.1.1.

Overlapping of study results with the results of study courses

Results of study programmes	Number of study courses covering the outcome of studies
Knowledge	
1. Demonstrate advanced knowledge in the field of data science, which includes relevant theoretical mathematics, mathematical statistics, statistical learning and machine learning, IT tools and knowledge of the programming languages Python and R.	24
2. Demonstrate an advanced knowledge of technology mathematics, including general knowledge of theoretical mathematics, industrial and engineering modelling principles, advanced and emerging technologies based on data-driven systems, neural networks and numerical methods.	21

3. Demonstrate a thorough knowledge of pure mathematics, which includes both general knowledge of theoretical mathematical methods and programming languages and specific knowledge of mathematical structures such as topology, fuzzy sets, abstract algebra, analytical methods, mathematics for quantum computing and computer science.	24
Skills	
4. Process and analyse data in depth, solve complex and original real data problems by building regression, classification and machine learning models, perform statistical tests, clustering, visualise data and data analysis results, work with IT technologies, version control systems, databases and data warehouses.	24
5. Analyse complex processes related to state-of-the-art technology and natural sciences, build mathematical models of complex systems, solve mathematical problems of optimisation, approximation, system control, differential and integral equations and apply numerical algorithms using modern IT technologies.	21
6. Prove and justify complex mathematical results, methods and formulae, describe theoretical mathematical methods in a clear and concise manner, justify theoretically obtained and proven results by carrying out simulations and using IT technologies.	24
Kompetence	
7. Carry out independent research work, selecting appropriate complex and innovative methodologies, creating original mathematical, modelling, algorithmic and statistical methods and knowledge, being aware of the principles of academic integrity and the potential impact of research results on the environment and society, critically interpret the results obtained, summarise them in the form of publications.	52
8. Qualitatively oriented in the development trends and latest achievements of modern mathematics, able to solve complex practical problems in the fields of industry, data science and mathematical statistics, lead and implement interdisciplinary applied and fundamental research projects, make a unique contribution to the national economy by contributing to the creation of new products and technologies.	37

The 5 courses in the overall compulsory Part A study programme achieve almost all of the 8 possible learning outcomes, as the results of all three sub-programmes study courses are based on part A: “Applied Algebra” and "Graphs, networks and discrete optimisation algorithms" achieves 7 course results, but "Nonlinar optimization", “Modern Statistics and Data Science”, “Advanced Mathematical Methods with Python, R and Matlab” all 8 course results. Also, the mandatory parts of all three sub-programmes cover significant study results (typically 4 or 5 results), which are more relevant to specialisation in these sub-programmes. Courses such as the “Academic Practice” and “Master's Thesis in Mathematics” reach all 8 results.

The common compulsory Part A of all sub-programmes contains subjects such as "Nonlinear optimization", "Applied algebra", "Modern statistics and data science", "Graphs, networks and discrete optimisation algorithms", "Mathematical methods with Python, R and Matlab". There will also be an Academic Internship and a Master's thesis in mathematics. The information, outcomes and objectives contained in these courses are closely linked to the objectives and outcomes of the study programme as a whole. Knowledge of current programming languages, linear algebra, nonlinear optimization and data science fundamentals are important for all sub-programmes.

Data Science sub-programme. Data scientist is currently one of the most popular and highest paid professions in the world and in Latvia. For many years now, PhD students and staff of the SPDAL laboratory have been working alongside university activities as experts in the field of data science and have also helped to develop the programme (together with the head of the laboratory, Professor Jānis Valeinis). Therefore, the content of the courses/modules in the field of data science was updated according to the trends of the industry, the labour market and scientific developments. The work of a data scientist requires both mathematical knowledge, Python and R programming languages, machine learning methods, mathematical statistical methods, etc.

In the previous accreditation period (as already mentioned in point 3.1.1), the Master's programme included a specialization on Probability Theory and Mathematical Statistics, which included more lectures on probability theory and mathematical statistics (e.g. "Nonparametric Statistics", "Statistical Modelling", "Random Processes", "Asymptotic Statistics"). The study programme was updated by the creation of a compulsory sub-programme Part A containing the following subjects: "Statistical learning", "Deep learning", "Statistical modelling" and "Bayesian statistics". The information, outcomes and objectives contained in these courses are also closely linked to the objectives of the programme.

The choice of Part B courses, on the other hand, must be made from two modules: the Statistics module and the Data Analyst module. The Statistics module contains more subjects related to probability theory and mathematical statistics: “Selected chapters in probability theory and mathematical statistics”, “Random processes”, “Nonparametric statistics”, “Time series and signal analysis”, “Stochastic differential equations and their applications”, “Asymptotic statistics”. The Data Analyst module contains topical subjects in the field: “Selected chapters about data warehousing”, “Big Data technologies”, “Business intelligence tools and data visualization”, “High performance computing in data science and modelling”, “Risk analysis”, “Selected chapters on financial mathematics”. Some of these courses are to be taught by experienced professors from both the Department of Mathematics and the Faculty of Computing, while others are to be taught by young researchers and/or PhD students in the field.

In order to achieve the objectives of the programme, it is recommended that subjects from both modules should be selected in Part B to cover both the statistics and the analytics modules. However, students who enter with a good knowledge of statistics will be able to choose Part B from the Data Analyst module and vice versa. The design of the programme has been informed by the latest developments in similar programmes abroad (e.g. Stanford University's MSc in Statistics Data Science and other programmes with similar course content).

Technology mathematics sub-programme. In the previous accreditation period, the MSc programme included a specialization on Differential Equations and Mathematical Modelling. Based on the students' questionnaires (desire for more applied subjects in the field, computer programs, etc.), the leading experts in the field in Latvia (Professor Uldis Strautiņš, leading researcher, docent Janis Bajārs and scientific and academic staff of the Chair of Differential Equations and Approximate Methods) modernized the content of the sub-programme with 1) elements of data science and AI algorithms; 2) development of an applied and numerical module.

Two important aspects should be mentioned here. Firstly, the staff of the Chair of Differential Equations and Approximate Methods are doing their research mostly at the IMCS UL, as well as they have close cooperation with the Institute of Physics, the Institute of Numerical Modelling and the Institute of Electronics and Computer Science and other institutes. Secondly, the staff of the Chair is well acquainted with the latest technologies, computational methods and the specificities and demands of the engineering sector. In the Chair they develop applied mathematics research in mathematical modelling, numerical computation, development of new algorithms, dynamical systems, incorporating the latest data-driven and machine learning techniques. Consequently, there is close collaboration in various international research projects with other experts in the field and the programme can be considered to reflect the latest trends and developments.

The compulsory Part A subjects ("Industrial Mathematical Modelling", "Dynamical Systems", "Numerical Methods for Partial Differential Equations" and "Theory and Control of Systems") were created. In this case, it can be said that the information, the results to be achieved, the objectives to be achieved in these courses are closely linked to the objectives and results to be achieved in the entire study programme.

The two sub-modules: Applied Mathematics and Numerical Mathematics contain Part B or free elective subjects, where many modern subjects have been developed. The Computational Mathematics module includes courses: "Data-driven numerical algorithms", "Mathematical foundations of neural networks", "Numerical methods for integral equations", "Numerical methods for hydrodynamics", as well as courses from the Data Science sub-programme, namely "Big Data technologies" and "High performance computing in data science and modelling". This modernisation and the outcomes of the individual courses are linked to the objectives and outcomes of the entire study programme.

The Applied Mathematics module consists of the courses “Methods of functional analysis for differential and integral equations”, “Analytical methods for partial differential equations”, “Non-linear boundary value problems” and, in addition, courses from the Data Scientist sub-programme: “Stochastic differential equations and their applications”, “Time series and signal analysis” and “Harmonic analysis”. These courses are particularly important if knowledge of partial differential equations, functional analysis of integral equations is to be supplemented, and time series and signal analysis, harmonic analysis and stochastic differential equations are additional upgrades. The learning outcomes of the individual courses in this module are also linked to the objectives and learning outcomes of the programme as a whole.

Sub-programme of Pure Mathematics. In the previous accreditation period, the MSc included specializations in Topology, Algebra and Discrete Mathematics and Modern Elementary Mathematics and Mathematical Didactics. Mathematical didactics, according to the regulations of the MK "Latvian groups of scientific branches, scientific branches and sub-branches", is included in the branch of Educational science (group of Social sciences branches), therefore the Pure Mathematics sub-programme does not include mathematical didactics. It should be stressed that this is the only study programme at this level in Latvia that trains mathematicians who may become either scientists or university lecturers at the highest level. It was therefore important to modernise and maintain this specialization, following the needs of the sector. Professors from the Department of Mathematics, IMCS UL and the Faculty of Computing helped to set up this sub-programme.

After collecting information on similar pure mathematics Masters courses, and also based on expert opinion, the compulsory Part A courses were created: "Theory of Functions and Functional Analysis ", "Category theory", "Measure and integral" and "Number theory". These subjects form the foundation of the pure mathematics strand and the outcomes of the individual courses are thus closely linked to the objectives and outcomes of the whole study programme.

Three modules were created: 1) *Mathematical structures module* ("Topology", "Abstract algebra", " Fuzzy logic based structures and methods ", "Fractal geometry"); 2) *Analytical Methods module* ("Ill-posed problems", "Approximation theory", "Harmonic analysis", "Optimal control theory"); and 3) *Quantum computing and computer science mathematics module* ("Quantum computers", "Mathematical foundations of computer science", "Combinatorics", "Automata and Theory of Algorithms", "Applied cryptography").

The Mathematical structures module combines the research of several groups of professors, which has always been scientifically highly appreciated at the University of Latvia. This area is led by Professor Aleksandrs Šostaks, Professor Svetlana Asmuss and Associate Professor Ingrīda Uļjane. The Analytical Methods module has been developed after research in the field, i.e. analysis of similar programmes at other universities. The Quantum computing and computer science mathematics module reflects the excellence of the Latvian scientific community in this field, represented by the world-renowned mathematician Professor Andris Ambainis. Although Professor Ambainis works at the Faculty of Computing, mathematicians also work in his working group. This is a modern field in the world and certainly reflects the needs of the sector. Overall, it can also be concluded that the course outcomes are closely linked to the objectives and outcomes of the entire study programme.

Survey of students on the content of studies. A survey was conducted in March 2022, which presented the content of the AMSPMDS study programme to currently PBSPMS and ABSPM students (answers received from 35 respondents), with a view to obtaining an insight into the effectiveness of the innovations carried out in the Master's Programme.

The survey shows that 85% of students welcome the innovative orientation of the programme – 47% agree and 38% - partly agree that the study programme is innovative. 91% of students, including 53% totally, agree and partly agree (38% of respondents) that the “study programme includes modern topics”. The evaluation of the innovative element of the programme and the interest of students in the sub-programme section is presented in Figure 7.2.1.1.

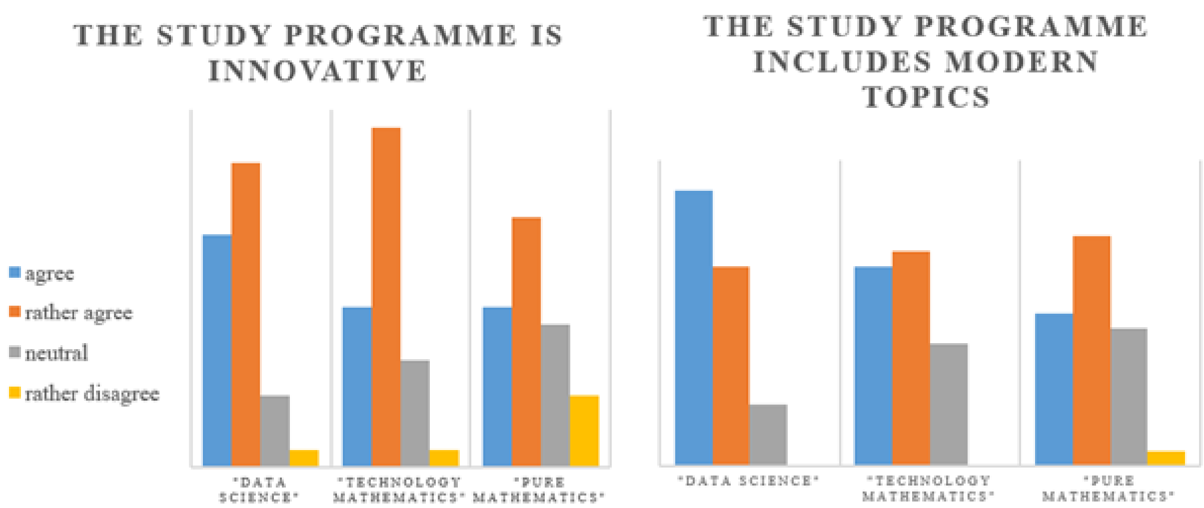


Figure 7.2.1.1. Student survey results - evaluation of the content of the programme (Programme is innovative (agree/quite agree/neutral/rather disagree) Data science/technology mathematics/Pure mathematics) (modern topics (Data science/Technology mathematics/Pure mathematics))

Students have welcomed the quality of the work of associated academic staff in all three sub-programmes. The highest interest of students in the programme is observed in the data science sub-programme: 71% of respondents agree with the statement “I am interested in the programme” in the case of the data science sub-programme. 17% of respondents have an interest in the technology mathematics sub-programme, while 22% are interested in pure mathematics sub-programme (see Figure 7.2.1.2).

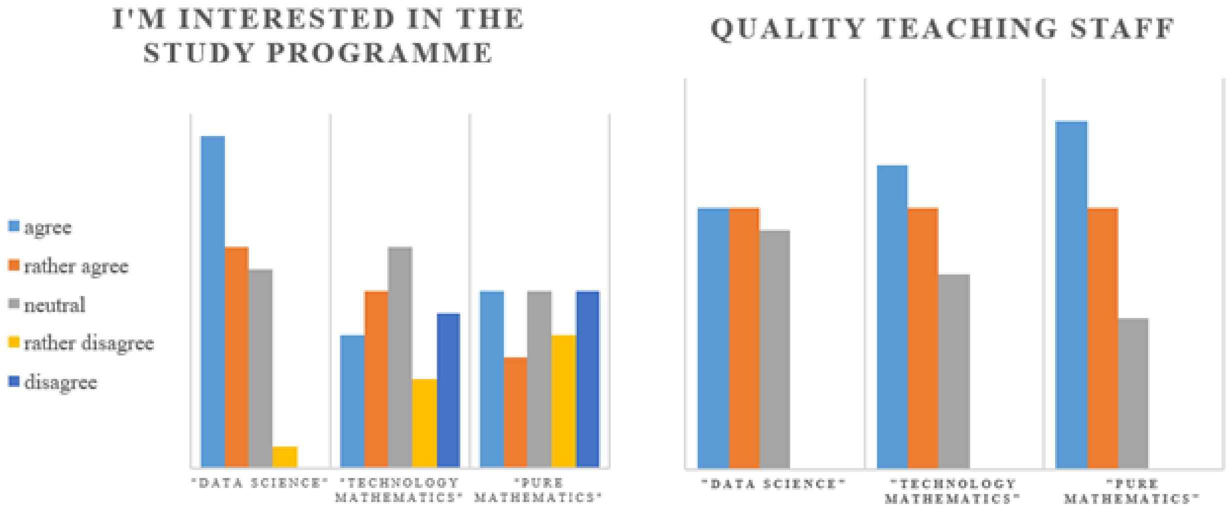


Figure 7.2.1.2. Student’s survey results - student engagement and quality of lecturers

More specifically, the interest of students is characterised by the willingness of responses to study in AMSPMDS, were studies decided today, 88% of the students surveyed would choose to study in UL FPMO AMSPMDS, 70% in the data science sub-programme, 10% in the technology mathematics sub-programme, and 20% in the pure mathematics sub-programme (see Fig. 7.2.1.3.). It should be noted that 67% of students currently studying in Year 4 would take a positive decision on Master Studies in UL FPMO.

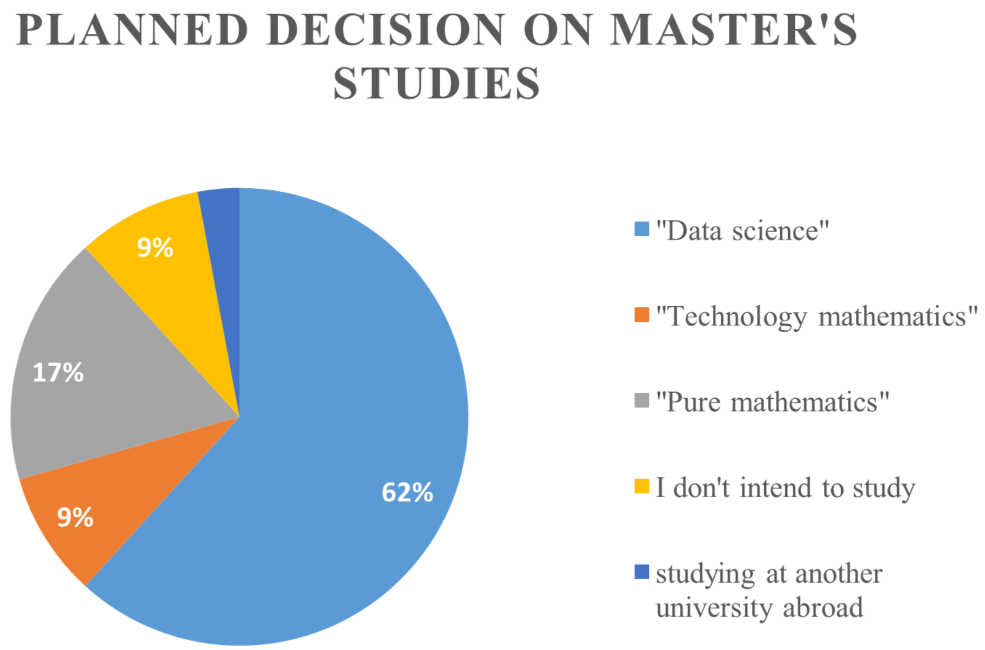


Figure 7.2.1.3. Results of the student’s survey - students' readiness to join AMSPMDZ

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).

Master studies workshops and seminars provide the discussion of the themes arising from the materials of existing scientific projects and academic staff scientific publications. Also, planned academic practices will be realized in interaction between industry and academic staff. Industry will play an active role in developing and evaluating practice reports. In most cases, the Master's theses are developed on the scientific research ideas and topics of the academic staff, so that the master's degree is based on the achievements and knowledge of science.

The academic staff of the study programme are the industry's leading specialists in their fields. 9 professors and 2 associate professors participate in the implementation of the mandatory and the limited selection part of the programme. Most of the professors have the rights of an expert of the Latvian Council of Sciences, which shows the investment and professional qualifications in these fields of science. On the basis of the scientific activities of the academic staff, students are attracted to the development of fundamental and applied projects and studies, as a consequence of which the results of the Master's theses may be published. Thus, the scientific activities of professors are integrated into the implementation of the study programme.

In developing and teaching study courses, the academic staff integrate innovation and knowledge of their scientific activities into the content of study courses. For example, the lectures "Non-parametric statistics" and "Asymptotic statistics" both set out the standard methods and techniques such as kernel smoothing, non-parametric regression, empirical likelihood function, Edgeworth expansions etc. and also outline scientific results in the case of two and more samples, as well as show applications from the R package "EL" developed by the staff of SPDAL laboratory. In the data science course "Statistical learning", Rotterdam Professor Anastasia Tetereva uses both classical books and methods and shows students a variety of ideas in a scientific way, especially when working on the tree and forest algorithms where non-parametric statistical tests can be used in decision-making process.

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.

Both oral, written and combined study and assessment methods are used during the study courses and examinations. Latvian and English streams have a similar approach in the implementation of studies.

The study programme uses a variety of methods to acquire and consolidate knowledge, such as introductory lectures, interactive lectures, summary lectures, problem-oriented lectures, seminars. Lectures are usually given by a more experienced lecturer, but practical work also involves young lecturers and PhD students (e.g. "Modern Statistics and Data Science", "Random Processes" and "Asymptotic Statistics"). In this case, the lecturer works synergistically with the supervisor of the practical work in order to run the course in a coherent manner. The lectures are based on practical exercises, seminars, individual, pair and group work, discussions.

Employers are involved in the implementation and development of the courses (invited to lead individual seminars, often organised as exchange visits to workplaces, etc.). This is particularly the case for the course "Statistical Modelling", where mostly professionals from different institutions (Lavia Bank, IT Accenture, different insurance companies) share their experience of problems to be solved at work.

In order to foster the development of students' research skills, students have the opportunity to analyse and study in depth problems of interest to them in the field (e.g. in the courses "Selected chapters in probability theory and mathematical statistics", "Data-driven numerical algorithms", "Asymptotic statistics" and "Master thesis in mathematics") in successive courses.

The seminars in the courses promote students' speaking, presentation and discussion skills. This is particularly promoted in the courses "Academic Practice", "Statistical Modelling", "Selected Chapters in Probability Theory and Mathematical Statistics".

During the academic placement, it is planned to solve a variety of problems: both to solve practical tasks / sub-tasks of a project under the supervision of a specialist from the financial and other fields, and to participate in the realisation of a scientific project (e.g. LCS projects). The duration of the traineeship is intended to be the whole semester, in line with the 2 CP course. Each week the student has to either contact the employer by presenting/receiving assignments or consult a supervisor from the University of Latvia. The idea of the internship is not to work for a while in a company, but to carry out scientific research on behalf of a specialist, applying the knowledge acquired in lectures. One of the reasons for this type of internship is that all Masters students usually already work part-time or full-time in a company/institution.

The physical environment has changed a lot due to the use of the new UL House of Science: classrooms can be easily converted for group work, individual work, students can use digital technologies. Lecturers mostly use methods that encourage students' active participation, critical thinking and reflection. The e-learning environment is used to support the learning process and independent study. An e-learning environment (MOODLE) has been created for each study course, where students have access to lesson materials, assignment descriptions, additional study materials related to the course topics, as well as study assignments (tests, forums, seminars, conferences, etc.). All mid-term and final examinations, with the reasons for the marks, are recorded and made available to students in the e-learning environment.

The student-centred approach is followed in the updating of study programmes and their courses of study, with particular attention being paid to the meaningful formulation of learning outcomes in order to promote dialogue between lecturers and students on study content, forms of organisation and methods. Correctly formulated learning outcomes, in turn, promote students' understanding and ownership of their own learning, self-assessment and understanding of the assessment received. In the study process, lecturers use methods, forms of examination and assessment criteria that are appropriate to the aim of the study and the planned study outcomes.

It is planned to use similar study methods in the implementation of the study programme in English, using existing experience. Particular attention will be paid to the availability of study materials in both Latvian and English in the e-learning environment. At the beginning of the first semester, lecturers will need to identify the different levels of prior knowledge that students may have and take this into account in the further implementation of courses.

The Covid-19 situation has implications for the teaching and examination process. As the national situation is changing rapidly, the forms of face-to-face and online classes are often changing rapidly. Therefore, study materials have been developed for all lecture courses in the MOODLE environment. Examination processes are adapted to both face-to-face and online formats. Perhaps learning to survive in Covid-19 has made lecturers more available for consultation, as it has become routine for many to respond to students on the online platform MS Teams, which also hosts tutorials and sessions.

By observing the study principles of student-centered education, student mobility is promoted (recognition of study results), students are involved in research initiated by academic staff and social activities in society, thus gaining significant experience using what they learned in their studies in practice. By implementing the internal quality assurance policy, the study program is implemented in such a way that students are encouraged to actively participate in the improvement of the study process. There are rules and procedures for submitting student proposals and resolving complaints, and examining student appeals. The results of student surveys are evaluated and taken into account in the improvement of the study process. Students are happy to express their suggestions for improving the study program in discussions with lecturers and the program director.

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).

The duration of the academic practice in AMSPMDS is 2 weeks (20 credit points) and it is 80 hours. The scheduled duration of the practice is the 2nd semester of study. The practice in AMSPMDS is governed by:

1. *Regulations on University of Latvia Study and Continuing Education Programmes* (Decision No 102 of the Senate of UL, 24.04.2017.),
2. *Principles and Procedures for Student Placement at the University of Latvia* (Order No 1/417 of UL 25.11.2019.),
3. Statute for the practice of the UL academic master's study programme “Mathematics and Data Science” (UL FPMO 02.02.2022. Council Decision No 21-2/23),
4. Description of the course “Mathematics master's academic practice” (2 credits) and the corresponding e-study course.

The aim of the AMSPMDS academic practice is to complement theoretical knowledge acquired in the study process, to get an appropriate expertise for the study programme and to obtain practical skills. The main objectives of practice are:

1. to apply the knowledge and skills acquired in studies to practical problems in applied mathematics applications or academic research,
2. to train problem-solving skills, communication skills, IT skills,
3. to develop expertise related to analytical and research skills as well as ethical action.

The practice is organised in UL faculties or other UL departments, as well as in other institutions, companies or organisations (further on, institutions), in which it is possible to apply the knowledge and skills acquired in the Mathematics Master's programme in practice. (1) the practice organiser - Director of the Mathematics Master's Studies Programme and/or a teacher assigned by the Department of Mathematics, whose duties are: to organise the provision of the places of practice and cooperation with places of practice, as well as to control the conduct of student practices registered in the programme and to coordinate the work of the practice managers; (2) UL a faculty representative (usually representative of the UL FPMO Department of Mathematics), who supervises the conduct of the practice in the specific Institution and advises the student on specific mathematical issues related to the performance of the practice, advise on the drawing up of the practice report.

The specific practice task that the student reflects in the practice report depends on the place of practice. The results of studies in the course “Mathematics Master's Academic Practice” fully cover the 8 results of PBSPMS (see Annex 7.8 on the mapping of courses).

Students in the English flow will find appropriate places of practice in more international institutions and firms (e.g. IT *Accenture* or insurance firms Balta, BTA, as well as a cooperation agreement on practices with RAA *Consulting*), where a large part of the communication is already in English, employees from abroad are also involved. It would also be possible to implement the practice in any Latvian institution or firm by agreeing in advance and by ensuring the wording and communication of job tasks in English. The necessary support for students in English will be provided both from the programme director and from the Mathematics Department.

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 is the main evidence of the AMSPMDS qualification, a self-conducted study on a specific subject of a sub-programme with scientific or practical relevance. The individual subject and specific tasks of the Master's thesis are defined for each student by the scientific supervisor, the qualifications of which correspond to the advising of the Master's theses. The aim of the Master's thesis is systematically to use and expand theoretical knowledge and practical skills acquired during studies, through an independent scientific or practically relevant research, and to collect and analyse the results obtained, draw conclusions and formulate recommendations for further action.

The topics of the Master's thesis are selected according to the content and professional orientation of the study programme. Students are informed about the development of the Master's thesis prior to the commencement of the Master's thesis. The justification for the selection of a topic stems from the selected specialisation, relevance to the mathematics science sector, as well as the interests of the student, scientific integration, experience acquired during practice or professional activity.

In the reference period from 2013./2014 to 2020./2021. a total of 74 Master's theses have been defended. While defending around 15 students in the first few years, the number of theses has fallen to about 5 in the past few years. For example, in the academic years 2019./2020 and 2020./2021., a total of 9 Master's theses were defended, their titles given in Table 7.2.4.1.

Table 7.2.4.1

Titles of master thesis 2019/2020 and *2020/2021*

1.	Real-time series analysis for forecasting and anomaly detection
2.	Mathematical model of biomass thermal decomposition
3.	A Functional Dependency Based On an Orthoposet
4.	Fuzzy mathematical morphology operators: theoretical aspects and realization for specific conjunctor-implicator pairs
5.	Investigation of peace-wise linear difference equation systems
6.	Two sample empirical likelihood method for weakly dependent data
7.	Modeling heat generation and transfer processes on graphs
8.	Empirical likelihood for kernel smoothing methods
9.	Methods of parameter estimation for diffusion processes

As can be seen from these 9 Master theses, 4 have been written in the field of statistics and data science, 2 in the modelling area and the rest in the pure mathematics area. To judge the relevance of the topics of the Master theses in the field, including the labour market, let us consider three examples.

The master thesis "Real-time time series analysis for forecasting and anomaly detection" was defended in 2021 with a grade of 9 (excellent). This thesis was supervised by Professor Jānis Valeinis and was compiled by the current PhD student Artis Alksnis, who summarised the results of the project "Development of a prototype algorithm for anomaly detection and classification" at the University of Latvia. This project is a scientific project carried out in collaboration with the Department of Artificial Intelligence and Systems Engineering of RTU, which in turn collaborated with a client from industry. Real-time anomaly detection and classification is needed in many domains. In this case, it was important for the client to know in advance about damage to refrigerators and other storage areas in the shop system. Multiple sensors were placed in each unit to measure temperature and it was necessary to report anomalies in a timely manner. Different statistical models (SARIMA and Exponential Smoothing) and machine learning algorithms (SVM, XGBoost, LightGBM, CatBoost, LSTM models) were programmed in Python. Predictive models return the normal or predicted behaviour of the time series, which is compared with the behaviour of the real data. If the prediction differs significantly, then an anomaly is suspected.

Under the supervision of Professor Jānis Valeinis, Reinis Alksnis' master thesis "Empirical likelihood method for two samples of weakly dependent data" was awarded a grade 10 (with distinction) in 2021. This thesis is written in theoretical statistics, extending the empirical likelihood function for dependent observations to the two-sample case. In particular, it deals with the comparison of two-sample means, quantiles for dependent time series observations. A publication manuscript on change-point detection using the newly developed method with applications to meteorological data analysis was produced (submitted to the journal *Statistical papers*). The change points were determined by comparing two samples taken from the respective time series. Svetlana Aniskevich, another PhD student in the SPDAL laboratory, who herself works at the Latvian Environment, Geology and Meteorology Centre, was involved in writing the publication. Monthly wind speed data from Latvian meteorological stations from 1966 to 2021 were studied. The publication focused more on the Aluksne station, where by subtracting the measurements of the nearest stations, it looked for the change points that do not depend on the wind speed itself. For example, overgrowth of shrubs and trees, or instrument error, can introduce a systematic bias in time series measurements. In this case, both a theoretically novel method was developed and applied to real data. The newly developed method detected more change points than other classical methods (such as CUSUM statistics, etc.). Reinis Alksnis is now a PhD student, assisting in many practical work sessions. He teaches study course "Mathematical Foundations of Econometric Analysis".

Under the supervision of Professor Uldis Strautiņš, Māris Gunārs Dzenis wrote his Master's thesis "A mathematical model of the thermal decomposition of biomass". The thesis was evaluated with 10 (with distinction). The thesis is based on a project in collaboration with the Institute of Physics of the University of Latvia, which aims to study the effect of pre-treatment on the efficiency of biomass pellets as a fuel. An example of pre-treatment is to keep the pellets for a few minutes in a microwave oven. A number of processes take place, both related to drying and to the partial decomposition of the biomass at the molecular level, but also changes in the parameters of the porous material of the pellets, all of which have a direct impact on the subsequent combustion processes. In this work it was investigated how changes in porosity and permeability affect the combustion process. The work was of interest to the industry and the contractor was involved in the project, which has now been completed very successfully. A paper on the results has been written and published. Maris is a PhD student who is also involved in the supervision of the practical sessions.

All three of these examples show that Master's theses are of high quality, often a compilation of the results of projects, which are translated into scientific publications. Although the number of graduates has decreased in recent years, the contribution and impact of graduates on the study programme and the faculty as a whole is significant.

The evaluation of the final examinations is carried out by the final examination commission, which is approved on a proposal from the FPMO Council by the Vice-Rector of the relevant field UL. The Master's thesis is defended at the final examination commission meeting, taking into account the procedures and rules laid down by the UL and FPMO Department of Mathematics, and the criteria for its evaluation.

Table 7.2.6.2

Evaluation of the grades of the Master theses in the period from 2014/2015 to 2020/2021

study year	2013./2014.	2014./2015.	2015./2016.	2016./2017.	2017./2018.	2018./2019.	2019./2020.	2020./2021.
grades	number %	number %	number %	number %	number %	number %	number %	number %
10	9 - 60%	5 - 33%	6 - 60%	5 - 42%	2 - 25%	1- 20%	1- 25%	
9	4 - 27%	4 - 27%	2 - 20%	3 - 25%	3 - 38%	2 - 40%	1 - 25%	4 - 80%
8	1 - 7%	4 - 27%	1 - 10%	1 - 8%		1 - 20%	1 - 25%	1 - 20%
7		2 - 13%		3 - 25%	1 - 13%		1 - 25%	
6								
5	1 - 7%		1 - 10%		2 - 25%			
4						1- 20%		
total	15	15	10	12	8	5	4	5

In general, it can be concluded that the topics of the master thesis of AMSPMDS are in line with the three sub-programmes set up for the accreditation. As a general rule, the defended Master's theses have high grades (Table 7.2.2), some students from the graduates have been already working at the Faculty during their studies.

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.

All resources available to UL and FPMO are available for programme implementation. Both the information base (including the library) and the facilities, as well as the methodological provision, comply with the conditions for the implementation of the study programme, create preconditions for achieving the results of studies and demonstrate the possibility of ensuring to continue the quality study process.

The implementation of AMSPMDS UL is the responsibility of the programme director under the direct authority of the Department of Mathematics. FPMO support for the planning and implementation of the study process is provided by:

- The senior methodologist, common to FPMO study programs, administer student affairs, provides students with services that are the responsibility of the faculty,
- The mathematics department's specific study issues are sorted out by the senior secretary,
- Two computer network administrators at the House of Science.

Class scheduling is performed by the senior secretary of the Department of Mathematics.

Lectures are mainly carried out by the teaching staff from the Faculty of Physics, Mathematics and Optometry, however individual courses are run by the lecturers from the Computer Sciences Faculty.

The teaching of mathematics and statistical courses is provided by the FPMO Department of Mathematics, composed of 3 Chairs (Chair of Differential Equations and Approximation Methods, Chair of Mathematical Analysis and Chair of General Mathematics),as well as the Laboratory of Statistical Research and Data Analysis and the A.Liepa's Correspondence Mathematics School.

The material and technical support related to all study programmes is described in Part II, Section 2.3.2 and the resources of the UL Library are described in Part II, Section 2.3.3.

The House of Science has been commissioned in 2019. The total indoor area is 20018 m2, with a total of 15 auditoriums, 8 workshop rooms, 78 scientific and teaching laboratories and 430 places for scientific and academic staff. These resources are shared by two UL Faculties (Faculty of Physics, Mathematics and Optometry and Medical Faculty) and 6 scientific institutes. A wireless computer network is available in all rooms. The rooms are modern, the technical provision is sufficient. During the Covid-19 pandemic, rooms were equipped with webcams to allow online or hybrid mode (in which part of the students are present and others are remote). It is also planned to use these opportunities after the end of the pandemic to hold joint workshops with other university teachers and researchers.

Information resources are available in the UL Library according to UL study programmes and study fields. The library provides for the purchase of information resources on the orders of UL academic staff, a proposal from the student self-government or a proposal by Library employees that is entered in LUIS and approved by the faculty executive. For the available resources of the UL Library, read more in Part II, point 2.3.3.

The rooms of the Science Building Library, in which the collection of the physics and mathematics sector is located, are open to students at a comfortable time of 24 hours a day for 7 days a week. A free-access item is available for users. The Science Building Library is located on the 2nd floor of the building alongside auditoriums, computer classrooms and the Information Centre in rooms with a total area of 533 m^2. There are 110 places available to users in the Science Building Library. The user can use any workplace in the building to work with a portable computer.

The library's stock is in line with the implementation of studies and the development of scientific research, as it is complemented each year with the most up-to-date information resources, in line with the informational needs of academic staff and students.

There is no need for significant investment in infrastructure in the foreseeable future. There is a need for the maintenance and modernisation of technical provision on a regular and scheduled basis, in line with technical developments and changes in the content of studies.

In general, facilities are considered to be very good.

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).

The implementation of the study programme is intended in both Latvian and English languages. The calculation of the study programme cost-effectiveness is undertaken for a study programme with Latvian training and the same is applied to English training. According to the calculations in this chapter, the cost-effectiveness of the study programme is achieved by having 18 students. If both Latvian and English flows are maintained at the same time during both years of study, 18 students should be required in each of the flows.

Revenue of the Programme

For funding AMSPMDS, UL uses:

- a State budget grant from the Ministry of Education and Science determined for academic year 2021/2022 EUR 3667,75 for full-time studies;
- the fees of studies, taking into account all the factors referred to in the heading “Financial collateral” specified for the academic year 2021/2022:
- full-time studies of EUR 2000 per year;
- the fees for students in English have not been established at this time, since such studies are planned from 2023/2024 year.

In the light of the above, the overall budget for the study programme is expected to be EUR 110032,43 per year, the transcript is shown in Table 7.3.3.1.

Table 7.3.3.1

Budget of the study programme, EUR

Transcript of the budget	Budget, EUR
Tuition fee revenue	0
State budget grant	110032,43
Total	110032,43

Program income

Table 7.3.3.2.

Estimated annual income of the programme, EUR

Type of study	Number of students	Study fees/State grant	Total income
PLC (budget)	30	3667,75	110032,425
PLC (fee)	0	2000	0
Total			**110032,43**

Programme costs

In order to assess the amount of funds needed for financial collateral, UL study programmes calculate the costs according to a methodology developed by UL, which takes into account the previous field of study chapter 2.3.1. Financial support for the costs of ensuring the study process and information on the study programme plan, the participating teaching staff, the planned number of students, etc., thereby ensuring the reliability of the forecasts.

Full - time costs of the programme

For the purposes of the calculation, the implementers use the student data of the academic year 2021/2022- 16 students, the existing study programme plan, and the existing academic staff structure. In the light of the above, the full-time cost of the programme per student is estimated at EUR 3953 per year and the total cost of the programme at EUR 82288 per annum. A more detailed percentage of costs is shown in Table 7.3.3.3.

Table 7.3.3.3

Percentage of costs in the study programme

Heading of expenditure	**% of total**
Teaching staff costs	38,30%
General staff	7,28%
Other costs	0,00%
Infrastructure expenditure	10,30%
Property and services	2,67%
Indirect costs	41,45%
TOTAL COSTS	**100%**

The figure 7.3.3.1 shows the cost of the study programme depending on the number of students and the comparison with the proposed study fee and the State budget grant.

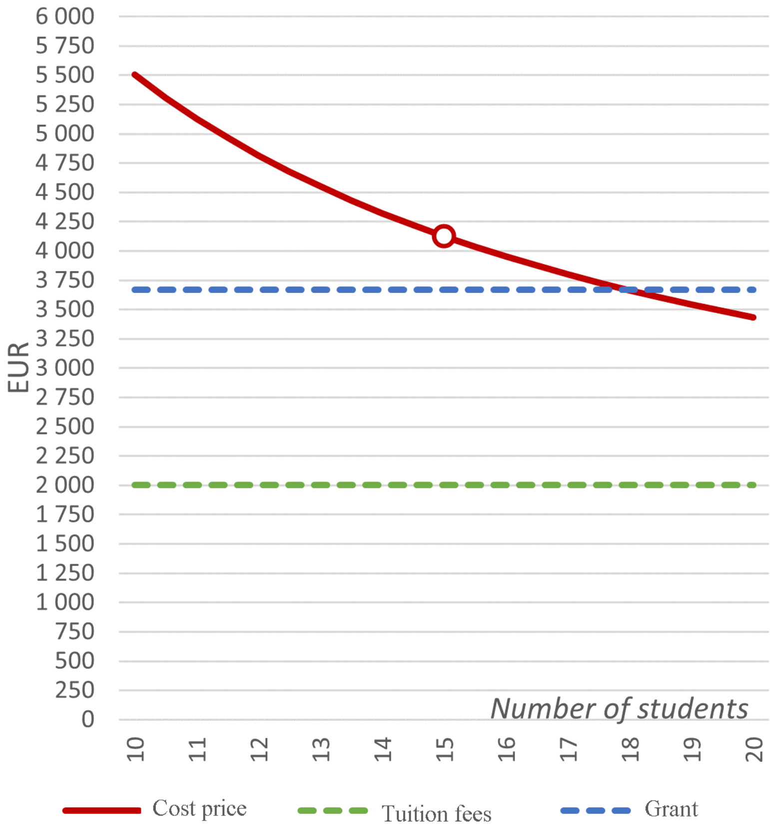


Figure 7.3.3.1. AMSPMDS Cost Based on Student Count

Based on the calculation, it can be seen that for the programme to be cost-effective and the students to have a high-quality study process, the total number of students in the study budget should be at least 18 (the intersection of red and blue lines) in all study years. In turn, tuition fees are historically uniform throughout UL and do not reflect real costs in science study programmes. However, this does not threaten the implementation of the AMSPMDS, since at present the budget grant covers the costs of implementing the study programme, and each additional student's place (in terms of paying students) is covered by study fees.

Summary of revenue and costs of the programme

Table 7.3.3.4 summarises the revenue of the programme, depending on the number of studies, State grants and study fees, and the expenditure of the programme at such a number of students.

Table 7.3.3.4

Outcome of the programme

Type of study	Number of students	Study fees/State grant	**Total income**	**Total cost**
PLC (budget)	30	3667,75	**110032,425**	**82288**
PLC (fee)	0	2000	0	0
Total			**110032,425**	**82288**

The data presented in the table shows that UL has sufficient resources to implement the study programme and to ensure its further development. In addition, the development of the programme may be financed from revenue received from lifelong learning services and from financial resources accruing from the departments. The faculty also receives financial support for the development of the programmes from the UL Studies Quality Development 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.

It is expected that the teaching staff (see Table 7.4.1.1.) will consist of 33 professionals who will be involved in the implementation of AMSPMDS. Teaching staff consists of 11 professors, 2 acting professors and 2 associate professors, moreover more than a half (24) have a doctor's degree. The vast majority of teaching staff are involved in scientific research as they are scientific assistants, researchers and leading researchers. Clearly, the best teaching staff in both the UL Faculty of Computer Sciences and UL Faculty of Physics, Mathematics and Optometry are conducting lecturing courses. Many have the status of LZP expert in Latvia, which allows them to advise doctoral theses and to carry out research at a high level. The teaching staff involved in the programme are competent and capable of providing all study courses according to AMSPMDS study plan, providing knowledge, skills and competence relevant to the results of the studies in the study programme.

Table 7.4.1.1

List of teaching staff involved in the programme

	Last Name	scientific degree	The position of UL, elsewhere	study courses
1.	Alksnis Artis	*Mg. math.*	university teacher (FPMO), scientific assistant, *Scandic Fusion*, analyst	Advanced mathematical methods with Python, R and Matlab
2.	Alksnis Reinis	*Mg. math.*	university teacher (FPMO), scientific assistant, LLU guest lecturer	Bayesian statistics

3.	Asmuss Svetlana	*Dr. math.*	FPMO professor, UL IMCS leading researcher	Graphs, networks and discrete optimization algorithms, Measure and Integral, Fuzzy logic based structures and methods, Harmonic Analysis, Ill-posed problems, Approximation Theory
4.	Bajārs Jānis	*Dr. math.*	FPMO docent, leading researcher	Data-driven numerical algorithms, Methods of functional analysis for differential and integral equations, Dynamical Systems
5.	Balodis Kaspars	*Dr Sc. comp.*	Faculty of Computing, associate professor	Mathematical Fundaments of Theoretical Computer Science
6.	Bārzdiņš Guntis	*Dr Sc. comp.*	Faculty of Computing, professor	Deep Learning
7.	Belovs Aleksandrs	*Dr Sc. comp.*	Faculty of Computing, professor	Quantum Computers
8.	Bēts Raivis	*Dr. math.*	FPMO docent, UL IMCS researcher	Applied algebra
9.	Bula Inese	*Dr. math.*	FPMO Professor, UL IMCS leading researcher	Nonlinear optimization, Fractal Geometry
10.	Buls Jānis	*Dr. math.*	FPMO Acting Professor leading researcher	Number theory, Abstract algebra, Automata and Theory of Algorithms
11.	Cibulis Andrejs	*Dr. math.*	FPMO Professor, UL IMCS leading researcher	Theory of Functions and Functional Analysis
12.	Delesa-Vēliņa Māra	*Dr. math.*	university teacher (FPMO), researcher	Time series and signal analysis, Risk analysis
13.	Dobkeviča Linda	*Dr. Chem.*	Faculty of Geography and Earth Sciences, university teacher, researcher	Environment protection
14.	Gredzens Jānis	*Mg. math..*	university teacher (FPMO), *Evolution Latvia* data scientist	Business intelligence tools and data visualization
15.	Grigorenko Olga	*Dr. math.*	FPMO docent, UL IMCS researcher	Selected Chapters of Financial Mathematics, Category theory

16.	Karnītis Ģirts	*Dr Sc. comp.*	Faculty of Computing, professor	Big data technologies
17.	Kokainis Mārtiņš	*Mg. math.*	Faculty of Computing, university teacher, researcher	Graphs, networks and discrete optimization algorithms, Approximation theory
18.	Līsmane Inta	*Dr. Ped.*	UL Faculty of Humanities, docent	Basic Latvian
19.	Luguzis Artis	*Mg. math.*	FPMO lecturer, scientific assistant	Statistical Modelling
20.	Marinaki Maksims	*Dr. math.*	FPMO lecturer, UL IMCS researcher, Novikonta Naval College, lecturer	Numerical Methods for Partial Differential Equations, Numerical Methods for Integral Equations, Mathematical Foundations of Neural Networks
21.	Nakurte Ilva	*Dr. Chem.*	UL Faculty of Chemistry, docent, leading researcher	Civil protection
22.	Niedrīte Laila	*Dr Sc. comp.*	Faculty of Computing, professor	Selected Topics about Data Warehouses
23.	Pahirko Leonora	*Mg. math.*	FPMO lecturer, scientific assistant	Stochastic Processes
24.	Pētersone Dace	*Mg. math.*	university teacher (FPMO), UL Faculty of Medicine, senior expert As *Printful Latvia*, data scientist	High-Performance Computing for Data Science and Modelling
25.	Smirnovs Sergejs	*Dr. math.*	FPMO docent, UL IMCS leading researcher	Ordinary Differential Equations and Modelling, Nonlinear boundary value problems
26.	Smotrovs Juris	*Dr Sc. comp.*	Faculty of Computing, professor	Combinatorics
27.	Strautiņš Uldis	*Dr. math.*	FPMO professor, UL IMCS leading researcher	Industrial mathematical modelling, Systems and control, Analytic methods for partial differential equations, Numerical methods for hydrodynamics, Optimal control theory
28.	Šostaks Aleksandrs	*Dr. Hhabil. mathematics.*	FPMO acting professor UL IMCS leading researcher	Topology, Fuzzy logic based structures and methods, Category theory

29.	Šteinberga Dzintra	*Mg. math.*	university teacher (FPMO), AAS *Balta*, group leader	Life Insurance Mathematics
30.	Tetereva Anastasija	*Dr. Oec.*	University of Rotterdam (Netherlands), assistant professor	Statistical learning
31.	Uļjane Ingrīda	*Dr. math.*	associate professor of FPMO, UL IMCS leading researcher	Category theory, Topology
32.	Valeinis Jānis	*Dr. math..*	FPMO professor, leading researcher	Modern statistics and data science, Stochastic Differential Equations with Applications, Supplementary Chapters of Probability and Statistics, Nonparametric Statistics, Stochastic Processes, Asymptotic Statistics
33.	Juris Vīksna	*Dr Sc. comp.*	Faculty of Computing, professor	Applied cryptography

Annex 2.5 contains the CVs of the teaching staff.

The knowledge of the official language of the academic staff employed in the study programme complies with the *Regulations Regarding the Extent of the Knowledge of the Official Language, the Procedures for Examining the Proficiency in the Official Language and the State Fee for Examining the Proficiency in the Official Language* (Cabinet Regulation No 733, 07.07.2009), which allows the teaching of the study courses in the official language. All the teaching staff also have sufficient qualifications and language skills to give lectures in English.

In the light of the above, it can be confirmed that the composition of the teaching staff involved in the implementation of the programme provides for the acquisition of high-quality theoretical knowledge and the development of professional skills in mathematics.

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.

The changes in the composition of teaching staff during the reporting period are illustrated by the comparison between tables 7.4.2.1 and 7.4.2.2.

Table 7.4.2.1

Teaching staff in 2013/2014

Position	Number of
Professor	7

Associate Professor	5
Docent	4
Lecturer	1

Table 7.4.2.2

Teaching staff and their capacity 2021/2022

Position	Number of	CP, on average	CP, total
Professor	11	7,8	86
Acting Professor	2	10	20
Associate Professor	2	5	10
Docent	7	5,7	40
Lecturer	3	6	18
University teacher	8	4,5	36

The tables show that the number of docents, professors, lecturers and university teachers has increased. However, the number of associate professors has declined. The explanation that the number of teaching staff has increased is, firstly, the recruitment of teaching staff from the UL Computer Sciences Faculty. A total of 8 teaching staff have been involved from the Computer Science Faculty, covering important lectures in the Data Science and Pure Mathematics sub-programmes. Similarly, many doctoral candidates and young scientists with a doctorate are attached to the teaching of one or two subjects. Here you should note the involvement of the staff of the department SPDAL (Laboratory of Statistical Research and Data Analysis), which helps to implement the study courses in the Data Science sub-programme.

Table 7.4.2.3.

Changes to teaching staff in the programme AMSPMDS

Teaching Staff	2013/2014	2021/2022
Agnis Andžāns	Professor	----
Svetlana Asmuss	Professor	Professor
Uldis Raitums	Professor	----
Andrejs Reinfelds	Professor	----

Aleksandrs Šostaks	Professor	Acting Professor
Mihails Belovs	Professor	----
Inese Bula	Assoc. Professor	Professor
Jānis Buls	Assoc. Professor	Acting Professor
Viktorija Carkova	Assoc. Professor	----
Jānis Cepītis	Assoc. Professor	----
Andrejs Cibulis	Professor	Professor
Ojārs Lietuvietis	Assoc. Professor	----
Dace Kūma	Docent	----
Nadežda Siņenko	Docent	----
Ingrīda Uļjane	Docent	Associate Professor
Jānis Valeinis	Docent	Professor
Uldis Strautiņš	Lecturer	Professor
Raivis Bēts	----	Docent
Māra Delesa-Vēliņa	----	University teacher
Jānis Gredzens	----	University teacher
Olga Grigorenko	----	Docent
Artis Luguzis	----	Lecturer
Maksims Marinaki	----	University teacher
Sergejs Smirnovs	----	Docent
Jānis Bajārs	----	Docent
Artis Alksnis	----	University teacher
Dzintra Šteinberga	----	University teacher
Dace Pētersone	----	University teacher
Reinis Alksnis	----	University teacher
Ģirts Karnītis	----	Professor
Guntis Bārzdiņš	----	Professor

Aleksandrs Belovs	----	Professor
Juris Smotrovs	----	Professor
Juris Vīksna	----	Professor
Kaspars Balodis	----	Assoc. Professor
Laila Niedrīte	----	Professor
Anastasija Tetereva	----	Docent
Mārtiņš Kokainis	----	University teacher
Leonora Pahirko	----	Lecturer
Ilva Nakurte	----	University teacher
Linda Dobkeviča	----	University teacher
Inta Līsmane	----	Docent

Comparing the structure of academic staff, in 2012 (Table 7.4.2.3.), only 8 of the teaching staff from 17 continue teaching in the academic year 2021/2022. In addition, two of them have retirement ages, so they are acting professors. As you can see, many of the UL professors of Faculty of Computing have joined the programme. It has also been possible to compensate for the changes with new employees who have returned from abroad (professors Jānis Valeinis and Uldis Strautiņš, leading researcher and docent Jānis Bajārs), with new doctoral students who have good knowledge in the professional sphere (Jānis Gredzens, Artis Alksnis, Reinis Alksnis, Dace Pētersone, Dzintra Šteinberga, Mārtiņš Kokainis, Artis Luguzis), as well as to new lecturers who have recently obtained a doctorate degree (Raivis Bēts, Maksims Marinaki, Māra Delesa-Vēliņa). This opens up a sustainable view of the future.

More detailed analysis of the impact of changes in the quality and composition of the curriculum.

1. The professors and lecturers from the Faculty of Computing (subjects "Deep Machine Learning", "Big Data Technologies", etc.) involved in the new programme are leading scientists in their field and experts of the Latvian Council of Sciences, so the impact on the implementation of the study programme is positive.
2. The field of probability theory and mathematical statistics in previous accreditation period was covered by professor Viktorija Carkova and docent Nadežda Siņenko. Now the statistics and data science area is covered by professor Jānis Valeinis who returned from Germany, docent Māra Delesa-Vēliņa and the SPDAL laboratory (established from J. Valeinis) - both young scientists and PhD students who are professionals in the field of data science. In addition, assistant professor Anastasija Tetereva, who is working abroad, is teaching one subject ("Statistical learning"). The generational change seems more positive in this case, as there are both academic staff and younger specialists who are well versed in the latest statistical software and in the tools and applications of data science. Professors from the Faculty of Computing will also help to cover the theoretical knowledge in the new programme.
3. Professors Uldis Raitums, Jānis Cepītis and Andrejs Reinfelds in field of Differential Equations and Mathematical Modelling were replaced by professor Uldis Strautiņš, docent Sergejs

Smirnovs, docent Maksims Marinaki and leading researcher, docent Jānis Bajārs, as well as, who returned from abroad. The changes are quite significant as the academic staff was very outdated in the previous period. However, for many years now, professor Uldis Strautiņš and other faculty members from the Chair of Differential Equations and Approximate Methods have been successfully covering lecture courses in all study programmes and carrying out international projects. Leading researcher Jānis Bajārs, who works on data-driven numerical methods and applies modern machine learning methods to dynamical systems, is a new light in this direction.

4. The core of the pure mathematics strand consists of many professors from the previous accreditation period: professor Aleksandrs Šostaks, professor Svetlana Asmuss, professor Jānis Buls, professor Inese Bula, professor Andrejs Cibulis. The younger faculty members: associate professor Ingrīda Uļjane, docent Olga Grigorjenko and docent Raivis Bēts take over lectures and research from the older professors. Here, the quality is roughly the same, with positive trends of generational change.

It should be emphasized that the teaching staff are among the best specialists in their field in Latvia. The quality of the program could be further improved by attracting foreign specialists, which is expected to be done in the future, especially for the needs of the English language stream.

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).

The cooperation of teaching staff takes place at four levels:

- personal contacts,
- inter-branch cooperation (meetings of the Chairs),
- cooperation at MD level (MD meetings and Board meetings),
- institutional cooperation.

The teaching staff involved in AMSPMDS communicate regularly. There are regular meetings of the Chairs and Department of Mathematics, which discuss issues relating to the development of study courses, the promotion of cooperation, the raising of qualifications for staff, the introduction of student proposals in the training process and the consideration of other topics related to the provision of the study programme.

In a number of study courses (such as “Modern Statistics and Data Science”, “Asymptotic Statistics”, “Statistical learning”), the lectures are implemented by a more experienced professor, while the practical exercise part is conducted by a doctoral candidate, scientific assistant or a lecturer. The content and continuity of the course in the presentation should be agreed between the two teaching staff.

The work of the Statistical Research and Data Analysis Laboratory (SPDAL) for young doctoral candidates and professionals in the field of data science and mathematical statistics plays an important role in both the planning and advertising study courses.

Close cooperation is planned with the 8 teaching staff of the UL Computer Sciences Faculty on a variety of study courses. It should be noted that the Department of Mathematics has already worked closely with the Department of Computer Science and Mathematics since autumn 2021, a joint doctoral programme on “Computer science and mathematics” has been implemented. Although various courses in IT fields could also be referred to by the staff of the Department laboratory (e.g. “Deep Machine Learning”, “Data Warehouse Selected Chapters”, etc.), these types of study courses are already provided to the Computer Sciences Faculty and there is no need for duplication of study courses.

Following the formation of the FS PMSMS Council, the Mathematical Studies Programme Board has lost its role. At present, the Council of FS PMSMS has been entrusted with the functions of controlling the content of the study courses to the MD Board. The Board of MD examine the content of all new and substantially altered study courses.

Academic staff regularly update the content of study courses, adapting them to new requirements and trends. The quality of course descriptions is maintained, taking into account the academic standard for the development of descriptions of all courses and knowing the importance of the information contained in them in ensuring a high quality study process. Teachers respect the principles of student-centred education. There is cooperation with employers (some employers are also teaching staff) to improve the content of study courses according to employers' views. Discussions following the defence of the masters' theses give the teachers involved in the commission an incentive to continue teaching courses in the same way as in the past or to make changes. Thus, communication between teaching staff ensures the consistency of study courses in the course of the study programme with the objectives and objectives pursued by the programme.

In the course of the year 2013/2014, 17 teaching staff were involved, with a total of 39 students, a ratio of $39/17 \approx 2{,}3$. If calculated for 2021, the teaching staff are 33 and 16 students, that is to say, the ratio is $16/33 \approx 0{,}5$. However, it should be noted that polls are expecting a much higher number of students in the reorganised master course, where 3 sub-programmes are set up. If no students from PBSPMS were enrolled in the Master's programme in 2021, the surveys show that over 90% of students from Years 2, 3, 4 would like to join the newly established “Data Science” sub-programme (as shown by the results of the student survey conducted). In contrast, from an academic bachelor's program “Mathematics” many students also choose “Technology mathematics” and “Pure mathematics.” Students see the reorganized program as innovative and contemporary.

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	annex_MSPMDZ_Sample of the diploma and its supplement.pdf	piel_MSPMDZ_Diploma un tā pielikumu paraugs.pdf
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)	annex_MSPMDZ_Opinion of the Council of Higher Education.docx	piel_MSPMDZ_Augstākās izglītības padomes atzinums.docx
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	7.5.annex_MSPMDZ_Statistics on the students in the reporting period.docx	7.5.piel_MSPMDZ_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	7.6.annex_MSPMDZ_Compliance with the study programme with the State Education Standard.docx	7.6.piel_MSPMDZ_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	7.8.annex_MSPMDZ_Mapping of the study courses.xlsx	7.8.piel_MSPMDZ_Studiju kursu kartējums.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	7.9.annex_MSPMDZ_The curriculum of the study programme.docx	7.9.piel_MSPMDZ_Studiju programmas plāns.docx
Descriptions of the study courses/ modules	7.10.annex_MSPMDZ_Descriptions of the study courses.docx	7.10.piel_MSPMDZ_Studiju kursu apraksti.docx
Description of the organisation of the internship of the students (if applicable)	annex_MSPMDZ_Description of the organisation of the internship of the students.docx	piel_MSPMDZ_Studējošo prakses organizācijas apraksts.doc
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)	annex_MSPMDZ_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher.docx	piel_MSPMDZ_Apliecinājums par akadēmiskā personāla atbilstību Augstskolu likuma 55. panta 1.d. 3.p.pdf

Physics (43443)

Study field	*Physics, Material Science, Mathematics, and Statistics*
ProcedureStudyProgram.Name	*Physics*
Education classification code	*43443*
Type of the study programme	*Academic bachelor study programme*
Name of the study programme director	*Ģirts*
Surname of the study programme director	*Barinovs*
E-mail of the study programme director	*girts.barinovs@lu.lv*
Title of the study programme director	*Dr.chem.*
Phone of the study programme director	*+371 26120244*
Goal of the study programme	*To develop an understanding of physical laws in the surrounding world and technology, to develop creativity, critical thinking, experimental skills, physics and mathematical modelling capabilities, by preparing students for work in research, industry, education or other fields. The acquired knowledge, skills and competence must comply with the 6th level of the framework specified in the classification of Latvian education, ensuring the ability of a student to study in the Master of Physics and other related master programmes, including the Master of Physics programmes in the world's best (top 100) universities.*
Tasks of the study programme	*• Provide an opportunity to learn general and modern physics under the leadership of skilled faculty. • Promoting the availability of individualised studies by specialising in one of the sub-fields of physics or interdisciplinary fields under guidance of experienced scientists. • Develop students' mathematics skills and IT skills. • Provide students with the opportunity to develop laboratory work in modern teaching and scientific laboratories, train students to plan and conduct experiments, carry out experimental data processing, analyse and present the results. • Maintaining and developing the quality of studies through the use of effective and student-centred methods in the study process. • Provide the opportunity to carry out scientific research on topics of modern physics in the framework of Bachelor's thesis.*

Results of the study programme	*Knowledge:* *1. are familiar with basic parts of physics, including classical mechanics, electromagnetism, quantum physics, thermodynamics, statistical physics, waves, optics, structure of matter, atomic structure, a qualitative understanding of the development of modern physics;* *2. know in depth one of the individual fields of physics, such as atomic physics, spectroscopy, material physics, astronomy, and their highlights.* *Skills:* *3. formulate and apply physical models, correctly use the terms of physics, perform justified approximation, estimate the order of magnitude for relevant physical quantities;* *4. plan and carry out experiments, acquire experimental data independently and process the results of experiments, analyse the data obtained, assess measurement errors, compare the results obtained with theoretical models;* *5. use mathematics to describe physical models and solve problems;* *6. apply programming languages and prepared software packages to address physical problems, processing, describing and communicating results;* *7. present complex information in a clear and concentrated manner, construct logical arguments, citing sources and using technical terms correctly.* *Competence:* *8. carry out independent research, independently seek and collect information using scientific literature, organise time in respect of deadlines, collaborate constructively with colleagues, identify the limits of their knowledge, respect academic honesty.*
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 school education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor’s degree of Natural Sciences in Physics*
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

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.

The venue of the study programme has changed since the previous accreditation period. By January 2018, the ABSPP was implemented in the Zeļļu Street 25 (numbering changed, now 8), Riga. Starting from the spring semester of 2018, studies take place at the UL Sciences Building, Jelgava Street 3, Riga. Spatial proximity to research institutes and related science faculties facilitates collaboration between the programme's staff and scientists, and reduces the time needed in transit between classrooms. World-class teaching and research facilities at the Academic Centre of the University of Latvia at Jelgavas Street, new teaching and scientific laboratories, computer classrooms, have allowed to modernise the study environment, improving the quality of the study programme.

The objectives and tasks of the ABSPP have been clarified since the previous accreditation. The aims are set up in accordance with the *Latvian Qualifications Framework* (LQF), but the objectives are structured, formulating each as an action to be carried out in the implementation of the study programme. The results of the studies are reformulated by separating the knowledge, skills and competences to be acquired, allowing the objectives of the study programme to be clearly linked to the outcomes of individual courses and the quality of the study programme to be efficiently monitored.

The ABSPP study plan submitted to accreditation has changed the amount of study courses in the compulsory part A and the restricted elective part B, as shown in Table 4.1.1.1.

Table 4.1.1.1

Changes in the size of ABSPP study courses in Parts A and B

Study courses	2013./2014.	2023./2024.
Part A	76	88
Civil protection		1
Environmental protection		1
Practice		2
Bachelor's thesis	10	10
Part B	40	28
Practice		2

Part C	4	4
Total	**120**	**120**

The minimum compulsory part has been increased from 76 CP to 88 CP since the previous accreditation, including all courses in the compulsory part for the first semester (namely, including in the compulsory part “Computers and programming” 4 CP, “Introduction to Mathematics for Physicists” 4 CP, “Physics and Engineering Seminar” 2 CP). Completion of these core courses is a prerequisite for the ABSPP programme, in order to ensure the quality in implementation of later advanced physics courses. Courses “Civil Protection” 1 CP and “Environmental Protection” 1 CP are included as requested by Cabinet Regulation No. 240 *Regulations Regarding the State Academic Education Standard* (only in Latvian). In order to encourage better quality and faster entrance of bachelor students into labour market, the Bachelor's Programme includes academic practice courses in the compulsory part of 2 CP and 2 CP in the restricted elective part (Part B). 10 CP invariably are bachelor's thesis work.

The offer of the courses in Part B of the restricted elective courses has been updated, taking into account the developments of the field of study in Latvia, in order to maintain the quality of the study programme. The size of the restricted elective part has been reduced to 28 CP, which is more than the minimum of 20 CP specified in the Cabinet Regulation No 240 *Regulations Regarding the State Academic Education Standard* (only in Latvian).

The amount of the elective part (Part C) has remained 4 CP.

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.

ABSPP compliance with the FS “Physics, Material Science, Math and Statistics” has been determined since the creation of the field of study by the study programmes related to mathematics, physics, statistics and material science that have been included in it.

The name of the study programme, the degree to be granted, the professional qualification, as well as the eligibility of the parameters of the study programme in achieving the results of the specified study programme is governed by external standards, i.e. Cabinet Regulations No 240 *Regulations regarding the state academic education standard* (only in Latvian) and MK Regulations No. 322 *On the classification of Latvian education* (only in Latvian).

ABSPP code (43443) according to the Cabinet Regulation No. 322 *On the classification of Latvian education* (only in Latvian) corresponds to the sixth qualification level of the Latvian educational qualification structure. The scope of the study programme, the duration of the studies, parts of the study programme and their size, minimum content, professional qualifications, basic principles and procedures for evaluation and the extent of study practice, implementation principles, etc. are governed by the Cabinet Regulation No 240 *Regulations Regarding the State Academic Education Standard* (only in Latvian) and comply with the requirements set out in the Regulations.

The “Physics” academic study programme is an academic education programme of 120 credit points in Latvian with the duration of 3 years according to the Cabinet Regulation No. 240 *Regulations Regarding the State Academic Education Standard* (only in Latvian). The duration of the studies is 6 semesters.

The duration of the study programme is consistent with the Bologna process, resulting in harmonised study programmes across the European Higher Education Area. As a result of the Bologna process, 90% of the Bachelor of Physics programmes in the European Higher Education Area, including ABSPP (43443) are 3 years long (the implementation of the Bologna Process reforms Into physics programmes in Europe, Report of the EPS https://www.eps.org/resource/resmgr/policy/eps_bp_study_bphys.pdf, 2009).

Secondary education is necessary to start the studies at ABSPP. According to the *Law on Higher Education Institutions*, students are accepted on the basis of the results of centralised examinations. For persons who have completed secondary education before 2004, the rules describe a separate evaluation procedure. The largest contribution to the admission score derives from the centralised physics examination (CE), so that the maximum points of the admission competition require the knowledge and the application skills of the basic concepts of physics, mathematics and communication skills, which are necessary to achieve the results of the studies of the ABSPP. Graduates who have not taken the CE in physics have the possibility of participating in the admissions contest with fewer points using the CE in mathematics.

The admission criteria for persons who have acquired secondary education before 2004:

Option 1: 15% CE in Latvian + 10% CE in English or CE in French or CE in German + 65% CE in maths* + 10% CE in physics (0 if not available)

Option 2: 15% CE in Latvian + 10% CE in English or CE in French or CE in German + 5% CE in mathematics* + 70% in CE physics.

Additional points can be obtained if a pupil has improved physics knowledge at the School of New Physicists and is able to certify it with a certificate, has obtained award-winning places or recognition in physics and mathematics Olympiads at Latvian or higher levels, or rewarded at the Contest for Young Scientists conference or open astronomy Olympiad.

The skills acquired in the bachelor's programme are sufficient for studies in the higher level of physics and material science programmes and, after the end of the bachelor studies, graduates acquire the opportunity to study in the “Physics, Material Science, Mathematics and Statistics” academic master's study programme “Physics” and after graduation of the master programme to study in the doctoral programme “Particle Physics and Accelerator Technologies”.

ABSPP students participate in practice, work on thesis, or work after graduation from the programme in scientific institutes in the Physics and Material Science field, such as the UL Institute of Solid State Physics, UL Institute of Physics, the UL Institute of Chemical Physics. The scientific staff of these institutes are involved in teaching the programme courses.

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

Technological progress is a driver of the economic growth of today's society. Technological progress is taking place by conducting scientific research, developing new technologies or adapting existing technologies. Physics creates knowledge of nature: for technological development, for understanding and efficient application of technologies. This knowledge is necessary for a fundamental understanding of physics and other sciences. The development and adaptation of knowledge and technology requires human resources, the skills of which need to be developed through education, the development of knowledge transfer mechanisms and the provision of professional experience during studies.

ABSPP of the University of Latvia is the largest bachelor's degree programme in Latvia in the field of physics. ABSPP was closed at the University of Liepaja in 2020. ABSPP Daugavpils University is significantly smaller than the bachelor's programme of the University of Latvia. ABSPP graduates of the University of Latvia continue their studies at the University of Latvia, Riga Technical University or universities abroad, work in companies, work as teachers in schools or as academic staff at universities.

ABSPP offers classes, lectures, laboratory work and tutoring to students under guidance of highly qualified lecturers, the possibility to work on final theses in international scientific projects. The closeness of UL to scientific institutes and businesses provides students with easy access to an essential research and technology base.

"Information report on medium and long-term forecasts of the labour market (2020)" (only in Latvian) by Ministry of Economics shows that 5.4 thousand people with higher education are working in the field of physical sciences in 2020, but it is expected that 7.0 thousand specialists will be needed in this field in 2027, but the estimate of the number of available specialists in this field will not change.

By looking at the opportunities of graduates of the programme to work in school and by analysing the employment structure of STEM teachers, it can be seen that in Latvian schools 15% of STEM teachers teach physics, which is 791 teachers (ESF Study 'The Research on Coverage of Education Provision and Learners' Involvement in STEM.' Riga, Latvia, June 2021). In 2018, only one physics teacher (https://www.la.lv/fizikas-skolotaju-nav-un-nebus) (only in Latvian) graduated from the UL, resulting in a catastrophic lack of physics teachers in the country, which will only increase in the future.

According to the Latvian National Development Plan for 2021-2027 (National Development Plan of Latvia for 2021-2027 (pkc.gov.lv)), the percentage of graduates in science, mathematics and information technologies from the total number of graduates in higher education should be increased from 6.8% in 2018. up to 12% in 2027.

Labour shortages lead to demand for students of the Bachelor of Physics programme and in recent years, according to the UL survey, around 90% of graduates have work experience in the field of physics (2019 – 90%, 2020 – 92%) at the completion of their studies.

After graduation most graduates continue to study at UL or other universities. Collecting employment information after a longer time since graduation from the bachelor's programme, when graduates have already completed further studies and stabilised their careers (2020 survey of 2010-2013 graduates), out of 107 graduates 40 continue to work at universities or research laboratories in Latvia and abroad, 9 works in schools, 20 works as specialists in the field of physics in companies (SAF, *Light Guide Optics, Siltronic, Groglass, Latvenergo*, etc.), 34 are specialists in companies (MikroTik, Tieto, HansaMatrix, Airbaltic, Accenture, etc.) not working in the main field of specialization. This information is summarised in Figure 4.1.3.1.

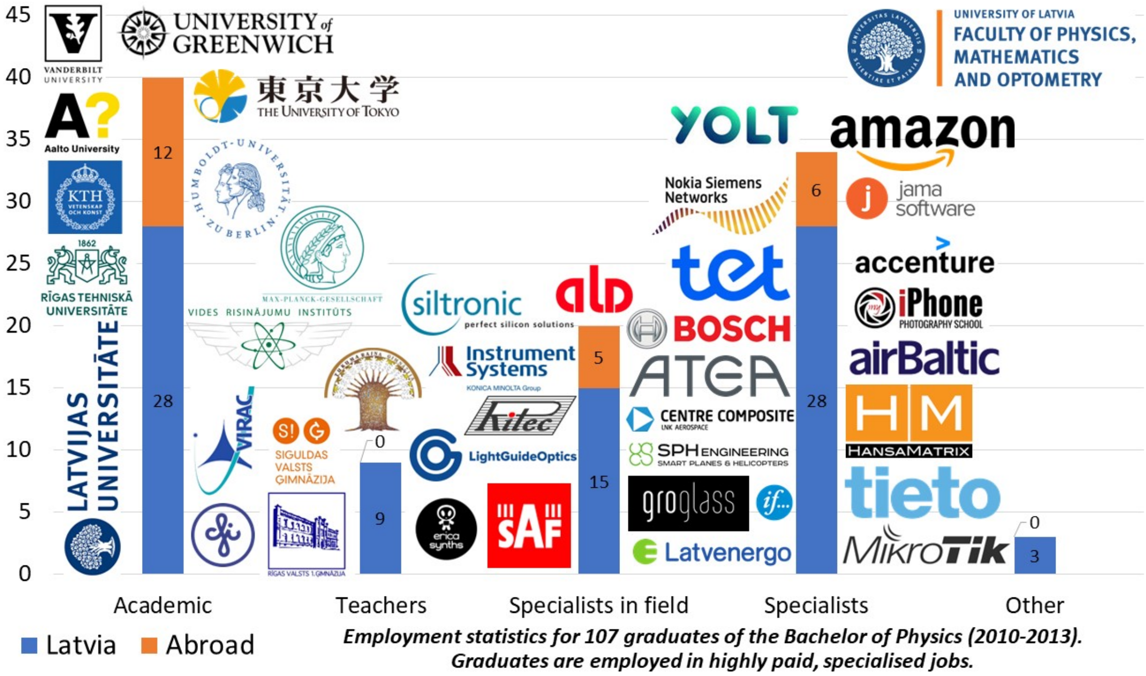


Figure 4.1.3.1. Employment statistics of ABSPP graduates 7-10 years after graduation

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.

The average annual number of students in the ABSPP in the period between 2013 and 2021 is 108 students. In 2021, 101 students were studying, corresponding to a slight drop in the number of students relative to the average of the period. In that period, an average of 49 students studied in the first year. In 2021 55 students studied in the first year. In recent years the number of students in the first year has tendency to grow slightly.

When looking at the number of students, it should be noted that during this period, the number of those pupils taking centralised physics examinations in secondary schools decreased from 866 pupils to 570 in 2021, which is well in line with the drop in the number of secondary school graduates from 14 380 to 11 704 in the same period. Despite the drop in the number of school graduates, ABSPP has managed to avoid a drop in the number of students in the first year of study, but the number in student drop-outs at the beginning of studies has increased, thereby reducing the number of graduates. As a reason for leaving, according to data from 2016/2017 (data on the entire faculty, indiscriminately of the programmes), graduates mainly mention the inability to combine studies with work (54%), personal causes (54%), lack of motivation (51%), lack of interest in a selected programme (49%). From the 2020 survey ABSPP students who dropped out had mainly (13 out of 15 students) had university admission score below 600 points. The stated reasons for leaving (in 2020 for ABSPP students) are the desire to study elsewhere or the inability to connect studies to work. In 2019, 13 out of 16 students dropped out with an enrolment score below 630 points, mostly mentioning personal causes. This shows the importance of previous student preparedness for successful further studies in higher education. However, it should also be noted that part of these students with low enrolment scores continued their studies. ABSPP has not chosen to strengthen admissions requirements, because given the lack of physics teachers in schools, the teaching conditions in different schools are extremely unequal and low levels of admission score do not necessarily lead to the drop-out from the studies.

In recent years, ABSPP introduced a series of measures to reduce student drop-outs: in addition to the “Mathematics for physicists” course a curator works for several years, a revised content of introductory physics courses ensures a more gradual increase in the difficulty of the material being studied, student-centred teaching methods are used more actively. In 2020-2022, students were also negatively affected by the restrictions following the Covid-19 epidemic, which currently makes it difficult to link the dynamics of the change in the student numbers to the effectiveness of the measures taken to reduce student drop-outs.

4.1.4.1.Table

Statistical data on students in ABSPP

Data on 1 October of the reference year	**Number of students enrolled in Year 1**	**Number of students by year of study**			**Total**	**Including paying**	**Number of graduates**	**Number of drop-outs**
		1	2	3				
2011	59	59	44	33	136	14	36	22
2012	59	59	40	36	135	9	28	38
2013	40	40	43	34	117	4	34	34
2014	41	44	26	40	110	16	30	26
2015	59	61	30	24	115	9	29	32
2016	54	59	44	24	127	12	17	30
2017	42	45	29	38	112	9	17	44
2018	50	52	18	29	99	11	29	30
2019	52	51	28	18	97	15	21	36
2020	52	53	27	17	97	18	12	44
2021	54	55	24	22	101	10	14	36

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 content of the ABSPP studies consists of 57 study courses, including 2 practice courses and a final examination – Bachelor's thesis. The content of the ABSPP study programme is based on the following external and internal laws and regulations:

1. *The Law on Higher Education Institutions* of the Republic of Latvia;
2. Cabinet Regulation No 240 (13.05.2014) *Regulations Regarding the State Academic Education Standard* (Only in Latvian);
3. *Regulations on University of Latvia Study and Continuing Education Programmes*.

The results of the study programme have been determined in compliance with the *Latvian Qualifications Framework* (LQF) and taking into account the specifications of *the European Physical Society for Bachelor of Physics Studies*.

The content of study courses is arranged hierarchically: initially, the General Physics Part A courses provide the basic principles of physical description by learning classical mechanics, electricity, optics. In parallel, student experimental skills, mathematics skills and IT skills are developed. In the following courses of physics, using an increasingly abstract approach, theoretical mechanics, electromagnetism, statistical physics of quantum physics are learned.

After strengthening the students' knowledge of general physics, the proportion of restricted elective courses (Part B) is increased. Restricted elective courses are closely linked to research, teaching courses by lecturers in their research directions as well as researchers of scientific institutes in their research directions, such as atomic physics, spectroscopy, solid-state physics, theoretical physics. Thus, the content of the courses can be immediately updated following science field developments. In experimental courses, students, in addition to developing experimental skills in university laboratories, benefit from the use of scientific equipment of institutes under the guidance of scientists. The 2 CP study course “Academic Practice” in Part B of the 4th semester and the 2 CP study course “Academic Practice II” in Part A of the 5th semester is included in the programme.

According to *Cabinet Regulation No 240, Regulations Regarding the State Academic Education Standard* (Only in Latvian) consist of compulsory (part A), restricted elective (part B) and elective courses (part C). The study programme consists of part A of 88 CP or 73%, part B is part 28 CP and 4 CP part C. The 6th semester includes the 10 CP course “Bachelor Thesis in Physics”. The study programme also includes study courses “Civil Protection” at 1 CP and “Environmental Protection” at 1 CP.

The amount of the mandatory part of the ABSPP (Part A) is 88 CP, which is more than required 50 CP for the mandatory part by the requirements *of Regulations Regarding the State Academic Education Standard* (Only in Latvian) in the Cabinet Regulation No 240.

40% of the amount of the bachelor's study programme (except for the amount intended for internships and the development of Bachelor's thesis) consist of contact hours in accordance with *the Cabinet Regulations No 240 Regulations Regarding the State Academic Education Standard* (Only in Latvian).

In the content of the ABSPP, the guidelines, principles, structure and methodology of the science field “Physics and Astronomy” in the compulsory part constitute 34 CP, in accordance with *the* Cabinet Regulations No 240 *Regulations Regarding the State Academic Education Standard* (Only in Latvian) (the compulsory part of the bachelor's study programme and the restricted elective part include guidelines, principles, structure and methodology of the relevant science field or sub-field (not less than 25 credit points):

- “Physics I” 6 CP
- “Physics II” 6 CP
- “Physics III” 6 CP
- “Introduction to Classical Mechanics” 3 CP
- “Quantum physics” 3 CP
- “Introduction to Electrodynamics” 3 CP
- 'Introduction to Statistical Physics' 3 CP
- “Astronomy and Astrophysics” 4 CP

The history of development of the physics and astronomy science field or sub-subfield and the current problems consist of 12 CP according Cabinet Regulation 240 (history of development of the science sector or sub-sector and current problems (not less than 10 CP)):

- “Large scale research infrastructure” 2 CP
- “Introduction to Nanoscience” 2 CP
- “Soft Matter Physics” 2 CP
- “Physics of Computation” 2 CP
- “Materials in Nature and Engineering” 2 CP
- “Standard Model of Elementary Particles” 2 CP

In addition, it is possible to familiarise themselves with the history of physics and technological development in a course in elective part (C):

- “History of Physics and Technique” 4 CP

Physics and astronomy field’s characterisation and problems in the interdisciplinary aspect in restricted elective part (B part) of the programme are included in courses amounting to 24 CP according to Cabinet Regulation No 240 *Regulations Regarding the State Academic Education Standard* (Only in Latvian) (the fields of science or subfields characterisation and problems in the interdisciplinary aspect (not less than 15 CP)):

- “Introduction to Nanoscience” 2 CP
- “Atomic and molecule spectroscopy” 2 CP
- “Soft Matter Physics” 2 CP
- “Introduction to hydrodynamics” 2 CP
- “Basics of the Solid State” 2 CP
- “Introduction to theoretical physics” 2 CP
- “Electronic Measurement Technologies” 4 CP
- “Introduction to radio astronomy” 2 CP
- “Atoms in external fields” 2 CP
- “Physics and engineering physics seminar” 2 CP
- “Machine Learning for Physicists” 2 CP

The courses are designed to meet the objectives and outcomes of the study programme. Study courses are designed to not duplicate their content. The study plan (Annex 4.9) is designed to ensure the continuity of study courses and an increase in the level of complexity. The study course outcome mapping (Annex 4.8) shows that the results of ABSPP study courses cover all the planned results of studies of the study programme (Table 4.2.1.1 gives a summary of the mapping) and the achievement of the learning outcomes of the study courses ensure the achievement of the learning outcomes of the study programme.

Table 4.2.1.1

Overlaps of the results of ABSPP studies with the results of study courses

ABSPP results	Total
Knowledge:	
formulate and apply physical models, correctly use the terms of physics, perform justified approximation, estimate the order of magnitude for relevant physical quantities;	56
know in depth one of the individual fields of physics, such as atomic physics, spectroscopy, material physics, astronomy, and their spotlights.	84
Skills:	
formulate and apply physical models, correctly use the terms of physics, perform justified approximation, evaluate the physical amounts required for the description;	76

plan and carry out experiments, acquire experimental data independently and process the results of experiments, analyse the data obtained, assess measurement errors, compare the results obtained with theoretical models;	60
use mathematics to describe physical models and solve problems;	96
apply programming languages and prepared software packages to address physical problems, processing, describing and communicating results;	59
present complex information in a clear and concentrated manner, construct logical arguments, citing sources and using technical terms correctly.	35
Competence:	
carry out independent research, independently seek and collect information using scientific literature, organise itself in respect of deadlines, collaborate constructively with colleagues, identify the limits of their knowledge, respect academic honesty.	48

The information on improvements needed in the programme is obtained from feedback from employers, student and alumni surveys, and in consultations with the programme's faculty, most of whom are active scientists and conduct research in physics. The representatives of companies are represented in the Physics, Material Science, Maths and Statistics Council, participating in the evaluation of study plans and changes in study programmes, in the discussions and evaluation of annual Self-assessment reports of study directions and applications for accreditation. At the time of the preparation of the accreditation report (early 2022), companies that employ graduates of the programme are represented by Normunds Bergs (SAF Technique, http://saftehnika.com, *Letera*, https://www.letera.lv/) and Guntis Mārciņš (*Groglass*, https://www.groglass.com/). In face-to-face discussions with representatives of companies, for example, during a visit of representatives of SAF Tehnika to the University of Latvia, the company representatives have pointed out the need to develop IT skills of the students. Within the SAM 8.2.2 project, lecturers were on internships in companies, studying the skills needed for the companies (e.g. doc. L. Goldšteins interned at the start-up company CENOS, prof. A. Šarakovskis is scheduled for an internship at SIA Groglass). As a result of employers' recommendations, new courses are included in the study programme and pre-existing courses are updated. For example, in order to develop students' IT skills, the programme includes a new 3 CP Part B course "Scientific Programming for Physicists", a 2 CP Part B course "Image Processing in Physics". By reorganising existing courses, a 2 CP "Machine Learning for Physicists", a 4 CP "Autonomous Experimental Systems" and a 2 CP "Computer Networking Laboratory" have been created as part B courses. In response to Latvia's recent accession to the international research organisations CERN and ESA, which are relying on the use of large-scale infrastructure, the Part B 2 CP course on "Large-scale research infrastructure" is included and in response to the development of the Ventspils International Radio Astronomy Centre (VIRAC) the programme includes new astronomy courses, 2 CP "Introduction to radio astronomy" and 2 CP "Solar system objects". The ABSPP has set up meta-courses in the electronic study environment for communication with students, where employers' advertisements are published on average twice a month and statistics show an acute need for physics teachers and university lecturers in physics. To develop the pedagogical skills necessary for students to work in schools, Part B includes courses on “Teaching and Learning Methodology of Physics I” (6 CP), “Teaching and Learning Methodology of Physics II” (6 CP) and “Teaching and Learning Methodology of Astronomy” (2 CP).

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.

The study progress of ABSPP students is monitored by summative assessment, formative assessment and the self-assessment of students. At the end of each course, summative assessment of the students’ knowledge is obtained in the final written or oral examination. Some courses for the final exam use an essay, a presentation of research or experiment results. The examination may be taken twice administered by course teatchers, and the third time, administered by a commission established by the dean. A commission also assesses the defence of Bachelor's thesis. The grades are marked on the 10-point scale. The final exam grade represents 10%-50% of the course's final grade, except for the Bachelor's thesis work. The rest of the course grade is obtained from interim assessments, which can be written tests, homework, computer quiz, an essay, class activity assessment, assessment of a presentation, written computer code, defended results of a performed experiment or laboratory work. The grades of interim assessments should be obtained throughout the semester.

The most widely used formative assessment is peer instruction during the lesson/lecture. Students are asked up to 10 multi-choice questions, voting on the correct answer, either by hand, by the the Plickers or Clicker voting devices at the disposal of Department of Physics. In addition to these, tests are available that are automatically assessed by the MOODLE system but their results are not used to calculate the final grade. These tests are either specifically prepared, or they are variations of tests or homeworks from previous years.

For self-assessment, the student may use the previous year available quizzes and exams, or the exercises recommended by a teacher to assess their level of knowledge.

Oral, written and combined study evaluation methods are used during studies and testing, with a tendency to increase the relative proportion of written tests in order to ensure equal difficulty test questions and fair assessment for all students.

Studies use a variety of techniques for acquiring and strengthening knowledge, such as introductory lectures, individual, pairs and group work, computer-class practical works, practice exercise tutorials, experimental demonstrations, laboratory work, project work, workshops, training tours to scientific institutes and businesses. The involvement of scientists from scientific institutes (employers) in the implementation of elective courses or as advisors of practices and bachelor's theses continues. Practitioners, professionals from different institutions are invited to teach individual lectures, aiding the integration of theory and practice.

In order for students to achieve the learning outcomes of their studies – learning and strengthening knowledge and skills – the study process is dominated by methods where student activity is important. The study process uses methods to promote student communication in the performance of study tasks, addressing real problems of the physics field, modelling situations. In line with the findings of modern physics education research, a systematic transition in the General Physics courses to the student-centred learning approach is undertaken, formulating the results achieved by the student at the highest levels of Bloom's taxonomy scale, reducing the role of lectures in information transfer in the course, and introducing the student-centred approach for more efficient achievement of the learning goals in the lessons by supplementing the lectures, with a "peer instruction" that is a vote on multiple-choice tasks with a follow-up discussion *of* students (Peer instruction, Crouch C. H. and Mazur E., *Peer Instruction: ten years of experience and results, Am. J. Phys.,* 69, P. 970 - 977, 2001), the introduction of working sheets in practical works or lectures, the abandonment of black box experimental works as opposed to research tasks in the physics laboratory. The development of teaching skills is gradually underway and also the conversion of elective courses through the introduction of student-centred learning methods. On average, 2 times a semester, teachers meet at a Department of Physics seminar dedicated mainly to describing student-centred methods or exchanging teaching experience. Seminars take place face-to-face and remotely for UL and foreign academic staff. Teachers are informed of on-site or remote training courses for learning active learning methods, several teachers have certificates from remote courses "*An Introduction to Evidence-Based Undergraduate STEM Teaching*" and "*Advancing Learning Through Evidence-Based STEM Teaching*", from *the Center for Integrated Research Teaching and Learning*, USA. Teachers present their experience and research in the field of Physics Didactics in a newly created section at the UL conference.

In order to promote the development of students' research competencies, students in follow-up courses have the opportunity to deeper analyse and study the problems of the field of their interest. In the seminars of study courses presentations of students are encouraged, promoting presentation and discussion skills of students.

The physical study environment is also gradually changing: lecture halls are easily transformed for group work, individual work, students can use digital technologies. Teachers mostly use techniques that encourage student active participation, critical thinking and reflections. The e-study environment is used in the study process and to promote independent studies. An e-study environment (MOODLE) has been set up for each study course, where learners have access to class materials, task descriptions in addition to course-related teaching materials, and study assignments (tests, forums, seminars, conferences, etc.). All assessments of interim tests and final examinations of study courses are registered with explanation and made available to students in the e-study environment.

The student-centred approach is followed when the updating study programmes and study courses, with a particular focus on meaningful formulation of study results, in order to promote dialogue between teachers and students on the content, forms and methods of study. In turn, properly formulated study results contribute to students' understanding and co-responsibility for their learning, self-evaluation and understanding of the grading they have received. In the study process, teachers use methods, test forms and evaluation criteria relevant to the purpose of the studies and the planned learning outcomes of the studies.

Students in the study process receive support and feedback from academic staff. The assessment criteria for grades have been published in advance in the course descriptions in the university information system, explained in the first lesson and are not changed during the semester. The evaluation gives students an opportunity to demonstrate to what extent they have achieved the expected learning outcomes.

In keeping with the principles of student-centre education, student mobility is promoted (recognition of study results for students in Erasmus+ exchange programmes, exchange programme with Merseburg Technical University, other study programmes in Latvia), and students are involved in research initiated by academic staff and social activities in society, thereby gaining significant experience through the practice of what was acquired in studies. In implementing internal quality assurance policies, study programmes are implemented in such a way that students are encouraged to be actively involved in the development of the study process. There are procedures for submitting and addressing student proposals, examining student appeals. The results of student surveys are assessed and taken into account in the development of the study process. Students are pleased to make their own recommendations for improving study programmes and the process of negotiating with doctors, programme directors.

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).

The objectives of the ABSPP practice courses “Academic Practice” and “Academic Practice II” are the acquisition of physicist professional skills and skills in real professional activity, in an environment relevant to practice objectives.

The tasks of the practice are:

1. familiarity with the work organisation at the specific workplace;
2. training the skills to work in a team;
3. apply the skills acquired in studies to the challenges of modern physics in academia, research, education or applied physics applications;
4. train problem-solving skills, communication skills, IT skills;
5. develop expertise related to analytical and research skills as well as ethical action.

Practice tasks are important for achieving the results of all ABSPP studies, as well as promoting students' familiarity and integration in students' potential future workplace.

The study load of one practice course is 2 CP or 80 hours. ABSPP's academic practice courses are offered in the 4th and 5th semesters, in the 4th semester as a limited elective course. Practice courses allow students to familiarise themselves with the possible research field for bachelor's thesis work and future workplace. At the beginning of practice, the UL practice manager presents students with course regulations and introduces the places of practice offered by UL. On the *ej.uz/LUFN-prakse* (Latvian only) UL site, the practice manager has gathered information on available places of practice. In addition, a student can offer his own choice of place of practice, such as other institute of the physics field or school. In the beginning of 2022, the list of suggested places of practice includes companies such as Latvenergo, SIA KEPP EU, SIA CEnOS, SIA *Baltic Scientific Instruments*, SIA *LightGuideOptics International*, SIA *Lightspace Technlogies*, SIA *Zippy Vission*, as well as 12 institutes, laboratories, or other scientific institutions. Companies and institutes have either signed a practice cooperation agreement, or a tri-party agreement is signed if the student chooses a place of practice without a cooperation agreement. The offer of places of practice significantly exceeds the number of students available. At the end of the practice course, the student compiles in the practice report a description of the works performed. As a result of a typical, successful collaboration, a student works on a bachelor's thesis at the place of practice.

The inclusion of practice courses in the compulsory and limited elective part of the programme, as well as the involvement of scientific institutes, leads to 90% of the Bachelor graduates having professional work experience in the field of physics.

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.

For spring 2021, the topics for final thesis developed in ABSPP are given in Table 4.2.6.1.

Table 4.2.6.1

Topics for Bachelor's works defended in ABSPP 2021

Bachelor's thesis tittle	Job development site
Raman spectroscopy of diamond crystals synthesized by CVD method	ISSP
Study and Optimization of Magnetic Field Distribution of Periodically Placed Permament Magnets	Institute of Physics
Luminescent properties of zinc oxide	ISSP
Research of actual efficiency of solar panels in Latvian climate conditions	SMI
Optical studies of diphenyl sulfone and benzophenone derivatives for organic light-emitting diodes of third-generation	ISSP

Fabrication and application of WGM resonators for frequency comb generation	IAPS
Influence of correlated disorder on localization phenomena in one-dimensional tight-binding models	Theoretical physics department, NTG
Asteroid regolith porosity approximation precision, comparing remote sensing methods and sample return missions.	Astronomy Institute
Synthesis of gallium oxide based core-shell nanowire heterostructures	ISSP
MHT-X: Offline Multiple Hypothesis Tracking Optimized With Algorithm X	SMI
Development of SU-8 waveguide optical gas sensor with optical lithography technique and characterization of its optical properties	ISSP
Magnetic droplets as a tool for characterizing temperature dependence of phase separated magnetic fluid properties	Theoretical physics department, MMML
Dynamic mode decomposition of magnetohydrodynamic bubble chain flow in a rectangular vessel	SMI
Electrocaloric effect of perovskite structure ferroelectrics at large electric fields	ISSP

The topics of the 2021 bachelor's theses are in line with the research directions of the institutes involved in the implementation of the ABSPP, demonstrating the programme's close links with potential employers of programme’s graduates, the programme's openness to cooperation with employers and employers' interest in attracting ABSPF students, proving the usefulness of the skills and knowledge acquired in the programme for the labour market.

2019 is the latest year in which all bachelors' theses (21) are available in an electronic catalogue (https://kopkatalogs.lv/, English version available after Guest Login (VIESIS) and choice of language → English. To view Theses tittles and Abstracts chooses Databases → Library of the University of Latvia → Student's theses → Basic Search → Bakalaura (Fizika) in the search field Word from Notes. Full-text online version is available by authorization with LUIS username and password). This year is well suited for deeper analysis as it is last year before Covid-19 restrictions. That year, 5 of the theses have been written at the UL Institute of Solid State Physics (ISSP), 4 at the UL Institute of Chemical Physics, 3 at the FPMO Laser Centre, 3 at UL Institute of Atomic Physics and Spectroscopy (IAPS), 3 at FPMO Numeric Modelling Institute (SMI), 2 at the Institute of Physics, 1 at the Astronomy Institute of the University of Latvia. The advisers were 18 doctors of physics or chemistry, and 4 masters of physics. According to the information available at the time of the thesis submission, the results of the Bachelor's thesis were published in 7 international reviewed publications and 35 conferences at different levels, most of which were international.

Similarly, 22 topics of bachelor's theses have been submitted in 2018. Out of them 5 have been written at the UL Institute of Solid State Physics, 2 thesis at UL Institute of Atomic Physics and Spectroscopy, 4 thesis at UL Institute of Chemical Physics, 4 works at FPMO Laser Centre and Magnetic Soft Materials Laboratory, 3 at UL Laboratory for Mathematical Modelling of Environmental and Technological Processes, 2 at UL Institute of Physics and 2 at UL Astronomy Institute.

The final thesis is evaluated by the defence commission in the 10-point grade system. The final grade consists of the following components:

- report by the author of the thesis (ability to present the study carried out, to formulate

conclusions, to indicate further possible directions of the study);
- answers to the questions of the commission and the ability to discuss the topic;
- quality of work.

At the time of the thesis defence, it is evaluated:

- if the student (according to the study plan) has timely started work with the research adviser and has devoted sufficient time to the work;
- if scientific and valuable results have been obtained independently;
- if the quality of written part obeys the requirements (minor technical shortcomings are allowed);
- if during the presentation and discussion, the student shows a good understanding of the topic and the knowledge of physics.

As a result, during the defence it will be assessed whether the student has acquired the knowledge and skills intended in the results of the ABSPP, with particular emphasis on the competence intended in the programme to carry out an independent research.

In the period between 2013 and 2021, the annual average score for final theses fluctuate around the long-term average of 8 (very well). The distribution of grades is shown in Figure 4.2.6.1. The distribution of grades is pretty invariable over the time.

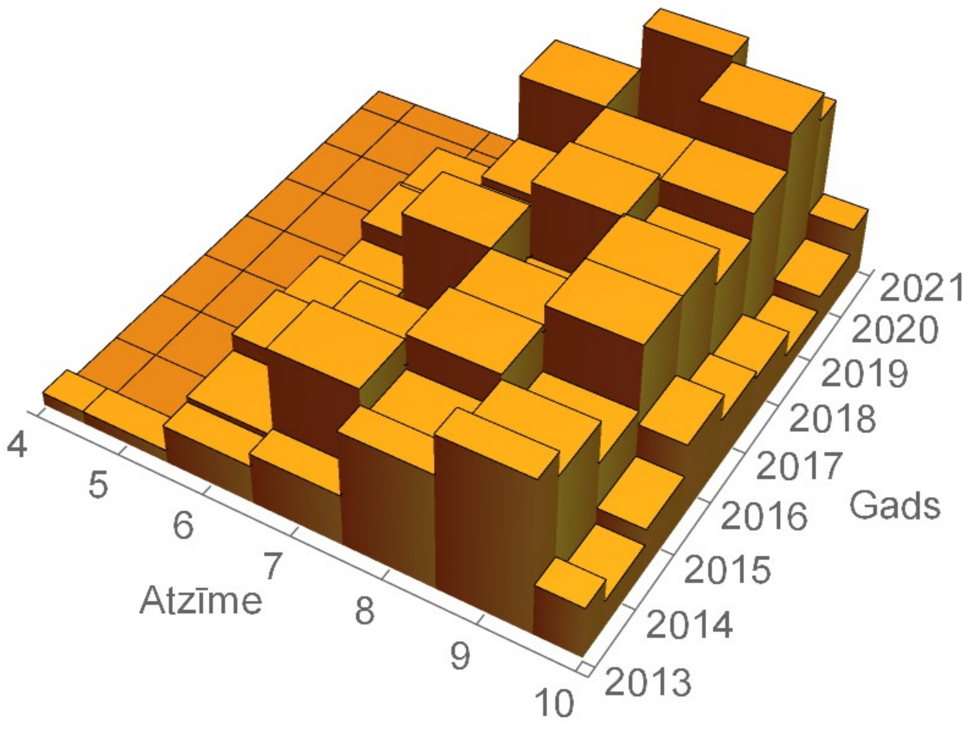


Figure 4.2.6.1. Distribution of the final examination grades from 2013 to 2021 (gads - year, atzīme - grade)

Students approach the final theses with great responsibility, and the final scores are high. Approximately 20% of the thesis receive the highest score of 10 (excellent), since all the requirements of the bachelor's theses work have been met, as well as the theses and the presentations have signs of excellence presenting and justifiably defending scientifically significant results.

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 implementation of the ABSPP in UL is the responsibility of the programme director, who is under the direct authority of the Department of Physics. At FPMO support for the planning and implementation of the study process is provided by:

- the senior methodologist, common to all FPMO study programmes, administers student affairs, provides students with services that are the responsibility of the faculty;
- the specific study issues of the Department of Physics are settled by the methodologist;
- the matters of the record keeping of the Department of Physics are taken by the senior secretary.

Class scheduling is performed by the Department of Physics methodologist.

Teaching staff from the Faculty of Physics, Mathematics and Optometry (FPMO), Faculty of Biology, Faculty of Chemistry, Faculty of Geography and Earth Sciences are involved in the implementation of ABSPP courses. Teaching of the program's mathematics courses is carried out by teaching staff from the FPMO Department of Mathematics, helping to achieve the outcome of the ABSPP program: Students apply mathematics to describe physical models and solve problems.

The teaching of physics courses is provided by the Department of Physics, composed of 5 Chairs (departments):

- Solid State and Material Physics;
- Experimental Physics;
- Electrodynamics and Continuum Mechanics;
- Theoretical Physics;
- Physics Education Research.

Department staff are involved in the teaching of ABSPP study courses as teaching staff within their own specialisation, the scientific staff of departments manage academic practices and guidance of bachelor's theses.

Teaching staff perform academic activities in the Chairs, while the scientific activities are carried out in the subdivisions of the faculty and in the institutes of the University of Latvia.

In addition to teaching, two FPMO research units are involved in the provision of laboratory equipment and support of laboratory work:

- FPMO Laser Centre,
- FPMO Numeric Modeling Institute,

as well as the institutes on Jelgava Street 3:

- The Institute of Physics,
- Atomic Physics and Spectroscopy Institute,

Jelgava Street 1

- UL Institute of Chemical Physics,

and others:

- UL Institute of Solid State Physics on Ķengaraga Street 8, Riga,
- Ventspils International Radio Astronomy Centre, Irbene, Ventspils municipality.

The institutes offer ABSPP scientists in the areas of their specialisation for teaching courses, provide laboratory equipment, scientific staff of the Chairs manage academic practices and bachelor's theses. The Physics Education Research Department facilitates the transfer of physics education studies to the study process by conducting research, organising seminars and lectures, helping to create teaching materials.

Strong Chairs in the Department of Physics and extensive cooperation with the institutes help to involve in the teaching of study courses specialists in the relevant physics sub-fields and to offer courses to students in the scientific field of specialisation of institutes. The institutes assist the involvement of the physics specialists as advisors of practice work and laboratory work, and help to involve the students into research, and the students achieve the learning goals of ABSPP:

- are familiar with basic parts of physics, including classical mechanics, electromagnetism, quantum physics, thermodynamics, statistical physics, waves, optics, structure of matter, atomic structure, a qualitative understanding of the development of modern physics;
- know in depth one of the individual fields of physics, such as atomic physics, spectroscopy, material physics, astronomy, and their highlights;
- formulate and apply physical models, correctly use the terms of physics, perform justified approximation, estimate the order of magnitude for relevant physical quantities;
- plan and carry out experiments, acquire experimental data independently and process the results of experiments, analyse the data obtained, assess measurement errors, compare the results obtained with theoretical models;
- carry out independent research, independently seek and collect information using scientific literature, organise time in respect of deadlines, collaborate constructively with colleagues, identify the limits of their knowledge, respect academic honesty.

The laboratories for general physics and electronics courses are provided by:

- UL FPMO Physics Practicum laboratories, Room 503, Room 505-507.

The Physics Practicum supports the ABSPP laboratory work for general physics courses (“Physics I”, “Physics II” and “Physical III”) and specialisation courses (“Electronic Measurement Technologies”, “Autonomous Experimental Systems”, “Computer Networks Laboratory”, “Spectral instrumentation and measurements”, etc.). Each practice room is tailored for groups of up to 16 students. These include 200 m^2 specially equipped rooms with laboratory tables fitted with auxiliary shelves and communication equipment, dimming option for optics labs, air extraction, soldering stations, a separate room for acoustics and very light-sensitive labs, gas supply pipes for thermodynamics labs. The technical support is diverse and recently modernised (EUR 150 000 invested over the last 3 years), includes suitable data collection systems for physical measurement (PASCO, *National Instrument*), hardware, various sensors, components and devices that can be combined, as well as specialised lab sets. In general physics courses, more than 20 laboratory works are available, most of which can be used at the same time by all students, allowing efficient teacher work. The teachers are assisted by 4 experienced technicians of Physics Practicum who have adequate education and skills. Their task is to prepare working space, and provide technical support during the laboratory work. The presence of the laboratory technician is ensured throughout the whole duration of general physics laboratory work.

In addition, in the general physics course “Physics III”, laboratory work is carried out at

- Chemical Physics Institute Radio Chemistry Laboratory, Jelgava Street 1.

General physics courses are provided with experimental equipment for physical experiments in mechanics, thermodynamics, electricity and optics.

- demonstration room (502).

More than 200 demonstrations in mechanics, thermodynamics, electricity and optics are provided with experimental equipment. The maintenance, development, preparation for demonstration at a lecture, including, demonstration if necessary, is performed by a Physics Practicum assistant with appropriate education and skills. A lecturer selects specific demonstrations from a list created by the staff of the demonstration room, according to the course plan and progress. Over EUR 10 000 has been invested in the renewal and development of demonstrations over the last 2 years.

The 501 auditorium is used for general physics courses, where blackboards, projector, video recording capability are available and used, additional monitor screen for lecturer, sound amplification through a microphone and acoustic system, room blackout, room ventilation, and measurement of CO2 gas concentrations. Teaching theoretical courses on Jelgava Street 3 takes place in auditoriums on the 1st and 2nd floors, using blackboards, projectors and recording capabilities available to auditoriums. Writing tests in larger student groups can take place in 103/104 combined auditoriums (98 places) and 105/106 combined auditoriums (134 seats).

For the purposes of the ABSPP study course “Machine Learning for Physicists”, “Scientific programming for physicists”, “Computers and programming”, “Statistical Analysis of Experimental Data”, “Numeric methods”, “Planning, implementation and control of an experiment”, “Introduction to statistical physics” computer classes in rooms 206 and 208 are in use, respectively providing 18. and 30 computer workspaces with the necessary software and IT support from UL IT professionals on the second floor of Jelgava Street 3. In addition, one can use computers from a self-service machine that offers to retrieve and use any of 36 portable computers at any time. All computers are equipped with licensed programs required for students of the UL Physics, Maths and Optometry faculty for carrying out their own work and are equipped with identical computer software such as *Wolfram Mathematica*, *MatLab*. If necessary, computer licenses are purchased for courses, such as *Labview* (an environment with graphical programming that is an industry standard for managing data recording, processing, automation and experiments — in the study course “Electronic Measurement Technologies”), *Autodesk Inventor*, in the study course “Planning, implementatin and control of an experiment”. 24 portable computers are available for laboratory work. A wireless Internet *Eduroam* network is available on campus premises. IT resources are sufficient to achieve the learning outcome of ABSPP studies: students apply programming languages and prepared software packages to address physical problems, processing, describing and communicating results.

All courses have an e-learning environment that uses learning management system MOODLE. The e-study environment is used to communicate easily with the students of each course of ABSPP. Training materials are placed in the e-learning environment of courses, such as:

- course notes,
- lecture presentations,
- summative or formative tests,
- original video materials, records of previous or current year lectures,
- descriptions of laboratory works,
- communication forums,
- exam questions, written quizes or exam assignments of previous years.

To support the introduction of student-centred methods, two sets of voting pads with the appropriate software are available.

For the promotion of international mobility of students, the UL FPMO has concluded Erasmus+ Mobility Agreements (Annex 2), and the faculty has annual student information activities on Erasmus+ exchange programmes. In cooperation with the Merseburg Technical High School in Germany, an annual exchange of the second year students of ABSPP (up to 10 students from each side) has been established for the laboratory works on experimental facilities not available in both universities.

The library contains mandatory literature for all courses in ABSPP studies. The emergence of new books in the world and the development of new research areas necessitates renewal of study literature. Every year the teachers of ABSPP study courses are surveyed about the need to purchase new textbooks. Books available on e-book platforms are preferred. For the purchase of new books for the purposes of ABSPP, more than EUR 10 000 has been used from PD funds 2021./2022, including books for new courses prepared for accreditation and updating books of earlier courses.

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

For the purpose of providing the resources necessary for the implementation of the study programme ABSPP, University of Latvia uses:

1. a State budget grant from the Ministry of Education and Science determined for academic year 2021./2022 EUR 3097.21 for full-time studies;
2. the fees of studies, taking into account all the factors referred to in the heading “Financial collateral” specified for the academic year 2021./2022: for full-time studies, EUR 2000 per year

In the light of the above, the overall budget for the study programme is expected to be EUR 313721,00 per year, the transcript is shown in Table 4.3.3.1

Table 4.3.3.1

Budget of the study programme, EUR

Transcript of the budget	Budget, EUR
Tuition fee revenue	4000
State budget grant	309721
Total	313721

Program income

Table 4.3.3.2

Estimated annual income of the programme, EUR

Type of study	Number of students	Study fees/State grant	Total income
Full-time (budget)	100	3097,21	309721
Full-time (fee)	2	2000	4000
Total	**102**	**5097,21**	**313721**

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.

Full - time costs *of the programme*

For the calculation, ABSPP implementers use the student data of the academic year 2020/2021 - 101 students, the existing study programme plan, and the existing academic staff in the Full-time studies. In the light of the above, the full-time cost of the programme per student is estimated at EUR 2956 per year and the total cost of the programme at EUR 306 138 per annum. A more detailed percentage of costs is shown in Table 4.3.3.3.

Table 4.3.3.3

Percentage of costs in the study programme

Expenditure item	**% of total**
Teaching staff costs	42,51%
General staff	11,90%
Other costs	0,00%

Infrastructure expenditure	8,97%
Property and services	4,64%
Indirect costs	31,97%
TOTAL COSTS	**100%**

Figure 4.3.3.1 shows the cost of the study programme depending on the number of students and the comparison with the proposed study fee and the State budget grant.

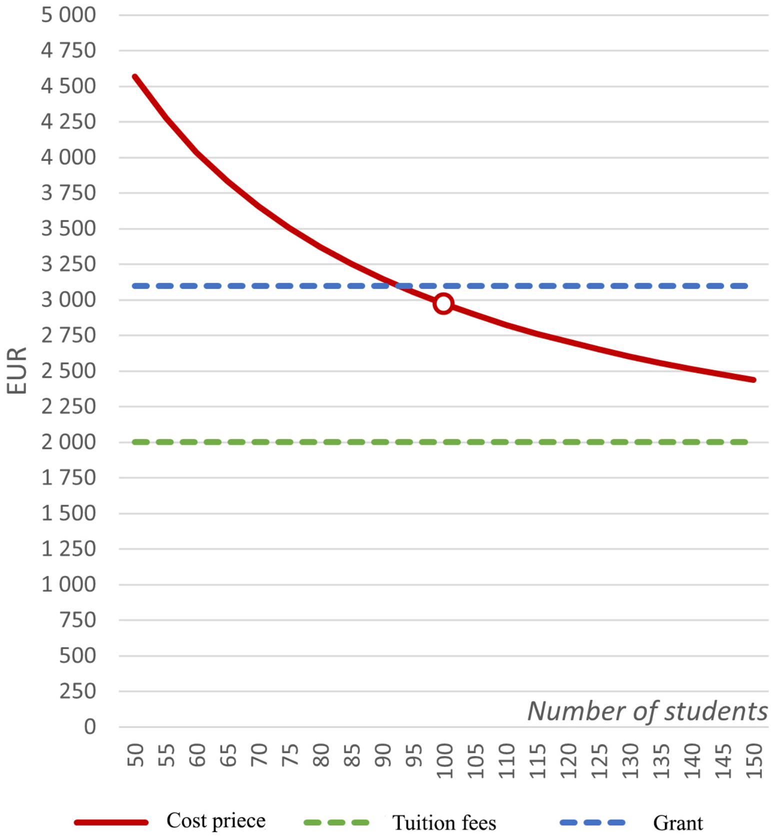


Figure 4.3.3.1. ABSPP cost from student number

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 paid students in the programme (all courses together) should be higher than 150 (red (cost) and the intersection of green (study fee) lines projected to x-axis). On the other hand, if there were only budget students in the programme, the number should reach 94 students.

Summary of revenue and costs of the programme

In Table 4.3.3.4. the revenue of the programme is aggregated, depending on the number of studies, State grants and study fees, and the expenditure of the programme at such a number of students.

Table 4.3.3.4

Outcome of the programme

Type of study	Number of students	Study fees/State grant	**Total income**	**Total cost**
Full-time (budget)	100	3097,21	**309721**	**300135**
Full-time (fee)	2	2000	4000	6002,68
Total	**102**		**313721**	**306137,7**

The data presented in the table clearly show that the University of Latvia has sufficient resources to implement the study programme and ensure its further development. 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.

The implementation of the ABSPP is intended involving 40 teaching staff (see Table 4.1.1).

Table 4.4.1.1

List of teaching staff involved in the ABSPP

No.	Last Name Name	Degree	Position	Study Course Title
1.	Ancāne Iveta	*Dr. Chem.*	doc.	Chemistry
2.	Auziņš Mārcis	*Dr. habil. phys.*	Prof.	Quantum physics Atoms in External Fields
3.	Barinovs Ģirts	*Dr. Chem.*	asoc.prof.	Bachelor Thesis in Physics Physics I Introduction to Nanoscience

4.	Cēbers Andrejs	*Dr. habil. phys.*	Prof.	Physics of Computation Introduction in theoretical physics
5.	Cīmurs Jānis	*Dr. Phys.*	doc.	Introduction to mathematics for physicists Soft Matter Physics
6.	Dobkeviča Linda	*Dr. Chem.*	researcher	Environment protection
7.	Driķis Ivars	*Dr. Phys.*	doc.	Autonomous experimental systems
8.	Dudareva Inese	*Dr. Phys.*	doc.	Teaching and Learning Methodology of Physics I Teaching and Learning Methodology of Physics II Teaching and Learning Methodology of Astronomy
9.	Ferbers Ruvins	*Dr. habil. phys.*	Prof.	Atomic and Molecular Spectroscopy Physics III
10.	Goldšteins Linards	*Dr. Phys.*	doc.	An introduction to fluid mechanics
11.	Grūbe Jurģis	*Dr. Phys.*	doc.	Methods and techniques for physical measurements Basics of the Solid State
12.	Guļāns Andris	*Dr. Sc. ing.*	leading researcher	Numerical methods
13.	Jēkabsons Normunds	*Dr. Phil.*	leading researcher	Introduction to Solid Mechanics
14.	Kalvāns Juris	*Dr. Phys.*	univ. teacher (Dr.) /leading researcher	Introduction to radio astronomy Solar System Bodies
15.	Kaščejevs Vjačeslavs	*Dr. Phys.*	Prof.	Introduction to classical mechanics Standard Model of Elementary Particles
16.	Kitenbergs Guntars	*Dr. Phys.*	doc.	Image processing in physics
17.	Knoks Ainārs	*Mg. phys.*	univ. teacher /UL ISSP Researcher	Materials in Nature and Technology
18.	Langins Aigars	*Mg. phys.*	research assistant	Machine Learning for Physicists
19.	Lācis Sandris	*Dr. Phys.*	asoc.prof.	Tensor analysis
20.	Mozers Artūrs	*Dr. Phys.*	doc.	Statistical Analysis of Experimental Data

21.	Pajuste Elīna	*Dr. Chem.*	asoc.prof.	Physics III
22.	Parasiga-Parasiņa Kristīne	*Mg. chem.*	lect.	Civil protection
23.	Paulins Paulis	*Dr. Phys.*	doc.	History of Physics and Technique
24.	Priede Jānis	*Dr. Phys.*	asoc.guest prof.	Introduction to electrodynamics
25.	Prikulis Juris	*Dr. Phys.*	doc.	Electronic Measurement Technologies Computer networks laboratory
26.	Pudža Inga	*Mg. phys.*	acting lecturer	Large-scale research infrastructure
27.	Puķītis Kārlis	*Mg. phys.*	research assistant	Astronomy and astrophysics
28.	Siliņš Andrejs	*Dr. Habil. phys.*	univ. teacher (Dr.)/em. Prof. & UL ISSP leading researcher	Physics of non-crystalline substances
29.	Sīle Tija	*Dr. Phys.*	doc.	Computers and programming Scientific programming for physicists
30.	Smirnovs Sergejs	*Dr. math.*	doc.	Linear algebra and analytical geometry I Linear algebra and analytical geometry II Differential equations
31.	Spīgulis Jānis	*Dr. habil. phys.*	Prof.	Laser physics
32.	Strautiņš Uldis	*Dr. math.*	Prof.	Methods of mathematical physics
33.	Šarakovskis Anatolijs	*Dr. Phys.*	asoc.prof.	Physics II
34.	Šmits Jānis	*Dr. Phys.*	doc.	Spectral instrumentation and measurements
35.	Tārs Kaspars	*Dr. Biol.*	Prof.	Introduction to molecular and cell biology
36.	Timošenko Jānis	*Dr. Phys.*	guest doc.	Introduction to statistical physics
37.	Uļjane Ingrīda	*Dr. math.*	asoc.prof.	Mathematical analysis I Mathematical analysis II Mathematical analysis III

38.	Vembris Aivars	*Dr. Phys.*	doc.	Methods of thin film preparation and patterning Planning, implementation and control of an experiment
39.	Virbulis Jānis	*Dr. Phys.*	leading researcher	Physics and engineering physics seminar Academic practice Academic practice II
40.	Zāģeris Ģirts	*Mg. phys.*	acting lecturer	Numerical methods for differential equations

In the compulsory and restricted elective part of the program, the study courses are run by 7 professors, 5 associate professors, 14 docents, 1 associate guest professor, 1 guest docent, all with a PhD degree. Study courses are also run by 1 lecturer without a PhD degree. 5 of the other teaching staff are PhD students. In addition 2 doctoral students teach practice tutorials in a General Physics Course (in the "Introduction to classical mechanics", "Introduction to statistical physics", "Introduction to electrodynamics" study courses) and in the teaching of laboratory works (in the study course “Physical II”).

The *Law of Higher Education Institutions* (Section 55, Paragraph one, Paragraph three) demands that not less than five professors and associate professors who have been elected to academic positions in the corresponding university participate in the implementation of the compulsory part of academic programmes and the restricted elective part. 12 professors and associate professors participate in the implementation of the compulsory part of the ABSPP and the restricted elective part of the programme, meeting the requirement of the Law on Higher Education.

The knowledge of the official language of the academic staff employed in the study programme comply with *Regulations Regarding the Extent of the Knowledge of the Official Language, the Procedures for Examining the Proficiency in the Official Language and the State Fee for Examining the Proficiency in the Official Language* (Cabinet Regulation No 733, 07.07.2009), which allows the teaching of study courses in the official language.

As can be seen from the CV and the list of publications, a larger proportion of teaching staff are active scientists whose engagement in the implementation of study courses allows for the acquisition of quality knowledge, skills, and competence in areas of physics and interdisciplinary fields, which are well developed in Latvia with international competitiveness. Recruitment of younger teaching staff ensures renewal of the teaching staff. The whole of ABSPP teaching staff combines pedagogical and research expertise at a high level, which allows competitive specialising in specific directions. Graduate employment confirms competitiveness in both the local and international labour markets.

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.

Since the previous accreditation report, the number of lecturers has increased from 26 to 40. The new lecturers, who are active in research, teach courses according to their scientific specialisation and develop course content based on practical applications and scientific activities, thus directly linking the content of the courses to the development trends in the field and thus contributing to the improvement of the quality of studies. The previous accreditation report stated that the programme has 5 professors, 4 associate professors, 4 docents, 4 lecturers and 9 non-elected lecturers. Looking at the number of teaching staff in the Physics Department, the number of docents has increased by 10 and the number of lecturers has decreased by 3 during the reporting period. The increase in the number of docents is mainly due to the decrease in the number of lecturers, the increase in the qualifications of lecturers and the entry of new lecturers into the programme, which reduces the teaching load of existing lecturers and increases the time available for scientific work and allows to increase the scientific qualifications of lecturers necessary for quality teaching work. The involvement of new lecturers is positively correlated with the introduction of student-centred teaching methods in lecturers' courses, which increases student study performance as known from the literature (e.g., Freeman, Scott, et al. "Active learning increases student performance in science, engineering, and mathematics." Proceedings of the national academy of sciences 111.23 (2014): 8410-8415). In a number of cases, lecturers have been replaced as a result of course quality improvement measures following student course surveys when the outcomes of course improvement plans have not been achieved. For example, in the courses Introduction to Molecular and Cell Biology and Differential Equations, the quality of learning has improved after the change of lecturer according to student surveys. The previous accreditation report stated that the average age of academic and scientific staff is 51 years. The average age of the academic and scientific staff mentioned in the 2022 accreditation report is 46 years, indicating that there is a renewal of the teaching staff, which is indispensable for the sustainability of the programme and the transferability of accumulated knowledge to ensure the quality of the studies.

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).

Teaching staff cooperation for the development of ABSPP takes place at four levels:

- personal contacts,
- inter-Chair cooperation (meetings of the Chairs),
- cooperation at PD level (meetings of the PD Board),
- inter-institutional cooperation, organised by the director of the study programme and by the head of the PD.

In addition, the exchange of experience between teaching staff is provided by an annual process of lecture observations (hospitations) as an opportunity for mutual enrichment.

The main organiser of the cooperation is the director of the study programme (responsible for the content), with the support of the Head of PD (planned financial resources).

The Physics Education Research Chair, twice in a semester, organises activities for the exchange of teaching experience, also inviting external teachers and informing of the insights and research in the field of Physical Education Research.

The content of the compulsory part (A) of the ABSPP content and the content of restricted elective part (B) is developed as a result of consultations and discussions within the PD Board, involving all PD staff in discussions, evaluating student surveys and the results of discussions with students, ensuring that the content of the elective part is consistent with the content of the compulsory part study courses.

The content of restricted elective part (B) is mainly the responsibility of the Chairs in the corresponding field of the specialization, developing or replacing the content. The Chairs also cooperate with the UL scientific institutes, leading to the development of offer of new study courses by institute specialists, often using institute infrastructure for laboratory work. The responsibility of the Chairs is preparation of a set of study courses for training in the area of specialization and the content linking of these courses, ensuring achievement of the study outcomes important for specialisation.

Following the formation of the FS PMSMS Council, the Physics Studies Programme Council, which carried out the role of control of the content of study courses and content linkage, lost its role. At present, the Council of FS PMSMS has entrusted the functions of controlling the content of study courses to the PD Board. The PD Board examines the content of all new and substantially altered study courses.

The ratio between the number of students and teaching staff can be described in a variety of ways, particularly in the bachelor's programme, where teaching staff are involved in the training of students from different programmes, and students also take a course in other UL faculty and PD departments. In total, 39 teaching staff are teaching, not including the teaching staff of laboratory work, practical training, company and institute representatives involved in a few classes, practice managers and bachelor's thesis managers. In 2021, 101 students studied in the programme, as a result, the ratio between teaching staff and students is that is sufficient to achieve the outcomes of the study programme.

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	annex_ABSPF_Sample of the diploma and its supplement.pdf	piel_ABSPF_Diploma un tā pielikuma paraugs.pdf
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)	annex_ABSPF_Opinion of the Council of Higher Education.docx	piel_ABSPF_AIP_atzinums.docx
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	4.5.annex_ABSPF_Statistics on the students in the reporting period.docx	4.5.piel_ABSPF_Statistikas dati par studējošajiem.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	4.6.annex_ABSPF_Compliance with the study programme with the State Education Standard.docx	4.6.piel_ABSPF_Atbilstība 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	4.8.annex_ABSPF_ Mapping of the study courses.xlsx	4.8.piel_ABSPF_Studiju kursu kartējums.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	4.9.annex_ABSPF_The curriculum of the study programme.docx	4.9.piel_ABSPF_Studiju programmas plāns.docx
Descriptions of the study courses/ modules	4.10.annex_ABSPF_Descriptions of the study courses.docx	4.10.piel_ABSPF_Studiju kursu apraksti.docx
Description of the organisation of the internship of the students (if applicable)	4.11.annex_ABSPF_Description of the organisation of the internship of the students.docx	4.11.piel_ABSPF_Prakses nolikums.docx
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)	annex_ABSPF_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher Edu.docx	piel_ABSPF_Apliecinājums par akadēmiskā personāla atbilstību Augstskolu likuma 55. panta 1.d. 3.p.pdf

Mathematician Statistician (42460)

Study field	*Physics, Material Science, Mathematics, and Statistics*
ProcedureStudyProgram.Name	*Mathematician Statistician*
Education classification code	*42460*
Type of the study programme	*Professional bachelor study programme*
Name of the study programme director	*Inese*
Surname of the study programme director	*Bula*
E-mail of the study programme director	*inese.bula@lu.lv*
Title of the study programme director	*profesore, Dr. math.*
Phone of the study programme director	*26470965*
Goal of the study programme	*Prepare qualified mathematicians and statisticians for Latvian State institutions, as well as private sector companies, taking into account that their knowledge, skills and competence correspond to the profession "Statistics Mathematician" referred to in the classification of the professions of the Republic of Latvia (2120 02).*
Tasks of the study programme	*• To provide an opportunity to obtain the sixth level professional qualification of a statistical mathematician and a professional bachelor's degree in statistical mathematics by acquiring a professional bachelor's program and successfully passing state examinations. • To develop mathematical thinking in students, to promote efforts to expand their knowledge independently and to strengthen practical skills. • To develop the skills of students for conducting independent scientific research and practical application of their results. • To develop high professional ethics in students and offer basic social skills in communication, independent and team work. • To ensure a stable and safe study process by implementing the content of the study program.*

Results of the study programme	*Knowledge: 1. demonstrate basic knowledge in the field of mathematics and information technology, demonstrate the understanding of key concepts and legal relationships in the field of mathematics science; 2. demonstrate specialised knowledge in mathematics, statistics and mathematical modelling in accordance with the knowledge required for the profession "Statistics Mathematician"; 3. demonstrate the underpinnings of economic theory, organisation of business processes, national legal processes, national civil protection and environmental protection issues. Skills: 4. mathematically formulate statistical problems and task guidelines and develop appropriate mathematical and statistical models; 5. obtain, select, process and analyse information, mathematically export and justify the findings, present the results obtained both orally, in writing, in the official language and in one foreign language, correctly use the terminology of the sector; 6. working with the information technologies needed by the statistical mathematician is the necessary digital literacy. Competences: 7. focus on key mathematics and statistical models and methods, advise industry, identify the boundaries of their knowledge, plan and implement their qualifications; 8. plan and carry out sector-specific theoretical and practical studies, analyse their results, use them competently, address both the relevant challenges of the mathematics sector and the problems of social and natural sciences, explain and interpret the results obtained, take decisions; 9. carry out independent scientific work, participate in the development of the professional field of statistical mathematics, recognise and respect the principles of academic integrity, understand professional ethics, assess the impact of their professional activities on the environment and society.*
Final examination upon the completion of the study programme	*Bachelor's thesis*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary school education*

Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Professional bachelor's degree in Statistics Mathematics*
Qualification to be obtained (in english)	*Statistics Mathematician*

Places of implementation

Place name	City	Address
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.

The FS PMSMS was accredited on 29 May 2013, including the second level vocational higher education study programme "Mathematician Statistician" with a duration of studies of 4.5 years or 9 semesters and 180 CP. On 13 December of the same year, the IZM Study Accreditation Commission adopted a decision (Decision No 270, 13.12.2013) which envisaged a change in the title of the study programme to the professional bachelor's degree programme "Mathematician Statistician" (PBSPMS), a change in the qualifications to be granted to "Statistics mathematician" and a change of degrees to "professional bachelor's degree in statistics mathematics", as well as changes in the duration of the study programme from 4,5 years to 4 years.

Since the previous accreditation, the purpose of the PBSPMS study programme has not been changed, but the tasks and study results have been specified and formulated in accordance with the level of the Latvian Qualifications Framework (LKI) for the description of the relevant knowledge, skills and competences, as determined by *the Regulations on the classification of Latvian education* (Cabinet Regulations No. 322, 13.06.2017) (available only in Latvian language).

Since the entry into force of Cabinet Regulation No 633 of 27 September 2016 ("Procedures for the development of professional standards, professional qualifications requirements (if the profession is not approved by professional standards) and the structure of sectoral qualifications") (available only in Latvian language), the professional standard "Statistics mathematician" has lost power and urgency. This has been the basis for developing a new standard. On June 8 and October 12, 2022, at the meetings of the Tripartite Cooperation in Vocational Education and Employment (PINTSA), a new professional standard "Senior Data Analysis Specialist" was agreed upon with two professional specializations "Statistics Mathematician" and "Financial Statistician". PBSPMS wants to maintain the possibility of awarding the qualification "Statistics Mathematician" (profession code 2120 02) based on the common professional standard, which defines the basic tasks and responsibilities of professional activity for both professional specializations. The compliance of the qualification to be obtained by PBSPMS with the requirements of the profession standard is added in Appendix 3.7.

Since the previous accreditation period, the place of implementation of the study programme has changed. By January 2018, the PBSPM was implemented in the Zeļļu Street 25 (numbering changed, above 8), Riga. Beginning with the spring semester of 2018, studies take place at the UL House of Science, Jelgava Street 3, Riga.

The PBSPMS study plan submitted for accreditation has changed the amount of study courses in the mandatory part A and part B of the restricted choice, as shown in Table 3.1.1.1. The full list of changes to study courses is given in Table 3.1.1.2.

Table 3.1.1.1

Changes in PBSPMS study courses in Parts A and B

Study courses	2013./2014.	2023./2024.
Part A, Compulsory part	108	114
General education courses	20	20
Field-specific theoretical foundation courses and information technology courses	36	38
Field-specific professional specialization courses	14	24
Practice	26	20
State examination	12	12
Part B, Restricted elective courses	46	40
Part C, Elective courses	6	6
Total	**160**	**160**

By Cabinet Regulation No 512 (26.08.2014) *Provisions regarding the national standard for second-level professional higher education* (available only in Latvian language) there should be at least 20 CP and students should develop and defend 3 course works, which explains a decrease in practice from 26 to 20 CP and an increase in the volume of field-specific professional specialization courses by 6 CP (three courses, each 2 CP). As well as the list of field-specific professional specialization courses, following the recommendations of employers, the study course "Actuarial Risk Management" on 2 CP and the increased level of the "Random Processes" study course at 2 CP, so that overall the field-specific professional specialization courses increased by 10 CP. The field-specific theoretical foundation courses and information technology courses have increased by 2 CP as the study course "Mathematical and Statistical Software Packages" has been transferred from Part B to this section in order to strengthen the size and relevance of information technology courses.

Table 3.1.1.2

Comparison of PBSPMS study courses in 2013/2014 and 2023./2024.

2013/2014			**2023/2024**
Course Name	CP	CP	Course Name
Part A (Compulsory part)	**108**	**114**	**Part A (Compulsory part)**
General education courses	**20**	**20**	**General education courses**

Basics of Economic Theory	4	4	Basics of Economic Theory
Introduction to Latvian Legal System	4	4	Introduction to Latvian Legal System
Oral and written communication of English	4	4	Spoken and Written Communication in English for Mathematicians
Entrepreneurship	4	4	Entrepreneurship
Introduction to Philosophy I	2		
Psychology of Communication	2		
		2	Database Systems Fundamentals
		1	Environment Protection
		1	Civil Protection
Field-specific theoretical foundation courses and information technology courses	**36**	**38**	**Field-specific theoretical foundation courses and information technology courses**
Algebra I	5	5	Algebra I
Algebra IIS	2	2	Algebra IIS

Analytic Geometry	3	3	Analytic Geometry
Mathematical Analysis I	6	6	Mathematical Analysis I
Mathematical Analysis II	6	6	Mathematical Analysis II
Mathematical Analysis III	4	4	Mathematical Analysis III
Elements of Mathematical Logic and Set Theory	2	2	Introduction to Mathematics Studies
Programming and Computers I	4	4	Programming and Computers I
Programming and Computers II	4	4	Programming and Computers II
previously in Part B		2	Mathematical and Statistical Software Packages
Field-specific professional specialization courses	**14**	**24**	**Field-specific professional specialization courses**
Random Processes	2	4	Random Processes
Time Series Analysis	4	4	Time Series Analysis
Mathematical Statistics	4	4	Mathematical Statistics
Probability Theory	4	4	Probability Theory

		2	Course Work for the Programme Mathematician Statistician (*course work*)
		2	Course Work Using the Package R (*course work*)
		2	Introductory Course Working with Data (*course work*)
		2	Actuarial Risk Management
Practice	**26**	**20**	**Practice**
Basic Practice for Mathematician Statistician	20	20	Basic Practice for Mathematician Statistician
Research Practice for Mathematics Statistics	6		
State examination	**12**	**12**	**State examination**
Bachelor's Thesis of Mathematician Statistician	12	12	Bachelor's Thesis of Mathematician Statistician
Part B, Restricted elective courses, Field-specific professional specialization courses)	**46**	**40**	**Part B, Restricted elective courses, Field-specific professional specialization courses)**

Differential Equations I	4	4	Differential Equations I
Mathematical Foundations of Econometric Analysis	4	4	Mathematical Foundations of Econometric Analysis
Portfolio of Securities and their Management	4	2	Mathematical Models in Finance
Introduction in the Complex Analysis	2	2	Introduction in the Complex Analysis
Survey Sampling	4	4	Survey Sampling
Introduction to Algorithm Theory Or Classical Cryptography	2	2	Classical Cryptography
Mathematical Models of Queueing Theory	4	4	Mathematical Models of Queueing Theory
Operations Research	4	4	Operations Research
Methods of Optimization	4	4	Methods of Optimization
Numerical Methods I	2	4	Numerical Methods I
Numerical Methods II	2	4	Numerical Methods II

Strategic Game Theory	2	2	Strategic Game Theory
Mathematical and Statistical Software Packages	2		transferred to Part A
Mathematical Principles of Economic Models Or Microeconomics (Mathematical Foundations)	2		
Mathematical Analysis IV	4		
		4	Mathematical Models in Data Science
Part C, Elective courses	**6**	**6**	**Part C, Elective courses**
Free Courses	6	6	Free Courses
Part A	108	114	
General education courses	20	20	
Field-specific theoretical foundation courses and information technology courses	36	38	

Field-specific professional specialization courses	14	24
Practice	26	20
State examination	12	12
Part B	46	40
Part C	6	6
Total	**160**	**160**

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 relevance of the Bachelor's study programme “Mathematician Statistician” to the field of study has been determined since the development of the field of study, the study programmes related to mathematics and physics. The name of the study programme, the degree to be granted, the professional qualification, as well as the eligibility of the parameters of the study programme in the attainment of the results of the specified study programme are governed by external standards, i.e. the *Provisions regarding the national standard for second-level Professional higher education* (Cabinet Regulation No 512, 26.08.2014) (available only in Latvian language), Regulations regarding the classification of Latvian education (Cabinet Regulation No. 322, 13.06.2017) (available only in Latvian language) and the professional standard “Senior Data Analysis Specialist” (approved by meetings of Tripartite Cooperation in Vocational Education and Employment (PINTSA) 08.06.2022 and 12.10.2022), which includes the professional specialisation 2120 02 Statistics Mathematician. (Professional standard "Senior Data Analysis Specialist" was agreed upon with two professional specializations "Statistics Mathematician" and "Financial Statistician". PBSPMS wants to maintain the possibility of awarding the qualification "Statistics Mathematician" (profession code 2120 02) based on the common professional standard, which defines the basic tasks and responsibilities of professional activity for both professional specializations. The compliance of the qualification to be obtained by PBSPMS with the requirements of the profession standard is added in

Appendix 3.7.)

The name and professional qualification of the programme correspond with the professional standard “Senior Data Analysis Specialist” with a professional specialisation of 2120 02 “Statistical mathematician” for the professional title and qualification requirements (Annex 3.7).

Code 42460 of the professional bachelor's study programme “Mathematician Statistician” according to Cabinet Regulation No 322 (13.06.2017) *Regulations regarding the classification of Latvian education* (available only in Latvian language) means:

1) first digit 4 - the higher education study programme;

2) the first two digits in total 42 - second level vocational higher education (fifth level vocational qualification and professional bachelor's degree), the sixth qualification level of Latvian education, duration of studies in full-time studies is four years;

3) third digit 4 - the thematic group on education is “Natural sciences, mathematics and information technologies”;

4) the third and fourth digits in total 46 – the thematic area of education is “Mathematics and statistics”;

5) the third, fourth and fifth digits together 460 – the education programme group is “Mathematics and statistics”.

The scope of the study programme, the duration of the implementation, parts of the study programme and their size, mandatory content, professional qualifications, basic principles and procedures for evaluation and the scope of study practice, implementation principles, etc. are governed by *Provisions regarding the national standard for second-level professional higher education (Cabinet Regulation* No 512 (05.4.2014) (available only in Latvian language) and they comply with the requirements laid down in the rules. The choice of study courses, the content and extent of study courses, and the content of the practice according to the professional qualifications to be obtained have been determined in accordance with the professional standard “Senior Data Analysis Specialist” with a professional specialisation of 2120 02 Statistics Mathematician.

The content of the study programme consists of study courses of 160 CP (Cabinet Regulation No 512): general education courses, theoretical study courses, practice and state examinations are the main part of the programme (90 CP), 64 CP are professional specialisation courses in the sector and 6 CP are free choice courses. Study courses include teaching theoretical and applied mathematics courses, as well as IT courses to the extent that the profession “Statistics mathematician” functions can be carried out.

The aims, objectives and results of studies defined by the study programme are interlinked with the results of study courses, as demonstrated by the mapping carried out.

The **aims** of the PBSPMS is to prepare qualified mathematicians and statisticians for the Latvian State institutions, as well as private sector companies, taking into account that their knowledge, skills and competence correspond to the profession “Statistics mathematician” referred to in the classification of the professions of the Republic of Latvia (2120 02).

PBSPMS **objectives** are

• To provide an opportunity to obtain the sixth level professional qualification of a statistical mathematician and a professional bachelor's degree in statistical mathematics by acquiring a professional bachelor's program and successfully passing state examinations.
• To develop mathematical thinking in students, to promote efforts to expand their knowledge

independently and to strengthen practical skills.
• To develop the skills of students for conducting independent scientific research and practical application of their results.
• To develop high professional ethics in students and offer basic social skills in communication, independent and team work.
• To ensure a stable and safe study process by implementing the content of the study program.

Successfully learning at PBSPMS, the following **study results are** planned:

Knowledge:

- demonstrate basic knowledge in the field of mathematics and information technology, demonstrate the understanding of key concepts and legal relationships in the fied of mathematics science;
- demonstrate specialised knowledge in mathematics, statistics and mathematical modelling in accordance with the knowledge required for the profession "Statistics Mathematician";
- demonstrate the underpinnings of economic theory, organisation of business processes, national legal processes, national civil protection and environmental protection issues.

Skills:

- mathematically formulate statistical problems and task guidelines and develop appropriate mathematical and statistical models;
- obtain, select, process and analyse information, mathematically export and justify the findings, present the results obtained both orally, in writing, in the official language and in one foreign language, correctly use the terminology of the sector;
- working with the information technologies needed by the statistical mathematician, is the necessary digital literacy.

Competence:

- focus on key mathematics and statistical models and methods, advise industry, identify the boundaries of their knowledge, plan and implement their qualifications;
- plan and carry out sector-specific theoretical and practical studies, analyse their results, use them competently, address both the relevant challenges of the mathematics sector and the problems of social and natural sciences, explain and interpret the results obtained, take decisions;
- carry out independent scientific work, participate in the development of the professional field of statistical mathematics, recognise and respect the principles of academic integrity, understand professional ethics, assess the impact of their professional activities on the environment and society.

The requirements for admission at PBSPMS have been developed in accordance with the aims and objectives of the study programme. In order to be able to start studies at PBSPM, the applicant must have obtained a secondary education. The competition for places of study takes place on the basis of the results of the centralised examinations or on the final marks of persons who have obtained secondary education by 2004, who have been released from the centralised examinations or have obtained secondary education abroad. As a result of the competition, applicants are ranked according to the points obtained. Applicants acquire points, taking into account the results of the centralised examinations in Latvian, foreign language (English or French or German) and mathematics, while in addition 100 points are obtained regarding the attendance of the UL Little Maths University (MMU) in the corresponding year of study and benefits are given in the Latvian State or international mathematics, physics or IT (programming) olimpiads winners of grades 1-3 and recognition diplomas in the past three years; winners of grades 1-3 of the National School

Education Conference in the past three years; winners of Open Physics or Mathematics Olympiads 1-3 in the last three years. As a result of the competition, it is expected that students who have good knowledge of the level of secondary education in mathematics and who are familiar with the official language and one foreign language will start their studies.

After completing the professional bachelor's study program "Mathematician statistician" according to the conditions of the professional program, the fifth-level professional qualification "Statistics mathematician" is awarded, which corresponds to the 5th Latvian professional qualification level, the 6th level of the Latvian qualification framework and the European qualification framework, and a bachelor's degree is awarded in statistics mathematics.

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

PBSPM was created in 1997 on the basis of demand from the economic, financial and insurance sectors for good professionals able to work competently and qualitatively in the field of statistics. Such specialists are needed both for public authorities at all levels and for organisations of all forms of property (ministries, municipalities, audit firms, insurance companies, etc.). The demand for statistical mathematicians has not abated at the moment, as is the case with the Ministry of Economics's “*Information report on medium and long-term forecasts for the labour market*” (only in Latvian), which points out that the shortage of the international workforce in the medium term (i.e. up to 2027) could be developed in the science and engineering professions, including mathematics, statisticians and actuarial professions. The lack of specialists for mathematicians has been shown by the fact that the “Statistics mathematician” profession is among those professions (on the list it is No. 46) referred to in Cabinet Regulation 108 (20.02.2018.) *Specialities (professions) in which a significant labour shortage is forecast and in which foreign nationals may be invited to work in the Republic of Latvia* (only in Latvian).

The professional bachelor's studies programme “Mathematician Statistician” is closely linked to *the Latvian National Development Plan for 2021-2027* (only in Latvian), as it will contribute to the achievement of the objectives of the course of action. As regards the objective [145] “Quality of education for the acquisition of entrepreneurial and life-based knowledge and skills for every citizen of the country”, the study programme will contribute to the acquisition of skills coordinated with employers through research-based studies and learning excellence. On the other hand, the attainment of the “Education for Economic Growth” target will be encouraged as the study programme relates to the achievement of the scoreboard “The share of graduates from science, mathematics and information technologies from the total number of graduates in higher education”.

An essential part of the study programme is the practice of 20 CP. For this to be successful, 8 practice cooperation agreements have been concluded (Central Statistical Bureau (CSB), Institute of Mathematics and Computer Sciene of UL (IMCS UL), TNS Latvia, Accenture Oy, Creamfinance Latvia, Dukascopy Bank SA, AS 4 finance, SIA RAA Consulting). The student can also choose another place of practice by entering into an individual contract between the practice authority and UL. Places of practice such as the Latvian Environment, Geology and Meteorology Centre, Statistics Unit of RSU Faculty of Medicine, Tet, Credit Institutions (Aizdevums.lv u. c.), Insurance Institutions (Balta, BTA, Ergo, etc.), Banks (Swedbank, SEB, Citadele, etc.). Feedback on students from places of practice has always been very good, many students have found their first jobs at the time with a place of practice. The surveys received from employers show that graduates have acquired relatively broad knowledge, skills and competences, since they are able to carry out their job responsibilities after a short period of training/entry into the workplace. The name of the programme, "Mathematician Statistician", is like a good brand for graduates because of the evidence of logical thinking, the ability to work with numbers and analyze them, to take responsibility. For example, among those 2021 graduates who answered the question in the survey, 6 were data analysts, 1 data scientist and 3 risk advisers/modellers, and they performed their duties in 13 different companies: Luminor Bank, Central Statistical Bureau, Creamfinance, Latvian Environmental, Geology and Meteoreology Centre, State Land service, Printful, AS KPMG Baltics, AS LPB Bank, Tele 2, Atea Global Services, Balta, AS CREFO Office, SIA A Project. Of the 15 responses presented in the survey, 8 graduates continued their studies at Master's.

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.

Table 3.1.4.1

Number of students PBSPMS

Data on 1 October of the reference year	Number of students enrolled in Year 1	Number of students by year of study				total	Including paying	Number of graduates	Number of extraterrestrials (drop-out)
		1	2	3	4./5.				
2011	37	37	23	23	24/21	128	12		
2012	31	32	24	21	21/24	122	4	19	24
2013	44	51	23	19	21/21	135	4	24	17
2014	47	55	30	18	35	138	1	20	28
2015	60	60	27	30	19	136	3	33	29
2016	63	65	32	25	24	145	5	15	41
2017	60	60	36	29	23	148	8	20	34
2018	62	63	25	29	29	146	11	19	44
2019	59	57	20	23	26	126	7	25	52
2020	59	59	25	18	26	128	11	20	42
2021	49	47	24	19	20	102	8	23	45

The number of students is given in Table 3.1.4.1 for the period 2011 to the end of 2021. For the period 2007-2013, the duration of the study programme was 4,5 years, so under "Number of

Students by Years", students in study years 4 and 5 are entered in the fourth column. From 2013 onwards (Decision No 270 of the Accreditation Commission for Studies of 18 December 2013), the duration of the study programme was reduced to 4 years from 4,5 years. The decision resulted in two groups of graduates in 2015 at the same time, with a total of 33 graduates. The number of students enrolled on budget funds has changed: 30 students were enrolled by 2012, 45 students were enrolled starting in 2013, while 60 students were enrolled in year 1 on budget funds. In 2014, 2016 and 2018, some students on personal funds have entered year 1.

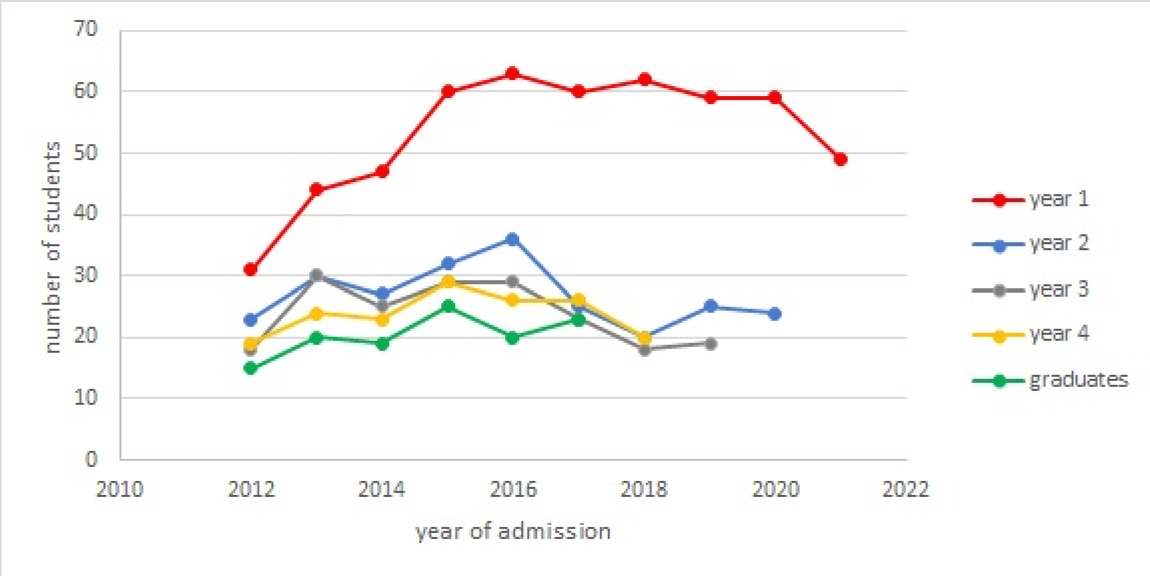


Figure 3.1.4.2. Dynamism by year of study, tracking students after year of joining

In 3.1.4.2, the figure shows the dynamism of students over the years of study, following students after the year of joining, namely 31 students in 2012 (the first point of the red curve), of which 23 students continued in year 2 (the first point of the blue curve below the first point of the red curve), 18 students went to year 3 (the first point of the grey curve) a dot below the blue curve's first score), further 19 students continued on (the yellow curve's first point above the gray curve's first score), suggesting that in the past year at least 1 student has returned from an academic break, but only 15 students graduated PBSPM. It is obvious that although the number of budget seats has increased since 2015 in year 1 and there are young people who want to study at PBSPM, the drop-out after year 1 is very high, it has increased without the expected effect. In order to reduce the number of students who are missing, year 1 sets up a course for the "Compensative course in Mathematics" to be attended by students who have not been able to reach a certain number of points during the test. In a survey conducted in October 2020 of 2nd year students on the impact of the "Compensative course in Mathematics", all those surveyed expressly acknowledged that this course had improved their mathematical knowledge, it was necessary and that the teaching staff of the course was suitable for its presentation. Each academic year, a curator is appointed for year 1, who takes particular care of the students of year 1, informs them about the field of study, study courses, organises cohesion measures. Teachers working in year 1 are asked to indicate more precisely and repeatedly to students the requirements of study courses and the course of their execution. Survey data on the causes of the discontinuing of studies is collected by the UL Academic Department. The biggest problem is to survey these students because there is no mechanism that would force all of the students to fill out the survey. PBSPM's 18 former students have been surveyed between 2017 and 2019, having ceased their studies during that period. Of which 6 lacks motivation for continuing studies, 6 is not interested in the selected programme, 3 have had a misconception of the content of the study programme, 2 is not satisfied with the attitudes of teaching staff, 1 wants to learn elsewhere. By analysing the number of points that students earn in admissions, it should be concluded that after the 1 st semester, almost all students with a score of less than 500 (the maximum score is 1000) have dropped out. But also young people with high scores discontinue their studies. For example, in 2019, after the 1 st semester, 26 students stopped their studies, 12 of them with a score above 700, while in 2020 33 students left after the 1 st semester, 8 of them with a score above 700. Starting in the 1 st semester of 2022, the course “Introduction to Mathematics Studies” is scheduled, which is intended to preserve the content of the previous course of mathematical logic, while the starting part of the course should be devoted to motivating students not to drop out of the chosen study program prematurely.

The number of graduates has been above 20 in the past three years, unfortunately it will be below 20 in the next three years (several students have stopped their studies due to Covid 19). In the last year of study, most students work, have a psychological load on how to connect work with studies and how to develop a bachelor's thesis, so you don't have to undertake mathematics courses in the last semester of the studies.

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.

PBSPMS studies consist of forty study courses, including 3 research papers, practice and state examinations. The content of the PBSPMS study programme is based on the following external and internal laws and regulations:

1. *Law on Higher Education Institutions* of the Republic of Latvia;
2. Cabinet Rules 512 (05.04.2014) *Regulations regarding the State standard of second-level vocational higher education* (only in Latvian);
3. Cabinet Rules No 240 (13.05.2014) *Rules regarding the national academic education standard* (only in Latvian);
4. *Regulations on University of Latvia Study and Continuing Education Programmes*;
5. the professional standard “Senior Data Analysis Specialist” (approved by meetings of Tripartite Cooperation in Vocational Education and Employment (PINTSA) 08.06.2022 and 12.10.2022) with professional specialisation 2120 02 Statistics Mathematician.

According to Cabinet Rules 512 (05.04.2014) *Regulations regarding the State standard of second-level vocational higher education* PBSPMS programme are made up (see also Annex 3.6):

- General education courses: 20 credit points,
- Field-specific theoretical foundation courses (field of professional activity) and information technology courses: 38 credit points (the requirement of the Cabinet rules is 36 credit points);
- Field-specific professional specialisation courses (field of professional activity) — 64 credit points (the requirement of the Cabinet rules is 60 credit points);
- Free-choice courses: 6 credit points;
- Practice: 20 credit points;
- Bachelor's thesis – 12 credit points.

On the other hand, according to *Regulations on University of Latvia Study and Continuing Education Programmes,* the study courses are divided into 114 credits for compulsory part (A), 40 credits for limited-choice (B) and 6 credits for free-choice (C) part courses.

Compliance with the professional standard "Senior Data Analysis Specialist" with professional specialisation 2120 02 Statistics mathematician is given in Annex 3.7.

From the mapping of study courses included in the study programme (Annex 3.8), it can be concluded how study courses ensure the achievement of the results of studies in the study programme. Study courses be designed in such a way as not to duplicate their content. The sequence of study courses (Annex 3.9) is designed to ensure the continuity of study courses and an increase in the level of complexity. The study course mapping (Annex 3.8) shows that the results of PBSPMS study courses cover all planned results of studies in the study programme (table 3.2.1.1 gives a summary of the mapping).

Table 3.2.1.1

PBSPMS overlaps of study results with study course results

RESULTS of studies in the PBSPMS study programme	Number of study courses covering the outcome of studies
Knowledge:	
1. demonstrate basic knowledge in the field of mathematics and information technology, demonstrate the understanding of key concepts and legal relationships in the field of mathematics science;	27
2. demonstrate specialised knowledge in mathematics, statistics and mathematical modelling in accordance with the knowledge required for the profession "Statistics Mathematician";	19
3. demonstrate the underpinnings of economic theory, organisation of business processes, national legal processes, national civil protection and environmental protection issues.	10

Skills:	
4. mathematically formulate statistical problems and task guidelines and develop appropriate mathematical and statistical models;	13
5. obtain, select, process and analyse information, mathematically export and justify the findings, present the results obtained both orally, in writing, in the official language and in one foreign language, correctly use the terminology of the sector;	35
6. working with the information technologies needed by the statistical mathematician, is the necessary digital literacy.	14
Competence:	
7. focus on key mathematics and statistical models and methods, advise industry, identify the boundaries of their knowledge, plan and implement their qualifications;	24
8. plan and carry out sector-specific theoretical and practical studies, analyse their results, use them competently, address both the relevant challenges of the mathematics sector and the problems of social and natural sciences, explain and interpret the results obtained, take decisions;	40
9. carry out independent scientific work, participate in the development of the professional field of statistical mathematics, recognise and respect the principles of academic integrity, understand professional ethics, assess the impact of their professional activities on the environment and society.	16

In the next Table 3.2.1.2 shows which PBSPMS study results are achieved in certain parts of the study programme.

Table 3.2.1.2

PBSPMS overlaps of study results with study course results in parts of study programme

	Knowledge			Skills			Competence		
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Part A, Compulsory Courses			x		x	x		x	x
Part A, Basic Theoretical Courses of the Industry and Information Technology Courses	x	x			x	x	x	x	x
Part A, Industry Professional Specialization Courses	x	x	x	x	x	x	x	x	x
Part B, Restricted Elektive Courses, Industry Professional Specialization Courses	x	x		x	x	x	x	x	x

6 study courses reach the results of 3 results in the study programme, while the largest number – 16 courses – reaches 4 results of the study programme. The two study courses — “Basic Practice for Mathematician Statistician” and “Bachelor's Thesis of Mathematician Statistician ” — achieve all 9 results of the study programme. The study course mapping (Annex 3.8) shows that the planned

results of the courses included in the study programme correspond to the results achieved by the study programme. Consequently, it can be concluded that by graduating the study programme the student will have achieved all the results of the studies planned for PBSPMS.

Information on updating the content of study courses in PBSPMS is obtained from feedback from internships (i.e. employers), student and graduate surveys, as well as from teaching staff who conduct scientific and applied research in the field of mathematics or are specialists in the field - practitioners. For example, based on employer feedback and graduate surveys, one of the objectives of the course “Introductory Course Working with Data” is mastering MS Excel. In Latvia, many institutions use MS Excel for data processing. As IT tools change, course content will also change.

Since 2013, changes to the list and content of PBSPMS courses have not only occurred as a result of regulatory requirements. Cabinet Regulations No 512 (26.08.2014) *Regulations regarding the State standard of second-level vocational higher education* (only in Latvian), which entered into force in autumn 2014, provided for the 3 study courses with study theses in vocational bachelor's study programmes and allowed a reduction in the amount of practice from 26 CP to 20 CP. In spring 2017, the PBSPM launched two study courses with study theses on “Course Work Using the Package R” and “Course Work for the Programme Mathematician Statistician”. The first of these causes students to understand and use the R package, which is currently the leading IT tool in the field of statistics. On the other hand, the course focuses on strengthening the mutual understanding of different mathematics courses, on addressing mathematical research issues, and on practical application of mathematical knowledge, including business statistics tasks. In the course of its execution, the students perform an independent work under the supervision of the principal of the course, which concludes with presentation and defence. In the spring semester of 2017, the study course “Actuarial Risk Management” was read for the first time. The initiative of this study course has come from the insurers; the course was developed by I. Helmane, head of the Board of the Association of Actuaries of Latvia at that time, who is also leading this course today. In the autumn of 2018, a third study course with study theses was launched “Introductory Course Working with Data”, which is set for the 3rd semester and is the first major introduction to data processing and analysis. Starting with the spring semester of 2022, the PBSPM includes two new study courses “Mathematical Models in Finance ” and “Mathematical Models in Data Science” that expand the topics of the “Portfolio of Securities and their Management” study course (which is closed), which are current in the labour market today. A survey of graduates in September 2021 showed that different companies needed the skills to handle databases. Therefore, the study course “Database Systems Fundamentals” will be read from September 2022.

All study courses are updated every three years, supplemented with the latest literature and industry news. At the beginning of each academic semester, the taught courses are regularly modified, applying them content-wise to the current events of the relevant time period.

Although there is a great need for statistical specialists in Latvia as a whole, only a few specialists are needed in each particular direction each year. Therefore, a detailed specialisation PBSPM is not possible and this programme is geared towards preparing high-profile statistical mathematics specialists. However, it is pleasing that, in the questionnaires of employers from different sectors, the question “How could you describe in general the graduates of the Bachelor of Business Studies Program, “Mathematician Statistician”, who have obtained education over the last 3 years?” highlights the answer “After a short period of training/introduction in the workplace, the ability to carry out their work. duties of employment”.

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.

Both oral and written and combined study and evaluation methods are used during the course of study and tests.

Studies use a variety of techniques for acquiring and strengthening knowledge, such as introductory lectures, interactive lectures, summary lectures, problematic lectures. Practitioners, professionals from different institutions are invited to teach individual lectures in study courses to promote the unity of theory and practice. In a number of study courses ("Mathematical Analysis I", "Mathematical Analysis II", "Mathematical Analysis III" and "Mathematical Analysis IV", "Algebra I", "Analytic Geometry"), lectures are conducted by one teaching member, while practical work is managed by another. Lectures are usually conducted by a more experienced doctorate, while in practice young teachers and doctoral candidates are employed. For the course to be successful, it must be consistent: In practice, you must talk about the subject discussed in the lectures, and you must harmonise the labelling system.

Practical tasks, seminars, individual, couple and group work, discussions and project development, training tours to industry organisations are widely used. Employers are involved in the implementation and development of study courses (calls for the management of individual seminars, often organised as exchanges of experience in workplaces, etc.). PBSPMS students are regularly visited by IT *Accenture* guest lecturers, who inform both of the possibilities of leaving the business and the story of the company's topics (e.g. a lecture on virtual agents in May 2020). We have hosted the Central Statistical Bureau, the insurance company ERGO, IT *Accenture*, *Kantar* TNS *Latvia*.

In order to promote the development of students' research competencies, students in follow-up courses have the opportunity to analyse and study in depth the problems of their interest in the sector. Senior students are involved in conducting peer *teaching-learning*.

In the course of study, workshops promote the presentation and discussion skills of students. In particular, it is promoted in the three study courses with study thesis entitled "Introductory Course Working with Data ", "Course Work Using the Package R " and "Course Work for the Programme Mathematician Statistician ".

In order for students to achieve the results of their studies – learning and strengthening knowledge and skills – the study process is dominated by methods where student activity is important. The study process uses methods to promote student communication in the performance of study tasks, addressing real sector problems, modelling situations.

The physical environment of studies is also gradually changing: auditoriums are easily transformed for group work, individual work, students can use digital technologies. Teachers mostly use techniques that encourage student active participation, critical thinking and reflection. The e-study environment is used for the study process and for the promotion of independent studies. An e-study environment (MOODLE) has been set up for each study course, where learners have access to lesson materials, task descriptions in addition to course-related teaching materials, and study tasks (tests, forums, seminars, conferences, etc.). All assessments of interim tests and closing examinations of study courses are recorded and made available to students in the e-study environment.

The student-centred approach is followed by the updating of study programmes and their study courses, with a particular focus on meaningful formulation of study results in order to promote dialogue between teachers and students on the content, forms and methods of study. In turn, properly formulated study results contribute to students' understanding and co-responsibility for their learning, self-evaluation and understanding of the assessment they have received. In the study process, doctors use methods, test forms and evaluation criteria relevant to the purpose of the studies and the results of the studies planned.

Students in the study process receive support and feedback from academic staff. The evaluation criteria for the marks have been published in advance. The evaluation gives students an opportunity to demonstrate to what extent they have achieved the expected learning outcomes.

Student mobility (recognition of study results) is promoted, students engage in studies initiated by academic staff and social activities in society, thereby gaining significant experience through learning practices. In implementing internal quality assurance policies, study programmes are implemented in such a way that students are encouraged to be actively involved in the development of the study process. There are procedures and procedures for submitting and addressing student proposals, examining student appeals. The results of student surveys are assessed and taken into account in the development of the study process. Students are pleased to make their own recommendations for improving study programmes and the process of negotiating with teachers, programme directors.

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).

Duration of the practice of PBSPMS is 20 weeks (20 credit points) and amounts to 800 hours. The scheduled duration of the practice is the 7th semester of study (from the first week of the semester of study in September to mid-January). The practice of PBSPMS is governed by:

1. *Provisions regarding the national standard for second-level Professional higher education* (Regulation No 512 of the Cabinet 26.08.2014; only in Latvian);

2. the professional standard “Senior Data Analysis Specialist” (approved by meeting of PINTSA 08.06.2022), which includes professional specialisation 2120 02 Statistics Mathematician;

3. *Regulations on University of Latvia study and continuing education programmes* (Decision No 102 of the Senate of UL, 24.04.2017);

4. *Principles and procedures for student placement at the University of Latvia* (Order No 1/417 of UL 25.11.2019);

5. professional bachelor's study programme “Mathematician Statistician” Regulations of practice/internship (UL FPMO 02.02.2022, Council Decision No 21-2/22);

6. description of PBSPMS study course “Basic Practice for Mathematician Statistician” (20 CP) and the corresponding e-study course.

The **aim** of the practice of PBSPMS is to strengthen and supplement the theoretical knowledge acquired, and to develop skills to apply them in professional activity, to develop the competence of the statistical mathematician. The main **tasks** of practice are:

1. to become acquainted with the place of practice/internship, the principles of the organisation thereof, the mathematical provision;

2. to develop and approve theoretical knowledge acquired by students in practical operation;

3. to acquire professional competence corresponding to the study programme;

4. to apply competence in real action;

5. to prepare students for the development of bachelor's thesis;

6. to acquire skills in research work.

The place of practice may be any Institution outside the FPMO UL where data can be collected, processed, mathematical models created, practical testing, etc. In practice, the students familiarise themselves with the structure, organisation of work of the Institution and with the statistical and/or mathematical issues of the Institution. A student may be involved in collecting real statistical data and in data-related work. In practice, the student must agree with the head of the Institution to address one problem. The day-to-day tasks of the Institution should address the above-mentioned problem, the development of which will have to be described in the practice report and presented orally in the last week of January.

The practice organiser - (1) the director of the PBSPMS programme and/or a teacher assigned by the Department of Mathematics, (2) the head of the practice of UL - a faculty representative (usually a teacher of the UL FPMO Department of Mathematics) who monitors the practice in the specific Institution, (3) The head of practice of the Institution - from the institution where the practice is taking place - leads the practice a member of staff is assigned by its manager who has practical experience. The more precise tasks of organisers and managers can be consulted in the PBSPMS Practice Regulations (Annex 3.11).

Organizers of the practice of the PBSPMS inform students about the conduct of the study course "Basic Practice for Mathematician Statistician” (practice time, duration, general practice tasks, practice assessment criteria, conflict resolution) and offer the student a place of practice in accordance with the 8 co-operation agreements that the faculty has concluded with places of practice. A student is entitled to offer another place of practice. The practice organisers evaluate its compliance with the requirements of the study programme. In this case, a tripartite agreement is concluded between UL, the institution of the place of practice and the student. In order to make it easier for students to choose the best place of practice for themselves, the director of PBSPMS organizes a meeting with potential partners (for example, in academic year 2021/2022 students met with IT Accenture, Central Statistical Bureau, *Creamfinance* Latvia, RAA Consulting, Balta employees).

The specific practice task that the student reflects in the practice report depends on the place of practice. The practice rules offer the following tasks: regression analysis, time series analysis, sample surveys, mathematical modelling of economic, financial and other social processes, analysis of queueing systems, task of operation research, analysis of securities portfolios, analysis of multidimensional data.

3.2.4.1 The table shows the names of the places of practice and works developed in the autumn 2021 semester.

Table 3.2.4.1

PBSPMS 2021 autumn semester practice site and practice reporting names

Place of practice	Practice Report Name
Latvian Environment, Geology and Meteorological Centre	Verification of seasonal air temperature forecasts
Latvian Environment, Geology and Meteorological Centre	Quality control of the data of Latvian State road meteorological observation stations
Latvian Environment, Geology and Meteorological Centre	Air temperature trends in Latvia and comparing them
Tilde Ltd	Analysis of human evaluation quality of machine translation systems
Central Statistical Bureau	Assessment of accuracy in sample surveys
RSU Statistics Unit	Method of logistic regression with application in an ageing study, comparison between Latvia and Sweden
Krišjāņa Valdemāra Ainažu elementary school	Analysis of the questionnaire on the organisation of the remote learning process for pupils in classes 4-8 academic year 2021/2022
Riga's 84 th secondary school	Analysis of students' grades
“Circle K Latvia” Ltd	Analysis of Latvian autogas data
"MSC Shared Service Center" Ltd	Forecasting future job volumes at MSC
Swedbank AS	Model selection for monthly analysis of the number of approved leasing applications
“Tet” Ltd	Customer segmentation
“Tet” Ltd	Create an anomaly size detection algorithm for AIOPS data

"Creamfinance Latvia" Ltd	Conclusion of rejected applications
"Creamfinance Latvia" Ltd	Align an aproxied string of symbols with two database entries
UL FPMO Laser Center	Laser-induced fluorescence (LIF) spectral line aproxying of potassium-caesium (KCs) spectral lines

Given the critical state of the country with mathematics teachers, it is permitted and supported that a PBSPM student serves their practice at school. As can be seen in Table 3.2.4.1, two students performed in schools during the autumn semester of 2021. All student practices in the fall semester of 2021 have been linked to data acquisition, analysis and interpretation of results.

The results of the studies of the course “Basic Practice for Mathematician Statistician” fully cover the all 9 results of studies (see Annex 3.8 on the mapping of the course).

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 main proof of the qualification of PBSPMS, a self-conducted study on a specific subject of mathematical statistical and/or mathematical importance with scientific or practical meaning. The individual subject and specific tasks of bachelor's thesis is defined for each student by the scientific supervisor, the qualifications of which correspond to the management of bachelor's theses. The aim of the bachelor's thesis is to use, systematise and expand theoretical knowledge and practical skills acquired during studies, use them by carrying out an independent scientific or practically relevant study, and to collect and analyse the results, draw conclusions and formulate recommendations for further action.

Students choose themes for their theses according to the content and professional orientation of the study programme. Students are informed about the development of the bachelor's thesis process befoe the work. The justification for the selection of a topic stems from the selected specialisation, relevance to the field of mathematics science, as well as the interests of the student, scientific integration, experience acquired during practice or professional activity.

A total of 175 bachelor's theses have been defended during the reference period from 2013./2014.y to 2020./2021. The range of topics of the work of the Bachelor who is studying PBSPMS is essentially related to mathematical statistics and its uses according to the profession “Statisticsl mathematician”. For example, 23 bachelor's theses were defended in the year 2020/2021, their titles are given in Table 3.2.6.1.

Table 3.2.6.1

PBSPMS bachelor theses titles 2020/2021

1.	Clustering analysis in non-life insurance
2.	Incomplete games, Opponent modeling in Texas holdem
3.	Image classification using automated machine learning library AutoKeras
4.	Application of Markov chains in the context of Latvian language dictionary
5.	Online Customer Segmentation, Using Clustering Methods
6.	Optimization problems of non-differentiable functions
7.	Confounding bias and confounder selection
8.	The iterative Brown-Robinson method
9.	A stohastic approach for project time and cost estimation
10.	Oligopoly in the context of Game theory
11.	Collaborative filtering in recommendation systems
12.	Most applicablepenalty functionselectionfor different datasets in logistic regression models
13.	Stochastic scenario simulator with ARCH effect modelling
14.	Generating pseudorandom number sequences with linear-feedback shift register and deciphering them
15.	Methods of analysis of hydrological data
16.	Recommendation model based on machine learning

17.	Optimal identification of auxiliary variables in sample surveys to reduce nonresponse bias
18.	Bayesian estimation of the SIR model parameters
19.	Queueing networks
20.	Epidemiological study designs
21.	Real estate price index calculation and forecasting
22.	Observing nonresponse bias and optimising data collection strategy for adaptive sample survey design
23.	Fallacies and paradoxes in statistics

Of these 23 bachelor's theses, 9 have been developed in close cooperation with a Latvian company, of which 5 works were an employee of the company. Of these 23 bachelor's theses, 18 topics are in mathematical statistics, while five relate to other subsectors of mathematics, the acquisition of which is required by the “Statistics mathematician” profession (game theory, optimization methods, linear programming).

The evaluation of the final examinations is carried out by the final examination commission, which, on a proposal from the FPMO Council, is approved by the Vice-Rector of the relevant field. Since PBSPMS is a professional bachelor's studies programme, the final commission of 12 commission members 7 are employers' representatives (JSC Latvia's State Forests, IT Accenture, JSC Citadele bank, KPMG Baltics JSC, Central Statistical Bureau, JSC Balta, Latvijas Banka), the rest are the staff of FPMO. In evaluating the bachelor theses, attention is paid not only to the content of the bachelor's thesis and to the requirements of the final work, but also to the ability to present the results of the thesis and to answer the questions raised by the reviewer and members of the final examination commission. Evaluations of bachelor's theses for the period from 2014/2015 to 2020./2021.2012 (in the 2013/2014 academic year, 20 works have been defended for which there are no electronically available data for ratings, see Table 3.2.6.2 and Figure 3.2.6.1) showing that students are able to demonstrate a high level of knowledge, skills and competence, in accordance with the requirements for the bachelor theses.

Table 3.2.6.2

PBSPMS bachelor thesis ratings from 2014/2015 to 2020./2021.

	2014./2015.	2015./2016.	2016./2017.	2017./2018.	2018./2019.	2019./2020.	2020./2021.
ratings	number – %	number – %	number – %	number – %	number – %	number – %	number – %
10	7 – 21,2%	3 – 20%	2 – 10%	1 – 5,3%	5 – 20%	3 – 15%	3 – 13%

9	11 – 33,3%	4 – 26,7%	6 – 30%	6 – 31,2%	2 – 8%	5 – 25%	6 – 26,1%
8	9 – 27,3%	2 – 13,3%	5 – 25%	6 – 31,2%	7 – 28%	6 – 30%	6 – 26,1%
7	5 – 15,2%	4 – 26,7%	4 – 20%	4 – 21,1%	4 – 16%	3 – 15%	2 – 8,7%
6	1 – 3%	1 – 6,7%	3 – 15%	2 – 10,5%	4 – 16%	3 – 15%	5 – 21,7 $
5	0 – 0%	1 – 6,7%	0 – 0%	0 – 0%	2 – 8%	0 – 0%	1 – 4,3%
4	0 – 0%	0 – 0%	0 – 0%	0 – 0%	1 – 4%	0 – 0%	0 – 0%
total	33	15	20	19	25	20	23

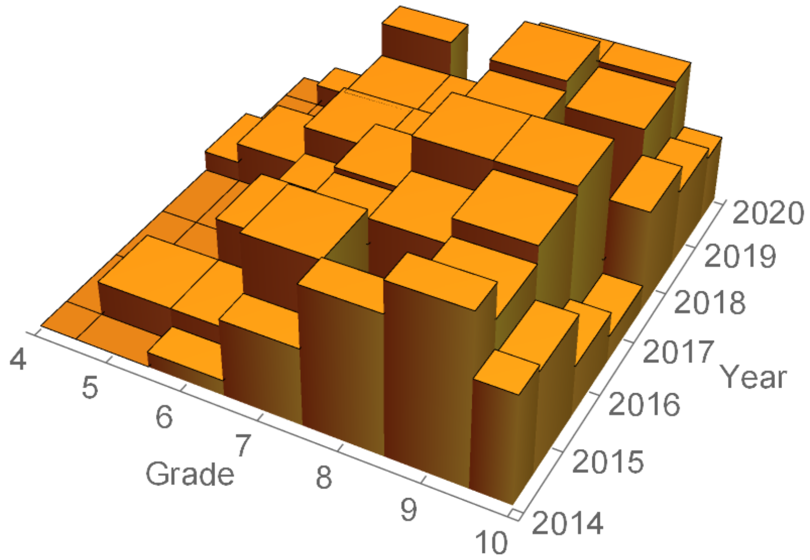


Figure 3.2.6.1. PBSPMS bachelor thesis ratings from 2014/2015 to 2020./2021.

In general, it can be concluded that the topics of the final work of PBSPMS are relevant to the title and content of the study programme, the results of the studies carried out by students are relevant in the mathematics sector, particularly in mathematical statistics, corresponding to the profession “Statistics Mathematician”, students receive sufficiently high grades in defending final theses, demonstrating the knowledge, skills and competence acquired during studies.

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.

All resources at the disposal of UL and FPMO are available for the implementation of PBSPMS. Both the information base (including the library) and the material technical base, as well as the methodological provision, comply with the conditions for the implementation of the study programme, create preconditions for achieving the results of studies and demonstrate the possibility of ensuring the quality study process to continue.

The implementation of PBSPMS in UL is the responsibility of the programme director under the direct authority of the Department of Mathematics. FPMO support for the planning and implementation of the study process provided by:

- the senior methodologist, common to FPMO study programs, administer student affairs, provides students with services that are the responsibility of the faculty,
- the Department of Mathematics specific study issues are sorted out by the senior secretary,
- the House of Science two computer network administrators.

Classes scheduling is performed by the senior secretary of the Department of Mathematics.

PBSPMS courses are mainly carried out by teachers from the Faculty of Physics, Mathematics and Optometry (FPMO), while individual courses are run by doctors from the Faculty of Chemistry ("Civil Protection"), Faculty of Computing ("Programming and Computers I", "Programming and Computers II", "Database Systems Fundamentals"), Faculty of Business, Management and Economics ("Entrepreneurship", "Basics of Economic Theory"), Faculty of Law ("Introduction to Latvian Legal System"), Faculty of Humanities ("Spoken and Written Communication in English for Mathematicians") and Faculty of Geography and Earth Sciences ("Environment Protection"), as well as three non-UL staff members, the main jobs of which are KPMG Baltics Ltd ("Actuarial Risk Management"), *Evolution Latvia* ("Mathematical and Statistical Software Packages") and RTU ("Survey Sampling", "Mathematical Models of Queueing Theory").

The teaching of mathematics and statistical courses is provided by the FPMO Department of Mathematics, composed of 3 Chairs (Chair of Differential Equations and Approximation Methods, Chair of Mathematical Analysis and Chair of General Mathematics), as well as the Laboratory of Statistical Research and Data Analysis and the A. Liepa's Correspondence Mathematics School.

Material technical provision covering all course of study programmes is described in Part II, point 2.3.2, and the resources of the UL Library are described in Part II, point 2.3.3.

The House of Science has been commissioned in 2019. The total indoor area is 20018 m2, with a total of 15 auditoriums, 8 workshop rooms, 78 scientific and teaching laboratories and 430 places for scientific and academic staff. These resources are shared by two UL Faculties (Faculty of Physics, Mathematics and Optometry and Faculty of Medicine) and 6 scientific institutes. A wireless computer network is available in all rooms. The rooms are modern; the technical provision is sufficient. During the Covid-19 pandemic, rooms were equipped with webcams to allow online or hybrid mode (in which part of the students are present and others are remote). It is also planned to use these opportunities after the end of the pandemic to hold joint workshops with other university teachers and researchers.

UL House of Science computer labs fully meet the needs of PBSPMS. Computer classrooms have the necessary software for study courses: Phyton, R, SPSS, Mathematica, Matlab, Microsoft Excel and other Microsoft products, as well as LaTex.

Information resources are available in the UL Library according to UL study programmes and study fields. The Library provides for the purchase of information resources on the orders of UL academic staff, a proposal from the student self-government or a proposal by Library employees that is entered in LUIS and approved by the faculty executive. For the available resources of the UL Library, read more in Part II, point 2.3.3.

The rooms of the House of Science Library, in which the collection of the physics and mathematics sector is located, are open to students at a comfortable time of 24 hours a day for 7 days a week. A free-access item is available for users. The House of Science Library is located on the 2nd floor of the building alongside auditoriums, computer classrooms and the Information Centre in rooms with a total area of 533 m ^{2}. There are 110 places available to users in the House of Science Library. The user can use any workplace in the building to work with a portable computer.

The library's stock is in line with the implementation of studies and the development of scientific research, as it is complemented each year with the most up-to-date information resources, in line with the informational needs of academic staff and students.

For example, in the first year of the study course "Algebra I" (5 CP) there are 4 books in the list of compulsory sources of information:

1. Belovs, M., Judrups, O., Matricas, determinanti un lineārās vienādojumu sistēmas, Rīga, LVU, 1987.
2. Belovs, M., Judrups, O., Lineāra telpa, Rīga, LVU, 1988.
3. Belovs, M., Judrups, O., Telpas ar skalāro reizinājumu, Rīga, LU, 1990.
4. Lay, D., C., Linear algebra and its applications, Boston, Pearson/Addison Wesley, 2006.

Of these, Book 1 is in the holdings of the UL Library in 62 copies, Book 2 in 15 copies, Book 3 in 29 copies, and Book 4 in 5 copies.

For the course "Mathematical Statistics" (4 CP), the list of compulsory sources of information includes 3 books:

1. Bain, L. J., Engelhardt, M., Introduction to probability and mathematical statistics. Brooks/Cole, 1987.
2. Casella, G., Berger, R. L., Statistical inference (Vol. 2). Pacific Grove, CA: Duxbury, 2002.
3. Teetor, P., R Cookbook: Proven recipes for data analysis, statistics, and graphics, O'Reilly Media, 2011.

The UL Library has 11 copies of Book 1, 2 copies of Book 2 and 1 copy of Book 3.

But, for example, the source of the list of information sources to be used for the study course "Mathematical and Statistical Program Packages" (2 CP): IBM SPSS Statistics 22 Brief Guide. IBM Corporation, is a freely available resource, but book: McKinney, W., Python for data analysis: Data wrangling with Pandas, NumPy, and IPython (2nd edition). O'Reilly Media, Inc., 2013, is an online resource available on the UL network by logging in with a UL username and password.

For all PBSPMS study courses, a corresponding e-learning course has been created in the Moodle environment. Study materials are placed in Moodle: lecture outlines, lecture slides, video materials, homework assignment formulations, etc.; grades are posted here throughout the semester for various test papers. Tests can be taken on Moodle, and various assignments can be submitted electronically for marking. Moodle is coordinated with the Microsoft Teams environment, where online lectures and tutorials can be given, if necessary, you can quickly and easily organize a video conference. Both tools are maintained by UL.

There is no need for significant investment in infrastructure in the foreseeable future. There is a need for the maintenance and modernisation of technical provision on a regular and scheduled basis, in line with technical developments and changes in the content of studies.

In general, material-technical provision is considered to be very good.

The resources and facilities are in line with the conditions for the implementation of the study programme and fully enable the achievement of the PBSPMS learning outcomes.

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).

Revenue of the Programme

For the purpose of providing the funding needed to implement PSPMS, UL uses

- a State budget grant from the Ministry of Education and Science determined for academic year 2021./2022EUR 2445,17 for full-time studies;
- tuition fees, taking into account all the factors referred to in the heading “Financial security” identified for academic year 2021/2022: for full-time studies, EUR 2000 per year.

In the light of the above, the overall budget for the study programme is expected to be EUR 262742,85 per year, the transcript is shown in Table 3.3.3.1 and in Table 3.3.3.2.

Table 3.3.3.1

Budget of the study programme, EUR

Transcript of the budget	Budget, EUR
Tuition fee revenue	6000
State budget grant	256742,85
Total	262742,85

Estimated annual income of the programme, EUR

Table 3.3.3.2

Estimated annual income of the programme, EUR

Type of study	Number of students	Study fees/State grant	Total income
Fulltime(budget)	105	2445,17	256742,85

Fulltime(fee)	3	2000	6000
Total	**108**		**262742,85**

Programme costs

In order to assess the amount of funds needed for financial collateral, UL study programmes calculate the costs according to a methodology developed by UL, which takes into account the previous course of study 2.3.1. Financial support for the costs of ensuring the training process described and information on the study programme plan, the participating teaching staff, the planned number of students, etc., thereby ensuring the reliability of the forecasts.

Full - time costs of the programme

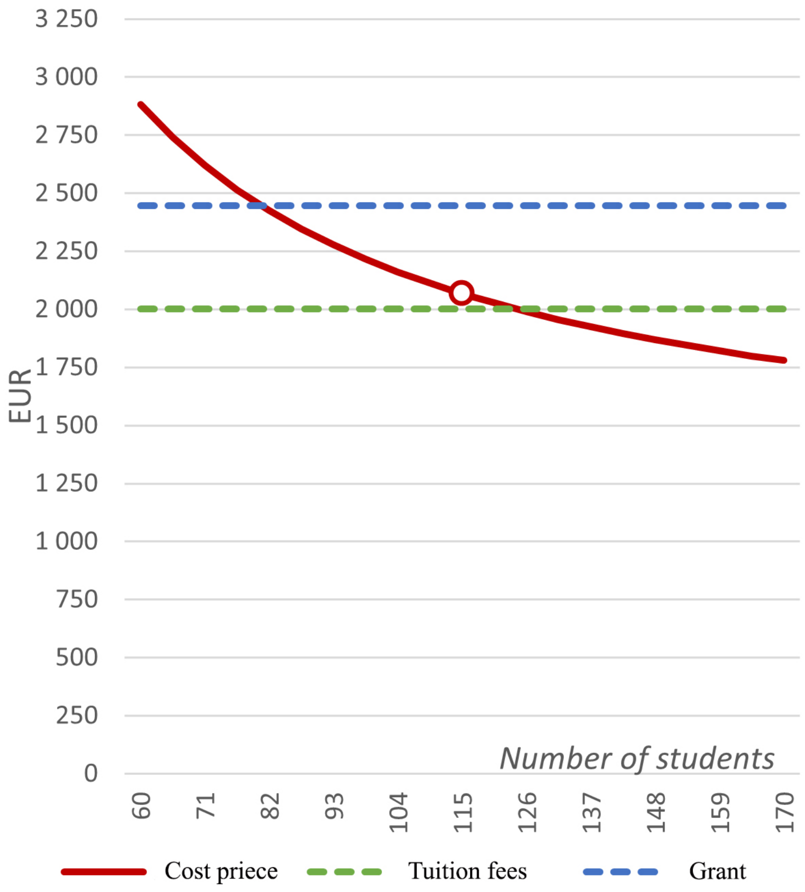
For calculations, PBSPMS implementers use the student data of 2021/2022 academic year: in the full-time programme, 108 students are studying, the existing study programme plan and the existing academic staff structure involved. In the light of the above, the full-time cost of the programme per student is estimated at EUR 2108 per year and the total cost of the programme at EUR 244421,03 per year. A more detailed percentage of costs is shown in Table 3.3.3.3

Table 3.3.3.3

Percentage of costs in the study programme

Heading of expenditure	**% of total**
Teaching staff costs	47,27%
General staff	8,98%
Other costs	0,00%
Infrastructure expenditure	8,28%
Property and services	2,15%
Indirect costs	33,32%
TOTAL COSTS	**100%**

Figure 3.3.3.1 shows the cost of the study programme depending on the number of students and the comparison with the proposed study fee and the State budget grant.



3.3.3.1. Figure PBSPMS cost depending on the number of students (red: cost; green: fee; blue: grant; number of students)

Based on the calculation, it is apparent that for the programme to be cost-effective and the students to have a high-quality study process, the number of students in the programme (all courses together) should be at least 126 (red (cost)) and the intersection of green (study fee) lines projected to x-axis). On the other hand, if there were only budget students in the programme, the number should reach 82 students.

Summary of revenue and costs of the programme

Table 3.3.3.4 summarises the revenue of the programme, depending on the number of students, State grants and study fees, and the expenditure of the programme at such a number of students.

Table 3.3.3.4

Outcome of the programme

Type of study	Number of students	Study fees/State grant	**Total income**	**Total cost**
Fulltime(budget)	105	2445,17	**256742,85**	**237755**
Fulltime(fee)	3	2000	6000	6666,03
Total			**262742,85**	**244421,03**

The data presented in the table shows that UL has sufficient resources to implement the study programme and to ensure its further development. In addition, the development of the programme may be financed from revenue received from lifelong learning services and from financial resources accruing from the departments. Faculty also receive financial support for the development of programmes from the UL Study Quality Development 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.

It is intended to involve 28 teaching staff (see Table 3.4.1.1) in the implementation of PBSPMS. Though PBSPMS is a professional study programme, there are 4 professors and 1 associate professor among its teaching staff, and half (14) have a doctorate. The vast majority of teaching staff (23) are involved in scientific research as scientific assistants, researchers and leading researchers. For two teachers, the main job is in companies. The qualifications of the teaching staff is sufficient to provide all study courses provided by the PBSPMS study plan, to provide knowledge, skills and competence relevant to the results of studies provided for in the study programme.

Table 3.4.1.1.

List of teaching staff involved in PBSPMS

	Last Name Name	Academic/doctoral degree	The position in UL, elsewhere	Study courses
1.	Asmuss Svetlana	*Dr. math.*	FPMO, professor, UL IMCS, leading researcher	Mathematical Analysis I, Mathematical Analysis II, Mathematical Analysis III, Operations research
2.	Āboltiņa Baiba	*Mg. math.*	FPMO, lecturer	Algebra I, Algebra IIS
3.	Barānova Daira	*Mg. oec. (business administration)*	Faculty of Business, Management and Economics, lecturer, researcher	Basics of Economic Theory
4.	Bēts Raivis	*Dr. math.*	FPMO, docent, UL IMCS, researcher	Classical Cryptography

5.	Budkina Nataļja	*Dr. math.*	university teacher (FPMO), RTU, associate professor, leading researcher	Survey Sampling, Mathematical Models of Queueing Theory
6.	Bula Inese	*Dr. math.*	FPMO, professor, UL IMCS, leading researcher	Course Work for the Programme Mathematician Statistician, Basic Practice for Mathematician Statistician, Bachelor's Thesis of Mathematician Statistician, Methods of Optimization, Strategic Game Theory
7.	Buliņa Elīna	*Mg. math.*	FPMO, scientific assistant, senior secretary	Mathematical Analysis I, Mathematical Analysis II
8.	Buls Jānis	*Dr. math.*	FPMO, *emeritus* professor, leading researcher	Introduction to Mathematics Studies
9.	Cibulis Andrejs	*Dr. math.*	FPMO, professor, UL IMCS, leading researcher	Introduction in the Complex Analysis
10.	Delesa-Vēliņa Māra	*Dr. math.*	FPMO, university teacher, researcher	Introductory Course Working with Data, Course Work Using the Package R, Mathematical Foundations of Econometric Analysis
11.	Dobkeviča Linda	*Dr. chem.*	Faculty of Geography and Earth Sciences, researcher	Environment Protection
12.	Dzenis Māris Gunārs	*Mg. math.*	university teacher (FPMO), UL Institute of Physics scientific assistant	Mathematical Analysis I, Mathematical Analysis II

13.	Gredzens Jānis	*Mg. math.*	university teacher (FPMO), *Evolution* Latvia data scientist	Mathematical and Statistical Software Packages
14.	Grigorenko Olga	*Dr. math.*	FPMO, docent, UL IMCS, researcher	Mathematical Analysis I, Mathematical Analysis II, Mathematical Analysis III, Introduction in the Complex Analysis
15.	Helmane Inga	*Mg. math.*	university teacher (FPMO), KPMG *Baltics* SIA senior project manager	Actuarial Risk Management
16.	Kalugins Emīls	*Bc. math.*	university teacher (FPMO), UL IMCS, scientific assistant	Algebra I
17.	Lapa Lauma Terēze	*Mg. philol.*	Faculty of Humanities, lecturer, researcher, translator	Spoken and Written Communication in English for Mathematicians
18.	Luguzis Artis	*Mg. math.*	FPMO, lecturer, Faculty of Medicine, scientific assistant	Mathematical Models in Data Science, Mathematical Models in Finance
19.	Marinaki Maksims	*Dr. math.*	FPMO, lecturer, UL IMCS, researcher, Novikontas Maritime College, lecturer	Numerical Methods I, Numerical Methods II
20.	Niedrītis Aivars	*Dr. sc. comp.*	Faculty of Computing, docent, researcher	Database Systems Fundamentals
21.	Pahirko Leonora	*Mg. math.*	FPMO, lecturer, scientific assistant	Random Processes, Probability Theory
22.	Parasiga-Parasiņa Kristīne	*Mg. chem.*	Faculty of Chemistry, lecturer	Civil Protection

23.	Purmalis Kārlis	*Dr. oec.*	Faculty of Business, Management and Economics, associate professor, leading researcher	Entrepreneurship
24.	Smirnovs Sergejs	*Dr. math.*	FPMO, docent, UL IMCS, leading researcher	Differential Equations I
25.	Valeinis Jānis	*Dr. math.*	FPMO, professor, leading researcher	Time Series Analysis, Mathematical Statistics
26.	Vēzis Viesturs	*Dr. sc. comp.*	Faculty of Computing, docent, leading researcher	Programming and Computers I, Programming and Computers II
27.	Vīnkalna Evija	*Mg. iur.*	Faculty of Law, lecturer	Introduction to Latvian Legal System
28.	Zīlīte Agnese	*Mg. math.*	FPMO, lecturer, scientific assistant	Analytic Geometry

Annex 2.5 contains the CV of all teaching staff.

The knowledge of the official language of the academic staff employed in the study programme complies with *the Regulations regarding the extent of the knowledge of the official language, the procedures for the verification of the official language proficiency and the State fee for the verification of the official language proficiency* (Cabinet Regulation No 733, 07.07.2009), which allows the teaching of study courses in the official language.

In the light of the above, it can be argued that the staff members involved in the implementation of the programme ensure the acquisition of high-quality theoretical knowledge and the development of professional skills in statistical mathematics.

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.

The changes in the composition of teaching staff during the reporting period are illustrated by the comparison between tables 3.4.2.1 and 3.4.2.2.

Table 3.4.2.1.

PBSPM teaching staff and their capacity in 2013./2014.

Position	Number	CP, on average	CP, total
Professor	5	4,8	24

Associate Professor	5	4,4	22
Docent	6	6	36
Lecturer	6	4	24
university teacher	2	5	10
	24	4,83	116

Table 3.4.2.2.

PBSPMS teaching staff and their capacity 2021/2022

(parentheses show changes to 2013/2014)

Position	Number	CP, on average	CP, total
Professors and acting professors	5 (0)	4,8 (0)	24 (0)
Associate Professors	1 (-4)	4 (-0,4)	4 (-18)
Docents	4 (-2)	5,5 (-0,5)	22 (-14)
Lecturers and acting lecturers	10 (+4)	3,5 (-0,5)	35 (+11)
university teacher	9 (+7)	3,5 (-1,5)	31.5 (+21.5)
	29	4.02	116.5

The tables show that the number of docents, associate professors, professors has decreased, but the number of lecturers and especially university teachers has increased. This is due to the fact that the Department of Mathematics has replaced generations of teaching staff during the reporting period, as demonstrated by Table 3.4.2.3.

Table 3.4.2.3.

PBSPMS teaching staff changes

Teaching	2013/2014	2021/2022
Asmuss Svetlana	professor	professor
Āboltiņa Baiba	lecturer	lecturer
Barānova Daira	lecturer	lecturer
Belovs Mihails	professor	-
Bēts Raivis	-	docent
Bičevskis Raivis	docent	-
Budkina Nataļja	university teacher	university teacher

Buiķe Margarita	docent	-
Bula Inese	associate professor	professor
Buliņa Elīna	-	university teacher
Buls Jānis	associate professor	acting professor
Cepītis Jānis	associate professor	-
Cibulis Andrejs	professor	professor
Delesa-Vēliņa Māra	-	university teacher
Dzenis Māris Gunārs	-	university teacher
Gredzens Jānis	-	university teacher
Grigorenko Olga	-	docent
Gultniece Iveta	lecturer	-
Helmane Inga	-	university teacher
Juhņeviča Kristīne	-	lecturer
Kalugins Emīls	-	university teacher
Lapa Lauma Terēze	lecturer	lecturer
Lapiņa Halina	lecturer	-
Lietuvietis Ojārs	associate professor	-
Luguzis Artis	-	lecturer
Marinaki Maksims	-	acting lecturer
Nīmande Elita	docent	-
Pahirko Leonora	-	lecturer
Purmalis Oskars	-	lecturer
Purmalis Kārlis	-	associate professor
Reinfelds Andrejs	professor	-
Rezepina Irina	lecturer	-

Siņenko Nadežda	docent	-
Smirnovs Sergejs	-	docent
Smotrovs Jānis	-	university teacher
Šostaks Aleksandrs	professor	-
Uļjane Ingrīda	docent	-
Valeinis Jānis	docent	professor
Veide Mārtiņš	university teacher	university teacher
Vēzis Viesturs	associate professor	docent
Vīnkalna Evija	-	lecturer
Zīlīte Agnese	-	lecturer

Comparing the situation in 2012 at the level of specific teaching staff (Table 3.4.2.3.) shows that 13 teaching staff out of 24 are no longer teaching courses in PBSPMS. Most of them have exceeded retirement age, but in one case the faculty member has gone to work for the bank. The changes have succeeded in compensating young workers with good knowledge in the fields of study courses and skills in dealing with practical challenges, which opens up a sustainable view in the future.

The content of classical mathematics courses ("Mathematical Analysis I, II, III", "Algebra I and IIS", "Analytic Geometry", "Differential Equations I", "Introduction in the Complex Analysis", "Operations Research", "Methods of Optimization", "Numerical Methods I, II") has not changed significantly in the reporting period; changes in the composition of the teaching staff have not affected the quality of studies.

But the composition of teaching staff in those study courses related to professional orientation has changed significantly ("Mathematical Statistics", "Probability Theory", "Random Processes", "Mathematical and Statistical Software Packages", "Time Series Analysis", "Mathematical Foundations of Econometric Analysis”). In the academic year 2013/2014, all these activities were carried out by docents N. Sinenko and J. Valeinis. Currently, N. Sinenko is an employee of the *Latvijas Banka*, while J. Valeinis has become a leading professor in probability theory and mathematical statistics and has mentored several new faculty members: M. Delesa-Vēliņa (18.03.2022 defended his doctoral thesis and obtained a PhD in mathematics), L. Pahirko, A. Luguzis, J. Gredzens. But new professionally oriented study courses have also been developed (course works "Introductory Course Working with Data" and "Course Work Using the Package R", as well as "Mathematical Models in Data Science" and "Mathematical Models in Finance"), therefore the reinforcement of teaching staff is needed. The young teaching staff are also practitioners of their field and are involved in the development of scientific and applied projects. Therefore, it can be concluded that the quality of professional study courses has changed, because the content of the study courses has changed, it has become more practical and more oriented towards the professional side. From the perspective of students and employers, this is a good change.

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).

The teaching staff co-operation takes place at four levels:

- personal contacts,
- inter-branch cooperation (meetings of the Chairs),
- cooperation at DM level (DM meetings and Board meetings),
- institutional cooperation.

The cooperation of the teaching staff involved in PBSPMS is regular. For example, there are regular meetings of the Chairs and Department of Mathematics, which discuss issues relating to the development of study courses, the promotion of cooperation, the raising of qualifications for teaching staff, the introduction of student proposals in the training process and the consideration of other topics related to the provision of the study programme.

In a number of study courses (e.g. “Algebra I”, “Mathematical Analysis I”, “Mathematical Analysis II” and “Mathematical Statistics”), lectures are given by a more experienced teaching staff, while the practice is conducted by a doctoral student, scientific assistant or lecturer. The content and continuity of the course in the material presentation should be agreed between the two teaching staff.

There is also cooperation with non-FPMO teaching staff providing general education courses. Five of these study courses are read for a number of study programs, and PBSPM's impact on the content of these study courses is weak. Study courses are selected on the basis of the content decided by other faculties.

Following the creation of the Council for the Direction of Studies (CDS), the Mathematical Studies Programme Council, which took control of the content of the study courses, lost its role. At present, the content control functions of the CDS study courses have been entrusted to the DM Board. The Board of Governors of DM examine the content of all new and substantially altered study courses.

Academic staff regularly update the content of study courses, adapting them to new requirements and trends. The quality of course descriptions is maintained, taking into account the academic standard for the development of descriptions of all courses and knowing the importance of the information contained in them in ensuring a high quality study process. Teaching staff respect the principles of student-centred education, while acknowledging the practical nature of the vocational study programme. There is also cooperation with employers (some employers are also teaching staff) to improve the content of study courses in line with employers' vision. Cooperation with employers is carried out through student practices, as well as in the Bachelor's Work Defences Commission, the largest party is employers' representatives. Discussions after the thesis defence commission give the teachers involved an incentive to continue teaching courses in the same way as in the past or to make changes. Thus, intercommunication between teaching staff ensures the consistency of study courses in the course of the study programme with the objectives and objectives pursued by the programme.

In the implementation of the PBSPMS in 2013/2014, 24 teaching staff were involved, with a total of 135 students (to be taken into account at the time the duration of the study programme was 4.5 years), with a ratio of 135:24≈5.6. Now in 2021/2022 when 29 teaching staff are involved, the ratio between the number of students and the number of teaching staff (to 102 students 29 teaching staff) is 102:29≈3.5.

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	annex_PBSPMS_Sample of the diploma and its supplement.pdf	piel_PBSPMS_Diploma un tā pielikuma paraugs.pdf
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	3.5.annex_PBSPMS_Statistics on the students in the reporting period .docx	3.5.piel_PBSPMS_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	3.6.annex_PBSPMS_Compliance with the study programme with the State Education Standard.docx	3.6.piel_PBSPMS_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)	3.7.annex_PBSPMS_Compliance of the qualification to be acquired upon completion of the study programme.docx	3.7.piel_PBSPMS_Studiju programmā iegūstamās kvalifikācijas atbilstība profesijas standartam.docx
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	3.8.annex_PBSPMS_Mapping of the study courses.docx	3.8.piel_PBSPMS_Studiju kursu kartējums.docx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	3.9.annex_PBSPMS_The curriculum of the study programme.docx	3.9.pielikums_PBSPMS_StudijuPlani.docx
Descriptions of the study courses/ modules	3.10.annex_PBSPMS_Descriptions of the study courses.docx	3.10.piel_PBSPMS_Studiju kursu apraksti.docx
Description of the organisation of the internship of the students (if applicable)	3.11.annex_PBSPMS_Description of the organisation of the internship of the students.docx	3.11.pielikums_PBSP_MatStat_prakses_nolikums.docx
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)		

Particle Physics and Accelerator Technologies (51443)

Study field	*Physics, Material Science, Mathematics, and Statistics*
ProcedureStudyProgram.Name	*Particle Physics and Accelerator Technologies*
Education classification code	*51443*
Type of the study programme	*Doctoral study programme*
Name of the study programme director	*Mārcis*
Surname of the study programme director	*Auziņš*
E-mail of the study programme director	*marcis.auzins@lu.lv*
Title of the study programme director	*profesors, Dr. habil. phys.*
Phone of the study programme director	*+371 29267402*
Goal of the study programme	*To provide the students with an opportunity to undertake scientific research and obtain a doctoral degree in high-energy particle physics and accelerator technologies in Latvia and to prepare world-class scientists with highly sought-after skills and competencies.*
Tasks of the study programme	*To prepare world-class specialists in high-energy particle physics and accelerator technologies. To provide students with such experience as to make them a sought-after workforce both in science and in the wider economy. To strengthen the scientific research community in Latvia and to strengthen the scientific collaboration between Latvia and CERN.*
Results of the study programme	*1. The ability to analyse the obtained knowledge and information, as well as to synthesize new knowledge arising from the analysis of the information gained. 2. The ability to identify specific, relevant to their research aspects of the information and knowledge gained and to utilize it in their research activities. 3. The ability to individually perform research work, to determine and perform the research activities necessary to obtain the expected scientific results and outcomes and to critically evaluate the quality of the obtained results. 4. The ability to find and utilize additional sources of information and knowledge to further develop their research skills. 5. The ability to collate and present the knowledge and results gained through their research activities; the ability to communicate the importance of said knowledge and results to various audiences. 6. The ability to appropriately use the research results and outcomes of other researchers for furthering their own research work and to gain further knowledge and understanding; the ability to assist and advice other researchers and to provide assistance to the development of their field of research in the country.*

Final examination upon the completion of the study programme	*At the end of their studies a student will have successfully defended their thesis (dissertation). Doctor of Science (Ph.D.) is awarded when a doctoral thesis, containing scientific novelty and appropriate scientific data, analysis and results, is successfully submitted and defended by the student in their respective scientific field.*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*192*
Admission requirements (in English)	*Master of natural sciences or engineering, or comparable education.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctoral Degree of Science Doctor of Science (Ph.D.) in Engineering and Technology*
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 - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*192*
Admission requirements (in English)	*Master of natural sciences or engineering, or comparable education.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctoral Degree of Science Doctor of Science (Ph.D.) in Natural Sciences*
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 - 4 years - english

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*english*
Amount (CP)	*192*

Admission requirements (in English)	*Master of natural sciences or engineering, or comparable education. Studies in English require English language skills at least at B2 level.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctoral Degree of Science Doctor of Science (Ph.D.) in Engineering and Technology*
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 - 4 years - english

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*english*
Amount (CP)	*192*
Admission requirements (in English)	*Master of natural sciences or engineering, or comparable education. Studies in English require English language skills at least at B2 level.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctoral Degree of Science Doctor of Science (Ph.D.) in Natural Sciences*
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

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.

The study programme was licenced on 29 September 2021. Its implementation started in the autumn semester of 2021 by enrolling five doctoral students.

On 29 July 2022, the "Amendments to the Law on Scientific Activities" entered into force. According to this law, the degree of "Doctor of Science" is now awarded in the relevant branch group of science. On 27 September 2022, the Cabinet of Ministers issued new Regulation No 595 "Regulations on Latvian branch groups, branches and sub-sectors of science". Consequently, there is a change in the degree to be awarded compared to the one entered in the licensing. In the doctoral study programme "Particle Physics and Accelerator Technologies", after successful defence of the doctoral thesis (dissertation) in the branch of Physics and Astronomy, the following degree is awarded

Doctoral Degree of Science Doctor of Science (Ph.D.) in Natural Sciences

or

after successful defence of the doctoral thesis (dissertation) in the branch of Mechanical Engineering and Mechanics, the following degree is awarded

Doctoral Degree of Science Doctor of Science (Ph.D.) in Engineering and Technology.

No other changes have been made to the parameters of the study programme.

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.

Within the study programme, students will acquire theoretical and practical skills for experimental high-energy physics research and become world-class specialists in this field of science. High-energy physics or particle physics is a branch of physics focused on research of the most fundamental laws of nature and their interactions. Consequently, particle physics is one of the most advanced and popular branches of physics in the world, attracting the best doctoral students and young researchers. High-energy physics research is carried out mainly using grandiose physics experiments that collect data and carry out studies in particle collisions, which in turn are created using particle accelerators. These particle accelerators are benchmarks for modern engineering equipment, and their creation and operation includes a huge set of interdisciplinary physics and engineering solutions. For example, the Large Hadron Collider (LHC) located at CERN is the largest and technologically most sophisticated man-made piece of equipment in the world. Accordingly, research and development of technologies involved in the development of particle accelerators attracts a large number of enthusiastic young scientists, researchers and engineers.

The primary objective of the study programme is to ensure the possibility of performing doctoral studies and obtaining a doctoral degree in high-energy physics and accelerator technologies in Latvia.

The primary condition for enrolment to the study programme is a Master’s degree obtained in an appropriate, compatible branch of research or science. Appropriate and compatible branches of science and research include branches of physics, astronomy, mathematics, computer science and engineering industries. The primary language of the study programme is English. The study programme enrols students who are able to demonstrate their knowledge of English corresponding to at least level CEFR B2. If necessary, students will be given the opportunity to improve their level of English during the study programme.

The duration of the study programme is 4 years broken down into 8 semesters (48 weeks x 4 = 192 weeks).

The volume of doctoral studies is 192 CP (1 CP/week x 192 weeks). The volume of the programme and the total duration of studies is the same for students with different prior education: 192 CP– full-time studies. Research work during studies is performed in cooperation with appropriate international scientific centres, for example, CERN, and by including into an appropriate research experiment and/or group, for example, in the CMS experiment. During the study programme, students are intended to spend a long-term attachment (LTA) in the specified international research laboratory. The time spent in LTA is considered a traineeship time. The optimal time spent in LTA is from 12 to 24 months in the second and/or third year. If for justifying reasons the student cannot spend time in an international laboratory, the student talks with his/her work supervisor finding a proper solution for continuing studies in Latvia. By individually assessing the amount of work performed and with the agreement of the work supervisor, the thesis can be submitted in an accelerated manner, but not earlier than three and a half years after the commencement of studies to provide the full scope of knowledge, skills and competences to be learned.

The study program has four tracks: one awarding a degree in physics and astronomy (particle physics) and one awarding a degree in mechanical engineering and mechanics (accelerator technologies), with both of these tracks duplicated in Latvian and English.

The different degree tracks are needed in order to award the student with a degree, which his maximally aligned with their actual research.

The program is predominantly implemented in the English tracks, as it aims to attract foreign students, however, the program can also be implemented in Latvian tracks in years, where the entire cohort is made up of Latvian students.

In view of the above, the study programme is fully in line with the study field “Physics, Material Science, Mathematics and Statistics”.

The parameters of this study programme are optimised such to allow the students to acquire all of the knowledge, skills and competences needed. The duration of the programme (4 years) is also optimal, allowing for the students to acquire the necessary theoretical base in the year one of study and to focus predominantly on their research in particle physics or accelerator technology development for the remaining three years. The degrees awarded to the graduates of this programme will be fully in line with one of these two fields of research, degree in physics and astronomy and a degree in mechanics and mechanical engineering, respectively.

Knowledge to be learned. Graduates of the study programme will acquire a full theoretical knowledge base and have a deep understanding of the selected specialisation of the study programme. This theoretical knowledge will be acquired by attending study courses specially designed and adapted for the study programme, as well as by attending appropriate schools, conferences and seminars during the course of studies. High-energy physics students will learn in depth the theory of particle physics, including the basic principles of quantum field theory, the Standard Model, and physics beyond the Standard Model. Accelerator technology students will learn in depth the theory of the physical operating principles of particle accelerators, basic principles of engineering solutions used to construct them, as well as the theoretical principles of the currently most advanced and researched accelerator technologies. In order to promote interdisciplinarity, study courses dedicated to learning of the main theoretical knowledge of two specialisations will be provided in divided times, encouraging students to learn not only the theoretical knowledge base the need most but also the theoretical knowledge of the second specialisation. In addition to the above, students from both specialisations will gain an in-depth understanding of the design of particle detectors, the theory of statistical and systematic analysis of data, and theoretical basic knowledge of radiation safety. Theoretical knowledge and understanding acquired during studies will make it possible for graduates of the study programme to become highly qualified and internationally competitive researchers and scientists in high-energy physics and accelerator technologies.

Skills to be acquired. Graduates of the study programme will acquire the skills to carry out independent scientific and research work, which includes the ability to find and understand causal links, to carry out qualitative and quantitative analysis of the data obtained, to apply existing most advanced research methods in high-energy physics or accelerator technologies, and to create and develop new research methods and tools by gaining new scientific and technological insights. These skills will be cultivated by carrying out independent scientific and research work during the development of the doctoral thesis. When drafting a doctoral thesis, students will use theoretical knowledge acquired in study courses and, by gaining new insights when drafting the paper, will widen the existing theoretical knowledge limit in high-energy physics or accelerator technologies. In addition to the above, students will acquire a broad range of interdisciplinary and transferable skills, such as computer programming and data processing, analysis and long-term preservation skills. Over the course of the study programme, the student will develop and strengthen scientific and general communication skills.

When attending study courses, schools, seminars and conferences, as well as training lower-level students at the university, doctoral students will acquire the skill to communicate scientific concepts and insights of general sciences, as well as those specific to their branch and their research activities to different target audiences.

Competences to be acquired. During the study programme, the student obtains the ability to plan, structure and to perform in the long-term and large-scale research work in high-energy physics and accelerator technologies. The student will be able to identify gaps within the existing knowledge limit, as well as to recommend, justify and perform scientific activities to fill such gaps and to extend the existing knowledge limit. The student will acquire the ability to lead scientific research activities of other researchers and scientists, as well as to recommend best research methods for achieving specific results. In addition, the graduate of the study programme will be able to introduce, demonstrate and approbate new research approaches and methodologies. The student will acquire sufficient above-mentioned theoretical knowledge and skills to be able assess and understand the existing state of the branch of research as a whole, and explain the strategic vision, necessity and potential contribution of the branch to the scientific community, the general public and action policy makers. Graduates of the programme will acquire the level of competence in high-energy physics or accelerator technologies competitive in the world to become internationally competitive scientists able to play a leading, accountable role in the further organisation and performance of research work in their branch.

The above-mentioned tasks of the study programme rare inextricably linked and can be performed during the defined period of the study programme. Their fulfilment, as well as the acquisition of the necessary knowledge, skills and competences, will be assisted by an extended traineeship, which will be completed at an appropriate scientific centre, such as CERN. During this traineeship, the student will have easy and permanent access to an extremely wide range of high-energy physics and accelerator technology experts, as well as the possibility to carry out a variety of practical works, outside of their specific research work, which will allow for the extension, supplementing and application of theoretical knowledge and skills acquired.

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

Graduates of the study programme, scientists with a doctoral degree in high-energy physics and accelerator technologies, will have acquired appropriately high knowledge, skills and competences so that they can continue their careers by choosing from an extremely broad range of employment options. Young scientists will be able to pursue academic and scientific careers in Latvian, foreign and international universities, laboratories and research centres; graduates will also be able to continue their careers in both the private and public sectors, such as information technology and engineering companies, the financial sector, as well as in local governments, ministries and other public administration institutions. According to the study carried out by the European Science Foundation in 2017, 89% of natural sciences PhD recipients in Europe find a full-time job immediately after they acquire the doctoral degree (57% find permanent work, 32% contract work) and in engineering and technologies these are 93% of PhD recipients (75% permanent work, 18% contract work). The great difference between natural sciences and engineering in the percentage of permanent and contractual work is due to the fact that the PhD recipients in natural sciences are most likely to choose a post-doctoral research path.

To describe physics PhD recipients and potential employers we can refer to the study of the American Institute of Physics of 2019 (https://www.aip.org/statistics/reports/physics-doctorates-initial-employment-2016). This study shows that 94% of physics PhD recipients are employed immediately after getting the degree, with 47% continuing their research career as a post-doctoral researcher, 40% getting potentially permanent employmentin the private or public sector, and 7% being employed in other short-term jobs, for example, in the development of different projects. Of those employed in the private and public sectors, most PhD graduate continue careers in the business and financial sector, information technology companies and engineering companies. Although the labour market in the United States and Latvia is not directly comparable, they are very similar in terms of the traditions and opportunities of the labour market, which allows for the provision of the statistics mentioned above about the potential employment directions of physicsand engineering PhD recipients.

Graduates of the study programme will be a highly qualified workforce with excellent data processing and analysis skills, able to work across a broad range of professions, such as the financial sector, the ICT (information and communication technologies) sector, engineering companies and other sectors. There is evident lack of such STEM (Science, Technology, Engineering, Mathematics) degree recipients in Latvia. Graduates of this programme will make a strong contribution to filling this gap.

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.

The implementation of the study programme started in the autumn semester of 2021. Taking into account that the study programme was not implemented before, it is not possible to carry out an analysis of the dynamics of the number of students and assessments.

Six doctoral students funded by the state budget from Latvia and Italy, as well as one foreign student from Montenegro, have been enrolled to the programme at the time of drafting this document. Taking into account the composition of international students, as well as the fact that several study courses are mastered by students from foreign teaching staff, in close cooperation with the researchers of CERN Baltic Group, CERN and other researchers, the study programme is implemented in English.

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).

The study programme is implemented in cooperation between two of Latvia’s leading universities – RTU and University of Latvia. Graduates of the study programme will acquire a scientific doctoral degree in physics and astronomy or mechanical engineering and mechanics.

The universities implementing the study programmes are the leading scientific institutions in Latvia and cover complementary scientific directions for each other. The University of Latvia is Latvia’s leading university in natural sciences while RTU is Latvia’s primary engineering university. Cooperation fully provid esthese institutions with all they need for the successful implementation and development of this study programme. Despite the above, both universities work in close cooperation and jointly implement all study parts, each bearing responsibility for the study courses under their control.

The two partner universities are selected due to being the two strongest and largest universities in Latvia, which allows this program to offer greater accessto resources for the students.

The development and partly the implementation of the study programme was carried out by a working group and now Study Programm working group composed of representatives from RTU, University of Latvia, CERN and CERN Baltic group. The rights, duties and responsibilities of the study program council are stipulated in the cooperation agreement concluded on August 12, 2022 between RTU and LU on the implementation of the joint doctoral study program "Particle Physics and Accelerator Technologies".

All activities for the development and implementation of the study programme are carried out in close cooperation with CERN Baltic Group (CBG). CBG is an official, statute-based, international group, in which leading Baltic universities and research institutes, whose scientific activities are linked to CERN, cooperate. CBG consists of eight universities and institutes in Latvia, Lithuania and Estonia:

- National Institute of Chemical Physics and Biophysics (NICPB), Estonia;
- Tallinn University of Technology (TalTech), Estonia;
- University of Tartu (UT), Estonia;
- Riga Stradiņš University (RSU), Latvia;
- University of Latvia (LU), Latvia;
- Riga Technical University (RTU), Latvia;
- Kaunas University of Technology (KTU), Lithuania;
- Vilnius University (VU), Lithuania.

CBG partners were involved in the development of the study programme mainly as experts and in the implementation – as experts and teaching staff. In the development process, the task of the experts was to make recommendations, as well as to carry out a thorough study of the content of the study programme, including the mapping of the study programme, the content of study courses and the objectives of the study programme, the possibility ofachieving them and assessment.

The study programme development working group was complemented by experts from CERN, as well as representatives of Latvian businessmen and employers, who were involved both as experts and as consultants. Doctoral students, whose research work corresponds to the target audience of the study programme, were also involved in the development of the study programme.

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 duration of the study programme is four full years, with the possibility of graduating faster, but not earlier than three and a half years after the beginning of the studies. The study programme includes two main specialisations of studies – high-energy physics or accelerator technologies. The study programme is implemented as lectures and independent work, which also includes independent scientific and research work, including by having a traineeship in an appropriate scientific centre, such as CERN, as well as the drafting of a doctoral thesis.

Study courses to be attended within the framework of the study programme are divided into compulsory, restricted elective and free elective courses, receiving 15, 21 and 6 credit points, respectively. Attendance of all lecture courses is planned in the first year of studies, while the rest of the studies is mainly intended for research work. Study courses are taught at Riga Technical University [RTU] and the University of Latvia [LU] .

The compulsory study courses intended for students in the high-energy physics specialisation (hereinafter – physics specialisation) are the Particle Physics Theory, Particle Detectors, Computing and Programming for Physicists, Statistical Methods in Data Analysis and Radiation Safety. The compulsory study courses intended for students in the accelerator technologies specialisation (hereinafter – accelerator specialisation) match with physics specialisation courses, while the accelerator specialisation course replaces the Particle Physics Theory course. These five compulsory courses have been selected in such a way as to allow students to acquire all the necessary basic knowledge in their respective study specialisation and in-depth knowledge in their respective study specialisation.

The study programme includes the following compulsory study courses:

Particle Physics Theory, 8 credit points, 12 ECTS, [RTU]. The main course in the physics specialisation will provide a full overview of the theory of the modern particle physics theory, from symmetry groups and the basics of the quantum field theory, to the description and phenomenology of the Standard Model of particle physics. This course will provide students with a modern appropriate theoretical knowledge base, which will enable students to continue their research activities in this field of science independently.

Accelerator Technologies, 8 credit points, 12 ECTS, [RTU]. The main study course in the accelerator specialisation will provide a review of the most advanced accelerator technologies and the full review of theoretical knowledge needed for accelerator physics. This course will provide students with a modern appropriate theoretical and practical knowledge base, which will enable students to continue their research activities in this field of science independently.

Particle Detectors, 2 credit points, 3 ECTS, [RTU]. This course will include a full review of particle-matter interaction and provide students with an understanding of the design of experimental high-energy experiments. The course will include a theoretical base of particle-matter interactions, and allow students to understand more deeply the way experimental high-energy physics data are obtained and how particle accelerators are controlled.

Computing and Programming for Physics, 2 credit points, 3 ECTS, [RTU]. This course will provide the students with computing and programming skills vital to further research in high-energy physics or accelerator technologies, including basic skills in Python and C++ programming languages. In addition, the course will provide the student with basic knowledge of the use of auxiliary software such as Git and LaTeX.

Statistical Methods in Data Analysis, 2 credit points, 3 ECTS, [LU]. This course will provide the student with the required base of mathematical and statistical analysis to be able to successfully carry out independent research work both during and after doctoral studies. The knowledge acquired will allow the student to understand more deeply the data and information obtained during the research work, their quality and their relevance.

Radiation Safety, 1 credit point, 1.5 ECTS, [LU]. This compulsory study course is necessary to provide students with an absolutely necessary level of understanding in relation to ionising radiation. The course will provide information on different types of ionising radiation, on methods to avoid negative radiation effects, and on how to ensure personal safety and safety of others when handling sources of ionising radiation. In addition to understanding, students will also get a radiation safety certificate that will allow students to handle sources of medium hazard radiation.

The content of compulsory study courses is fully relevant and sufficient to prepare highly qualified and internationally competitive researchers in the respective scientific directions. In addition to compulsory study courses, the study programme will also offer specially designed restricted elective study courses: Introduction to Particle Physics, Mathematics in Particle Physics, Relativity and Cosmology, Particles for Medical Physics, Data Science for Physics, Laboratory Exercises in Electronics and Introduction to CAD. These courses will not only provide students with a wider set of relevant knowledge, but will also help to further and more closely link the content of compulsory courses, allowing students of both specialisation to acquire an interdisciplinary knowledge base.

The study programme includes the following free restricted elective study courses:

Introduction to Particle Physics, 2 credit points, 3 ECTS, [RTU]. The aim of this course is to assess and align the theoretical level of knowledge of students in the physics specialisation, and to offer students of the accelerator specialisation an understanding of the foundations of high-energy particle physics.

Mathematics for Particle Physics, 4 credit points, 6 ECTS, [LU]. This course will allow interested students to understand even more deeply the basic theoretical and mathematical principles of particle physics, such as Lie algebra and Fourier transformations.

Relativity and Cosmology, 4 credit points, 6 ECTS, [LU]. Modern cosmology is the second of the two most fundamental directions of research in physics, which, unlike high-energy physics, studies our universe at the greatest scale. This course will provide students with an opportunity to further understand the laws of physics in our universe by covering fundamental physics theories such as General relativity.

Particles for Medical Physics, 4 credit points, 6.0 ECTS, [RTU]. The purpose of this course is to familiarise students with the application of particle physics and accelerator technologies in medicine. Students will be given an in-depth insight into radiotherapy, brachytherapy and radiosurgery and prepare students for a potential career in radiology.

Data Science for Physics, 4 credit points, 6 ECTS, [RTU]. This course will give students the opportunity to acquire basic knowledge and a general understanding of modern data science and machine science and will set out in detail and allow them to learn basic aspects of data science and machine science that are widely used in high-energy physics experiments.

Laboratory Exercises in Electronics, 3 credit points, 4.5 ECTS, [RTU]. The purpose of this course is to familiarise students with the operating principles of electronic components used in particle detectors and accelerators. Within the course, the student will acquire a general understanding of materials, equipment and systems that are widely used in the above-mentioned research directions and provide basic skills for their use.

Introduction to CAD, 3 credit points, 4.5 ECTS, [RTU]. Computer modelling is an extremely widely used design and prototyping technique in engineering and is indispensable in the development process of high-precision equipment, such as particle detectors and accelerators. As part of the course, students will be familiarised with computer modelling software as well as basic skills in its use.

The above-mentioned compulsory and restricted elective courses are about basic principles considering modernity, relevance and interdisciplinarity. The main courses of the specialisations of the study programme, the Particle Physics Theory and the Accelerator Technologies, which must be studied by students of the physics specialisation and accelerators specialisation, respectively, offer the most advanced scientific review of the specific research direction. For the promotion of interdisciplinarity, these same study courses are offered to students of the other specialisation as restricted elective courses. Similarly, all remaining compulsory and restricted elective courses have been selected in such a way as to promote interdisciplinarity between the fundamental science and engineering aspects offered by the study programme. The study courses proposed are comprehensive, relevant and fully sufficient to provide students with all the necessary knowledge, competence and skills to pursue a successful research career. During the study programme, students perform research work of 150 credit points based on an individual plan in high-energy physics and/or accelerator technologies.

The program is predominantly implemented in the English tracks, as it aims to attract foreign students, however, the program can also be implemented in Latvian tracks in years, where the entire cohort is made up of Latvian students. There are no substantive differences between the Latvian and English tracks, with the exception of the availability of guest lecturers, who would give their lectures in English even for the Latvian-tracked students.

The study programme is implemented as lectures and independent work, which also includes independent scientific and research work, including by having a traineeship in an appropriate scientific centre, such as CERN, as well as the drafting of a doctoral thesis. Learning of all lecture courses is planned in the first year of studies, while the rest of the studies (three years) is mainly intended for research work.

Since the licence was received too late, in the study year 2021/22, the timetable of study courses has a slight shift, resulting in some courses being offered to students enrolled this year in their second year of studies. In future years of studies, the study programme will be implemented based on the initial plan.

The main role of the partner institutions is to provide access to the experts and teaching staff in Latvia. UL is Latvia's leading university in natural sciences, including physics, whilst RTU is the leader in Latvia in technology sciences. Together the two universities are able to provide an appropriate level of expertise in the both fields of science concerning this study program.

The chief aim of the study courses offered is to provide the students with an appropriate level of knowledge and skills in order for them to successfully carry out independent research during their studies and beyond, which is fully in line with the overall aims and achievable results of the study program as a whole.

Information included in the study courses, as well as their attainable goals and objectives are mutually interconnected and developed such as to fulfill the three main objectives of a set of doctoral study courses: to give all students an overall insight in the state-of-the-art of the fields of high-energy particle physics and accelerator technologies; to provide the students with an in-depth theoretical knowledge in their respective field of science; to give all students the opportunity to attain a broad spectrum of skills needed for carrying out their research. The course offered by this program are highly topical and provide students with the knowledge and skills that are highly sought after in the modern labour market, such as statistical analysis of data, C++/Phyton programming and machine learning.

Study courses are designed so that graduates are not only world-class research staff, but also so that graduates are able to integrate into a broad range of labour market sectors.

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).

Modern high-energy physics studies mostly take place in grandiose experiments. For example, the CMS experiment at CERN is a 14,000 ton, 21x15x15 meterexperiment that requires huge human and monetary resources to ensure its operation. Such resources are not available to any individual national science programme. This means that, in general, all modern high-energy physics experiments take place in international scientific cooperation, laboratories and experiments, and national scientific programmes should ensure participation in them to enable national researchers to carry out scientific work. Students inthe study programme will perform particle physics analyses analysis and/or develop detector components in CMS or other equivalent experiment. About 1,000 doctoral students from around the world participate in the CMS experiment at any time. In this programme, students will develop a doctoral thesis comparable in quality and methodology to the standards adopted in this field.

Such physics activities require continuous improvements in accelerator technologies and innovations, which will be carried out by students in the accelerator specialisation during studies.

With growing capacity, Latvia’s involvement in other experiments is expected both in CERN and in other scientific laboratories. For example, involvement inone of the neutrino physics programme experiments in the United States or Japan is possible and recommended in the future. Neutrino physics is a rapidly growing sub-field of experimental high-energy physics with an extremely high potential for fundamental discoveries.

The 27 km-long LHC development programme was approved in 1994, the first beams were injected into it in 2008 and the end of its physics programme is planned for 2040. In parallel, an active study of future accelerators and their high-energy physics experiments is underway. One of the potentially grandiose and, at a given moment, the most realistic projects is the Future Circular Collider (FCC). This 100 km accelerator based at CERN uses the existing LHC as one of the pre-accelerators. In the event of the final approval of the FCC, Europe will continue to be the leader in high-energy physics and the development of accelerator technologies at least until the end of the 21st century.

According to the above, high-energy physics and the development of accelerator technologies are a modern field of science that is expected to be topical fora very long time. Therefore, this programme also has an extremely high prospects of development and topicality. In this programme, students will submit doctoral theses that will be evaluated based on the highest standards, and the quality of the submitted papers will be at least equal to the doctoral theses drafted by students from other countries performing research at CERN.

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.

Oral, written and combined study and assessment methods are used during study courses and in tests.

A variety of techniques for acquiring and strengthening knowledge, such as introductory lectures, interactive lectures, summary lectures, problem-oriented lectures, are used in studies. Practitioners, professionals from different institutions are invited to teach individual lectures in study courses to promote the unity of theory and practice. Practical tasks, seminars, individual, pair and group work, discussions and project development, field trips to industry organisations are widely used. Employers are involved in the implementation and improvement of study courses (invited to lead individual seminar classes, classes are often organised as experience exchange visits to the workplaces, etc.).

In order to promote the development of students' research competences, students in successive courses have the opportunity to analyse and study in depth the problems of their interest in the field. Senior students are involved in leading peer teaching-learning.

Seminars during study courses promote the speech, presentation and discussion skills of students.

In order for students to achieve the learning outcomes – learn and strengthen knowledge, skills and develop competences – methods where student activity is important dominate in the students' activities. The study process uses methods to promote student communication in the performance of study tasks, resolving real problems of the field, modelling situations.

The student evaluation methods ensure that the student will obtain an appropriate level of understanding in each of the study courses in order to be able to independently utilise this knowledge in their research work or in the broader job market. The methodology for the studies and acquisition of the necessary skills is based on intensive study courses and maximising the time allocated for the research work. This allows for the optimum development of the research skills, which is fully in line with the overall aims of the study program.

The physical environment of studies is also gradually changing: auditoriums can be easily transformed for group work, individual work, students can use digital technologies. Lecturers mostly use methods that encourage active participation of students, critical thinking and reflection. The e-study environment will be used in the study process and to promote independent studies. For each study course, an e-study environment (Moodle) has been established, where students have access to lesson materials, task descriptions, additional training materials related to course topics, as well as study tasks (tests, forums, seminars, conferences, etc.). All assessments of interim and final examinations of study courses are recorded with an explanation of the mark and made available to students in the e-study environment.

The running of the study program is overseen and regulated by the study program council, with representatives from RTU, UL, CERN and the CERN Baltic group. The council ensures that the two partner universities are implementing the study program in a cohesive manner both in terms of the study courses and the evaluation of the student's research performance. The students themselves are closely involved in the planning of their own research work for the entire duration of their studies. Students are involved in the development of the study program as well via provision of recommendations to the study program directors and/or the management of the structural units responsible for the implementation of the study program. Likewise, the students are asked to provide informal feedback on the quality and content of lectures directly to the lecturers in order to improve and optimise individual study courses.

The student-centred approach is followed when updating study programmes and their study courses, with a particular focus on meaningful formulation of learning outcomes, in order to promote dialogue between lecturers and students on the content of studies, forms and methods of organisation. In turn, properly formulated study results contribute to students' understanding and co-responsibility for their learning, self-assessment and understanding of the assessment they have received. In the study process, lecturers use methods, test forms and assessment criteria relevant to the objective of the studies and the planned learning outcomes.

In the study process, students receive support and feedback from lecturers. The assessment criteria for giving marks have been published in advance. The assessment gives students the opportunity to show, to what extent they have achieved the expected learning outcomes.

In line with the principles of student-centred studies, student mobility (recognition of learning outcomes) is promoted, students engage in research and social activities initiated by academic staff in the community, thereby gaining significant experience using in practice what was learned during studies. When implementing internal quality assurance policies, study programmes are implemented in such a way that students are encouraged to be actively involved in the improvement of the study process. There is a procedure for submitting of proposals by students and resolution of complaints, examination of appeals of students. The results of student surveys are assessed and taken into account in the improvement of the study process. Students willingly make their recommendations for improving the study programme and the process in talks with lecturers, programme directors.

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).

The promotion of the student is the responsibility of the university, to the Doctoral Council of which the student has submitted his/her doctoral thesis. The study programme provides that students may defend their doctoral theses in universities in already existing doctoral councils: RTU – Mechanical engineering and mechanics science branches; LU – Physics and astronomical science branches.

Students also draft their doctoral theses independently with the support of the work supervisor and the relevant scientific group in CERN and Latvia. The quality of the drafted paper is assessed primarily by the work supervisor, based on whose recommendation the student submits the doctoral thesis for the final assessment. The student's work supervisor provides the student with the possibility to perform one or more pre-defences not earlier than three and ahalf years and not later than four years after the commencement of doctoral studies, unless the student's time period for the submission of the paper is extended. Following a joint decision of the student and his/her work supervisor, the defence of the student is organised in the relevant doctoral council.

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.

This study programme is in its first year and a description of the analysis and evaluation of topics of graduation papers is not yet available.

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 study process of the study programme is ensured by RTU and LU in close cooperation with CBG, as well as with support of CERN. The RTU structural unit responsible for the study programme is the Centre of High- Energy Physics and Accelerator Technologies (HEP&AT Centre). The compulsory, restricted elective and free elective courses are provided by the HEP&AT Centre, involving other relevant RTU faculties and structural units where necessary. The LU structural unit responsible for the study programme is the Faculty of Physics, Mathematics and Optics (FPMO). The compulsory, restricted elective and free elective courses are provided by FPMO, involving other relevant LU faculties and structural units where necessary.

In the study programme, the matriculation of doctoral students takes place at RTU, LU includes these students in the register of students. Nevertheless, all students in this programme have access to the informative and methodological supplies of both universities provided to students matriculated at each individual university.

The study programme offers students full access to the infrastructure and material and technical supplies specified in Part II, Section 3, Paragraph 2.3.2, as well as the methodological and informative supplies described in Paragraph 2.3.3. Finances are provided in accordance with the procedure set at LU laid down in Paragraph 2.3.1.

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).

The two universities involved, as well as CERN, are able to offer free access to necessary scientific databases, including SpringerLink, ScienceDirect, SCOPUS and the Web of Science. Similarly, the Primo Discovery database search tool is offered for the use of students from both universities, allowing for the search literature on specific topics in all available databases at each university, as well as in the LNB catalogue.

Taking into account that the study programme is implemented in close cooperation with CERN, the scientific database CERN Document Server (CDS) is available for doctoral students, including abstracts, conference presentations and similar publications available to CERN, as well as access to CERN's scientific library. The students involved in the programme have full access to the relevant CERN experiments and their data, as well as access to an extremely broad and strong range of experts.

In high energy physics, it is widely accepted that all scientific results published in scientific journals should also be published in free-access databases such as arXiV. As a publicly funded international science organisation, CERN has defined that all scientific results published using resources offered by CERN, such as the CMS experiment, or conducted in close cooperation with CERN, should also be published in one of free-access scientific databases. Therefore, the academic staff and doctoral students involved in the study programme have free access to the latest scientific results and insights in the field.

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).

Income of the programme

To provide the funds necessary for the implementation of the study programme Particle Physics and Accelerator Technologies, RTU uses:

1. state budget grant from the Ministry of Education and Science, which is EUR 9300 for full-time intramural studies for academic year 2021/2022;
2. tuition fee, taking into account all the factors listed in the "Finances" section, which has been defined for academic year 2021/2022:

For full-time intramural studies – EUR 9300 per year;

Tuition fee for full-time intramural studies for foreign students – EUR 9300.

Table 8.3.3.1

Estimated annual income of the programme, EUR

Type of study	Number of students	Study fees/State grant	Total income
Full-time (budget)	20	9292.00	185840.00
Full-time (fee)	0	0	0.00
Total, EUR			**185840.00**

Programme costs

In order to assess the amount of funds needed for financial support, UL study programmes calculate the costs according to a methodology developed by UL, which takes into account the costs described in SF Chapter *2.3.1. Financial support for the costs of ensuring the training process* and information on the study programme plan, the participating teaching staff, the planned number of students, etc., thereby ensuring the reliability of the forecasts.

Full ***- time costs*** of the programme (Full-time)

For calculations, the implementers of theDoctoral Study Programme “Particle Physics and Accelerator Technologies” use the student data of the academic year 2021./2022: 6 students are studying full-time. In the light of the above, the full-time cost of the programme per student is estimated at EUR 9195 per year and the total cost of the programme at EUR 183907 per year. A more detailed percentage of costs is shown in Table 8.3.3.2.

Table 8.3.3.2.

Percentage of costs in the study programme

	Total		UL		RTU	
Heading of expenditure	amount	% of total	Su Mma	% of total	amount	% of total
Teaching staff costs	78060	42.45%	21952.95	42.45%	56107.54	42.45%
General staff	11709	6.37%	3293.01	6.37%	8416.29	6.37%
Other costs	12000	6.53%	3374.76	6.53%	8625.24	6.53%
Infrastructure expenditure	16167	8.79%	4546.64	8.79%	11620.36	8.79%
Property and services	8362	4.55%	2351.64	4.55%	6010.36	4.55%
Indirect costs	57608	31.32%	16201.09	31.32%	41406.91	31.32%
TOTAL COSTS	183907	100%	51720	100%	132187	100%

Figure 8.3.3.1. shows the cost of the study programme depending on the number of students and the comparison with the proposed study fee and the State budget grant.

8.3.3.1. Fig. The cost of the Doctoral Study Programme "Particle Physics and Accelerator Technologies" from Number of Students (Studentu skaits - Number of students; Pašizmaksa - Cost price; Dotācija - Grant)

Based on the calculation, it can be seen that for the programme to be cost-effective and the students to have a high-quality study process, the number of students in the programme (all years together) should be at least 19.

Program Costs for Overseas Students

The program's developers plan to admit 12 foreign students in the program. At such planned number of students, the full-time cost of the sDoctoral Study Programme "Particle Physics and Accelerator Technologies" is estimated at EUR 9195 per student per year and the total cost of the programme is EUR 183 907 per year.

A more detailed percentage of costs is shown in Table 8.3.3.3.

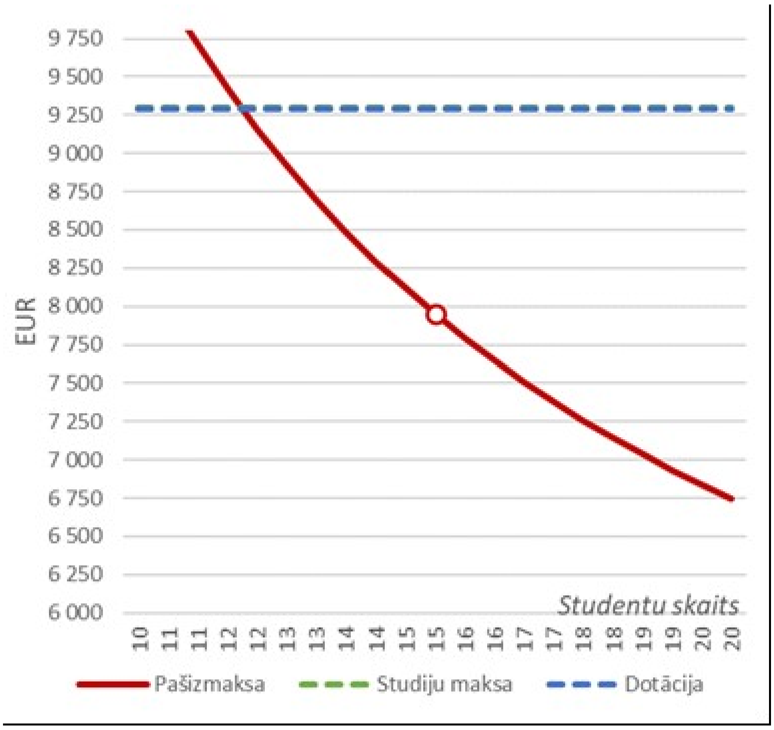
Table 8.3.3.3

Percentage of costs in the study programme

	Total		UL		OPEN the	
Heading of expenditure	amount	% of total	amount	% of total	amount	% of total
Teaching staff costs	53334	48,20%	14999,12	48,20%	38334,88	48,20%
General staff	8000	7,23%	2249,84	7,23%	5750,16	7,23%

Other costs	0	0,00%	0,00	0,00%	0,00	0,00%
Infrastructure expenditure	9709	8,77%	2730,46	8,77%	6978,54	8,77%
Property and services	5021	4,54%	1412,06	4,54%	3608,94	4,54%
Indirect costs	34596	31,26%	9729,43	31,26%	24866,57	31,26%
TOTAL COSTS	110660	100%	31121	100%	79539	100%

The figure of 8.3.3.2. shows the cost of the study programme depending on the number of students and the comparison with the proposed study fee and the State budget grant.



8.3.3.2. Fig. The cost of the Doctoral Study Programme "Particle Physics and Accelerator Technologies" from Number of Students (Studentu skaits - Number of students; Pašizmaksa - Cost price; Dotācija - Grant)

Based on the calculation, it appears that for the programme to be profitable and for students to have a quality study process, the number of students in the programme (all years together) should be at least 12.

Summary of revenue and costs of the programme

Table 8.3.3.4 summarises the revenue of the programme, depending on the number of students, the State grants and study fees, and the expenditure of the programme at such a number of students.

Table 8.3.3.4

Outcome of the programme

Type of study	Number of students	Study fees/State grant	**Total income**	**Total cost**
Full-time (budget)	0	0,00	0	0
Full-time (fee)	0	0	0	0
Part-time	0	0	0	0
Foreign students	12	9300	111600	110660
Total			**111600**	**110660**

The data in Table 8.3.3.4 demonstrate that UL and RTU have sufficient resources to implement the study programme and to ensure its further development. In addition, the development of the programme may be financed from revenue received from lifelong learning services and from financial resources accruing from the departments. Faculty also receive financial support for the development of programmes from the UL Studies Quality Development 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.

Highly qualified teaching staff from UL and RTU are involved in the implementation of the study program, as well as external experts from CERN and the CERN Baltic Group. In total, 12 teaching staff are involved in the study program. Five teaching staff participate in the implementation of the study program from the UL side, four of them have been granted LCS expert status in physics and astronomy, one in material sciences and one in chemistry.

The qualifications of the teaching staff are fully in line with the specifications of this study program; the teaching staff are researchers in high energy particle physics or are involved in projects aimed at the development of particle accelerator technologies. In certain cases, where a study course is aimed at other specific topics, the lecturer is selected such as to reflect the needs of this course.

The most qualified teaching staff of the relevant scientific directions available in Latvia are involved in the development of the content of the study programme.

The particle physics course and other closely related courses are either taught by active researchers in the field (Dr Kārlis Dreimanis) or researchers with an extensive and high-quality experience in the theory of particle physics (Prof Yuri Dokshitzer). Likewise, the responsible for the accelerator technology course and the supervision of the accelerator technology students is a researcher involved in projects aimed at the development of accelerator technologies (Prof Toms Torims). The aforementioned points allow the students to achieve high-quality research and study outcomes in their respective fields of research.

The involvement of Yury Dokshitser in the implementation of the physics specialisation should be particularly emphasises. Yury Dokshitser is a world-renowned professor of theoretical physics who has spent his career in Europe at prominent research institutes, including CERN. The involvement of UL professors Mārcis Auziņš and Vjačeslavs Kaščejevs, as well as the Head of the UL FPMO Department of Physics Dr. Guntars Kitenbergs and Director of the RTU Center of High Energy Physics and Accelerator Technologies Dr Kārlis Dreimanis in the implementation of the study programme should also be emphasised. Latvian primary expert in accelerator technology, RTU Professor Toms Torims is involved in the development and implementation of the Accelerator Technologies specialisation.

The main objective of the study programme is to be able to provide students with world-class scientific education and experience. The qualifications of the involved teaching staff is more than sufficient to achieve all the objectives set in the study programme and to ensure the highest possible quality of the studies for students.

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.

The implementation of the study programme started in the autumn semester of 2021. Taking into account that the study programme was not implemented before, it is not possible to analyse changes in the composition of teaching staff in the reporting period.

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).

12 doctors of science are involved in the implementation of study courses of the study programme, of which 10 are LSC experts in natural sciences, engineering and technologies:

1. Prof., Dr.habil.phys. Mārcis Auziņš, LSC expert in physics and astronomy (06.04.2025);
2. Prof., Dr.sc.ing. Toms Torims, LSC expert in engineering and technologies (04.11.2023);

3. Prof., Dr.phys. Vjačeslavs Kaščejevs, LSC expert in physics and astronomy (02.03.2025);
4. Prof., Dr.phys. Jurijs Dehtjars, LSC expert in physics and astronomy (24.03.2023), LSC expert in mechanical engineering and mechanics (24.03.2023), LSC expert in medical engineering (02.02.2025);
5. Prof., Dr.phys. Juris Blūms, LSC expert in physics and astronomy (03.02.2024), LSC expert in material science (03.03.2024);
6. Dr.phys. Anatolijs Šarakovskis LSC expert in material science (05.01.2025), LSC expert in physics and astronomy (06.07.2025);
7. Dr.phys. Guntars Kitenbergs, LSC expert in physics and astronomy (01.12.2024);
8. Dr.phil. Kārlis Dreimanis, LSC expert in physics and astronomy (07.10.2023);
9. Dr.sc.ing. Artis Kromanis, LSC expert in mechanical engineering and mechanics (18.09.2022);
10. Dr.chem. Elīna Pajuste LSC expert in chemistry (06.01.2024);
11. Dr.sc.ing. Māris Tērauds;
12. Dr.phys Yury Dokshitser.

Overall, in the period from 2017 the RTU teaching staff are authors or co-authors of more than 200 publications, of which 37 representative publications can be emphasised, a list of representative publications is attached.

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).

Member of Staff	Project Name	Source of funding	Amount of funding, EUR	Position
Mārcis Auziņš	*Coherent Optical Control of Atomic Systems*	Cooperation project for Latvia-Lithuania-Taiwan, 2022-2024		manager
Mārcis Auziņš	*Development of an Optical Magnetic Sensing System for Security Checkpoints, NATO Emerging security challenges divisions*	*Grant* ESC (2020) 0188 SPS MYP G5794, 2020-2023		project manager
Mārcis Auziņš	*Feasibility study of spacecraft magnetometers based on nitrogen-vacancy centres in diamond*	*European Space Agnecy project*, 2020-2021		project manager
Mārcis Auziņš	*Quantum Technologies in Space*	Cost *action* - CA15220, 2016-2020		LV coordinator

Mārcis Auziņš	*COLIMA – Coherent manipulation of light and matter via interferences of laser-dressed states*	FP7 Project, 2011-2013		project manager
Vjačeslavs Kaščejevs	*Physical aspects of quantum advantage for information and measurement technologies*	LSC, FLPP, 2018-2021		leading researcher/scientific head
Vjačeslavs Kaščejevs	*SEQUOIA: Single-Electron Quantum Optics for Interferometers and Applications*	EURAMET, 2018-2021		leading researcher
Vjačeslavs Kaščejevs	*Non-equilibrium charge dynamics in tunable-barrier single-electron current sources for metrological applications*	EURAMET, 2013-2014		leading researcher
Vjačeslavs Kaščejevs	*Silicon at the Atomic and Molecular scale, FET Pro Active*	EC, 2013-2016		leading researcher
Vjačeslavs Kaščejevs	Non-weighted quantum statistics in electronic nanodevices	LSC FLPP 2013-2016		leading researcher/scientific head
Guntars Kitenbergs	Magnetism and microhydrodynamics, from steered transport to supply (MaMi),	H2020, 2018-2020	3.7 m.	the head of the doctoral candidate and a member of the management board,
Guntars Kitenbergs	Microflows in a magnetic soft environment	ERDF PostDocLatvia, 2017-2020	133000	project Manager and leading researcher
Guntars Kitenbergs	Fluctuations in magneto-microhydrodynamics (FluMaMi)	French-Latvian bilateral cooperation programme Osmosis, 2018-2019	5000	project Manager and leading researcher
Guntars Kitenbergs	Biologically motivated active system models in electromagnetic field (BIMs)	LSC FLPP, 2021-2023	300000	leading researcher
Guntars Kitenbergs	Flexible magnetic strings: their properties and applications (FMF),	M-era.net, 2021	210000	leading researcher
Elīna Pajuste	Graphene-based electrochemical pumping for removal of radioactive hydrogen isotope, Growth and Employment	1.1.1.3 “Practical research”		scientific Manager

Elīna Pajuste	Peak quark and Higgs bozonal studies in the CMS experiment, developing crystal scintilators, CMS sub-detectors and particle accelerators for business use, in cooperation with CERN	TNP, 2020-2022	Scientific Head of the UL Task Force
Elīna Pajuste	Strengthening Radiation Technologies and Safety in Biomedical and Material Science Competencies	Draft Technical Cooperation of the International Atomic Energy Agency, 2020-2021	scientific Manager
Elīna Pajuste	*European Joint Programme-European Radiation Protection Studies Harmonised Programme*	H2020, 2015-2020	national Contact *Point* (NCP), Head of the Latvian Group
Elīna Pajuste	Plasma Contact Components – JET2 (*Plasma Facing Components* – JET2)	H2020	Member of the Project Management Board

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).

The study programme was developed by a study programme development working group with participation of experts from CERN Baltic Group and CERN, as well as the lecturers of courses of the study programme from RTU and LU. The biggest job, where the working group experts made their contribution and provided their evaluation, was the content of the courses, as well as the interlinking between them. Later, at the beginning of the study year 2021/2022, the Council of the Study Programme, composed of leading experts in the field from RTU, LU and CERN, and ensuring the quality management of the study programme, repeatedly analysed the interlinking of courses and the calendar plan of their implementation. At the end of the semester, directors of the study programme are expected to present again the results of the study programme, as well as draw attention to possible changes as needed. Such a management mechanism also planned further.

During approbation of the study programme and in the future, the cooperation of the teaching staff is promoted through participation of teaching staff in the CERN Baltic Group sub-group – the Study Programme Working Group. The implementation of the teaching staff cooperation mechanism through this group provides not only an opportunity for the potential development of cooperation between RTU and LU, but also for CERN Baltic Group partner staff, which, accordingly, provides access to a wide range of highly qualified visiting lecturers for the study programme. This is particularly important because the study programme, in order to promote internationalisation, interdisciplinarity and diversity in the content and presentation of study programmes, focuses in particular on attracting skilled visiting teaching staff. Visiting professors and cooperation with foreign academic staff also contribute to the development of scientific activity, joint research and creation of publications, ensuring the interaction between studies and science. It is essential that in the year of studies 2021/2022 four highly visiting lecturers were involved: Assoc. Prof. Stefan Groote (University of Tartu, Estonia), Assoc. Prof. Thomas Gajdosik (Vilnius University, Lithuania) and assistant Prof. Toni Ščulač (University of Split, Croatia) and Dr. Maurizio Vretenar (CERN, Switzerland).

The study programme working group is convened as often as necessary, but at least once a quarter.

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	annex_DSPDFPT_Sample of diploma.pdf	piel_DSPDFPT_DiplomaParaugs.pdf
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)	annex_DSPDFPT_Opinion of the Council of Higher Education.docx	piel_DSPDFPT_AIP atzinums.edoc
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)	annex_DSPDFPT_Compatibility of the joint study program with the requirements of the law of Higher educ..docx	piel_DSPDFPT_Kopīgās studiju programmas atbilstība Augstskolu likuma prasībām.docx
Statistics on the students in the reporting period	8.5.annex_DSPDFPT_Statistics on the students in the reporting period.pdf	8.5.piel_DSPDFPT_Statistikas dati par studējošajiem.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		
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)	Correspondence of the doctoral study programme to the specific normative regulation.docx	DSP atbilstību atbilstošās nozares regulejumam.docx
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	8.8_annex_DSPDFPT_Mapping of the study courses.pdf	8.8.piel_DSPDFPT_Studiju kursu kartejums.rtf
The curriculum of the study programme (for each type and form of the implementation of the study programme)	8.9.annex_DSPDFPT_study courses plan.pdf	8.9.piel_DSPDFPT_Studiju programmas plāns.rtf
Descriptions of the study courses/ modules	8.10.annex_DSPDFPT_Descriptions of the study courses.docx	8.10.piel_DSPDFPT_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)	annex_DSPDFPT_Confirmation that the academic staff of the doctoral study programme complies with the requirements.docx	Piel_DSPDFPT_Apliecinājums par doktora studiju programmas akadēmiskā personāla atbilstību prasībām.pdf
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)	annex_DSPDFPT_Confirmation that the academic staff complies with the req specified in S55 P1 C3 of the Law on Higher Educ.docx	piel_DSPDFPT_Apliecinājums par akadēmiskā personāla atbilstību Aukstskolu likuma 55. panta 1.d. 3. p.pdf

Physics (45443)

Study field	*Physics, Material Science, Mathematics, and Statistics*
ProcedureStudyProgram.Name	*Physics*
Education classification code	*45443*
Type of the study programme	*Academic master study programme*
Name of the study programme director	*Sandris*
Surname of the study programme director	*Lācis*
E-mail of the study programme director	*sandris.lacis@lu.lv*
Title of the study programme director	*asociētais profesors, Dr.phys.*
Phone of the study programme director	*+371 26483838*
Goal of the study programme	*To prepare highly qualified and internationally competitive master-level physics specialists for the labour market, providing an opportunity to specialise in sub-disciplines of physics specific to Latvia with high research and innovation potential and stimulating the acquisition of interdisciplinary competence during studies.*
Tasks of the study programme	*• To encourage students to develop as professionals in the field by providing the opportunity to complement the knowledge and skills acquired in the BSc programme in their chosen specialisation in physics. • To give students the opportunity to gain experience in independent research under the guidance of a supervisor. • To enhance students' scientific research skills and competence in analysing research problems. • To develop students' critical and creative thinking, reasoning and decision-making skills, and the ability to apply acquired knowledge and competences in physics and interdisciplinary research. • Ensure flexibility of the restricted elective part of the study programme in line with labour market requirements. • Ensure effective and monitorable delivery of the planned programme results. • To create the conditions for graduates to successfully pursue studies at doctoral level.*

Results of the study programme	*Knowledge:* *1. demonstrate advanced or expanded knowledge in certain areas of physics, in line with the selected specialisation topic under AMSPP. For example: atomic, molecular and optical physics, solid-state and material physics, physics of continuous media, technology physics, theoretical physics, etc.;* *2. demonstrate interdisciplinary knowledge that complements knowledge in the sub-disciplines of physics. For example: biophotonics, medical physics, nanostructure physics, chemical physics, atmospheric and/or environmental physics and other interdisciplinary fields.* *Skills:* *3. use mathematical description for explaining and analysing physical processes, formulating physical problems, choosing adequate approximation and solution methodologies;* *4. plan and carry out experiments or calculations in one of the fields of physics, obtain data independently, evaluate errors in measurements and calculations;* *5. analyse results by comparing them with theoretical models, numerical simulations and available experimental data.* *Competences:* *6. at a qualitative level, be aware of current developments in physics and demonstrate an understanding of the highest standards of physical science in their field of specialisation; summarise research results in the form of a scientific publication (e.g. a Master's thesis) based on knowledge of the current state of at least one sub-field of physics and be able to integrate knowledge from different fields as appropriate;* *7. sees essential details on the subject, manipulate precise and complex ideas, use logical arguments and correct terms in communication on the subject of physics with professionals and non-specialists;* *8. by conducting independent research with a high degree of autonomy within the framework of the master's thesis, demonstrates competence in information gathering and analysis, obtaining information from journal articles, databases and communications with colleagues, sorting it according to relevance;* *9. is aware that falsification and plagiarism of data are contrary to academic integrity, is objective and honest in his/her actions, recognises the limits of his/her knowledge, understands and is aware of the ethical responsibility for the potential impact of the results of his/her actions on the environment and society.*
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)	*Bachelor's degree or a second-level professional higher education (or equivalent higher education) in physics or mathematics or bachelor's degree or a second-level professional higher education (or equivalent higher education) in a natural sciences or engineering and technologies and the successful completion of courses of study in physics (at least 5 credits) and mathematics (at least 4 credits) attested by a diploma or other educational document.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master's degree of Natural Sciences in Physics*
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	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor's degree or a second-level professional higher education (or equivalent higher education) in physics or mathematics or bachelor's degree or a second-level professional higher education (or equivalent higher education) in a natural sciences or engineering and technologies and the successful completion of courses of study in physics (at least 5 credits) and mathematics (at least 4 credits) attested by a diploma or other educational document. Studies in English require English language skills at least at B2 level.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master's degree of Natural Sciences in Physics*
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

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 period, the location of the study programme has changed. Until January 2018, the Academic Master study programme "Physics" (AMSPP) was implemented at 25 Zeļļu street, Riga. Starting from the spring semester of 2018, the studies take place at the UL Science Building, 3 Jelgavas street, Riga. The new location brings the study programme closer to the physics institutes, allowing closer collaboration with physics research, including facilitating the involvement of recognized scientists in teaching. World-class teaching and research facilities at the Academic Centre of the University of Latvia on Jelgavas street, proximity to the research laboratories of the faculty and institutes, and computer classrooms allow modernising the study environment and improving the quality of the study programme.

During the inter-accreditation period, a joint academic master's degree study programme "Physics" has been licensed (joint programme of the University of Latvia and Daugavpils University, Licence No.2021/07K, issued on 10.11.2021). Thus, two different study programmes are formally compared, although the licensed study programme is very close in its curriculum to the modified previous Master's study programme in Physics at the University of Latvia.

The changes in the AMSPP study plan submitted for accreditation compared to the previous accreditation are summarised in Table 6.1.1.1.

Table 6.1.1.1

Changes to the AMSPP study plan for Parts A, B and C

Study courses	2013./2014.	2023./2024.
Mandatory (A) part	38+20	26(28*[1])+20 [1] The study course "Basic Latvian Language Course" is offered to students without Latvian language skills
Including practice	0	6
Including a Master's Thesis	20	20
Restricted choice (B)	22	32 (30*)
Free choice (C)	0	2
Total	**80**	**80**

Key changes:

1. A new joint study programme with DU is accredited,
2. Part C of 2 credits introduced,
3. changes to the scope of Part A,
4. Academic Practice of Physic's Master, 6 credits,
5. English language teaching is introduced alongside Latvian,
6. students without Latvian language skills must take the "Basic Latvian", 2 credits,
7. Adjusted the study programme code, 45443, to ensure compliance with changes in the regulatory enactments,
8. the study outcomes are reformulated, appling mapping which establishes a link between outcomes of individual study courses and the study programme, allowing monitoring of the achievement of the study programme's aim.

The changes that are made allow to offer students a study programme that is based on specialisations. Compulsory (A) part is reduced and the study plan allows easier access to study courses of the restricted elective (B) part in certain specialisations, even with a small number of students. The acquisition of the necessary transversal (soft skill) competences for a researcher has been increased. The changes in the content of the programme, combined with the changes in the infrastructure, will lead to a modern study offer that is more attractive to students.

The study programme licensed in 2021 is now being promoted for accreditation, but the transition was gradual as the changes to the curriculum as far as possible were already in place before licensing. In the academic year 2022/23, when 1st year students study the new curriculum and 2nd year students study the old curriculum, the only differences are in the availability of some of the restricted elective (Part B) courses for 2nd year students. They can take these courses with the permission of the programme director, as stated at the University of Latvia regulations. Therefore, there is no need to matriculate 2nd year students in the new study programme. From autumn 2023 only the new study programme will be implemented.

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 relevance of the Academic Master Study Programme "Physics" to the field of study is determined by its content. Physics is precisely and uniquely relevant only to the direction of studies Physics, Material Science, Mathematics and Statistics. It may also be added that this study programme is currently the only academic master's study programme in Latvia that is directly related to Physics. The name of the study programme, the degree to be awarded, as well as the compliance of the study programme parameters with the specified study programme results are regulated by external regulations, i.e. *Cabinet of Ministers Regulation No. 240 (13.05.2014) Regulations on the State Standard of Academic Education* (available only in Latvian language), *Cabinet of Ministers Regulation No. 322 (13.06.2017) Regulations on the Classification of Latvian Education* (available only in Latvian language).

AMSPP code 45443 in accordance *with Cabinet of Ministers Regulation No 322 (13.06.2017) Regulations on Latvian Classification of Education* (available only in Latvian language) means:

1) first digit 4 - higher education study programme;

2) first two digits together 45 - Academic (Master's) degree, as studies after the acquisition of a Bachelor's or Professional Bachelor's degree. Duration of full-time study: one to two years. Total duration (master + bachelor) of full-time studies at least five years

3) the third digit 4 - the subject group is "Science, Mathematics and Information Technologies";

4) the third and fourth digits together total 44 - the subject area of education is "Physical sciences";

5) the third, fourth and fifth digits together total 443 - the group of educational programmes is "Physics".

The scope of the study programme, the duration of implementation, the parts of the study programme and their scope, the compulsory content, the basic principles and procedures of evaluation, the principles of implementation, etc. are regulated by Cabinet of Ministers Regulation No.240 (13.05.2014) *Regulations on the State Standard of Academic Education* (available only in Latvian language) and comply with the requirements set out in the Regulations.

The content of the study programme consists of study courses of 80 credits (Cabinet of Ministers Regulation No.240 (available only in Latvian language)). At least 20 credits of the Master's study programme shall be devoted to the elaboration of the Master's Thesis (actually is exactly 20 credits). The compulsory (mandatory) part of the Master's study programme, except for the Master's thesis, is 26 credits and includes the study of theoretical findings in the chosen field or sub-field of the relevant branch of science and the approbation of theoretical findings in the aspect of topical problems in the chosen field or sub-field of the branch of science, amounting to not less than 24 credits (if the Master's study programme amounts to 80 credits).

In Europe, most bachelor's studie programs, including the ABSPP, are three years long. Therefore, in order to meet the requirement of the Law on Higher Education Institutions that the total amount of the first and second cycle of studies should not be less than 300 credits and five years, AMSPF has chosen a study duration of 2 years with a study programme content of 80 credits.

The admission requirements are designed in such a way that graduates of bachelor programmes in physics as well as graduates of bachelor programmes in related fields can continue their studies in the Master's degree programme, thus obtaining an interdisciplinary education for which there is a growing demand.

The parametric part of the study programme defines its aim, objectives and learning outcomes. The aim of the study programme implies its objectives, the achievement of which can be determined by the knowledge, skills and competences acquired during the studies. The possibility of achieving the set learning outcomes is confirmed by the mapping of the learning outcomes of the study courses. The mapping shows how the successful completion of the study courses leads the student towards the achievement of the programme outcomes.

As a new study programme, AMSPP's objectives and outcomes are driven by a number of factors, including:

1. targeting the supply of Master's degrees in Physics to meet labour market demand,
2. offers specialisations that match real opportunities (atomic, molecular and optical physics,

solid and materials physics, physics of continuous media, physics of technology, theoretical physics), mainly targeting specialisations in areas where there is a strong demand for qualified specialists and a clear potential to provide a high-quality and competitive study programme,

3. combines the potential of both UL and DU to create the only Master's programme in Physics in Latvia with the ambition to compete in the Baltic region, based on the outstanding scientific expertise in physics and the mutual synergy between the two universities,
4. The study programme is being developed as a new STEM study programme, jointly run by UL and DU, with the study plan being open to future changes if there is a need to include a new specialisation,
5. The study programme also ensures the development of generic skills and competences (presentation skills, searching for scientific information in publications, publication skills, etc.),
6. the implementation of the study programme (laboratory work, internships, master's thesis) is closely linked to research,
7. The study programme is also available in English, attracting international students,
8. The AMSPP builds on the experience of the two universities in running Master's programmes in Physics,
9. The programme will include support systems for both the teaching staff, supported by a physics education specialist who advises the teaching staff on appropriate teaching methods and organises exchange seminars, and for the students, supported by a methodologist who informs them in advance about the preferred course of action in problematic situations and proactively deals with non-standard situations,
10. The AMSPP content development is based on the European Master of Physics specifications produced by the European Physical *Society* (EPS), the most authoritative physics society in Europe,
11. Existing students were involved in the development of the content, both through student-graduate questionnaires and through face-to-face interviews with student groups,
12. Employers' representatives were involved in the development of specific content.

The AMSPP results are obtained by combining the Latvian Qualifications Framework (LQF) with "*A* European *specification for Physics* master studies, EPS *Publications*, 2010". The descriptors used in the learning outcomes are explained in an extract (translated) from the European Specification for Masters in Physics.

Two instruction languages have been chosen for the study programme: Latvian and English. This allows the programme providers to adapt to the needs of the labour market and prospective Master's students by choosing to implement the study programme in Latvian, English or Latvian and English simultaneously, according to demand.

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

In Latvia, the study field "Physics, Material Science, Mathematics and Statistics" is implemented by 4 higher education institutions: the University of Latvia, RTU, DU and LiepU.

Liepaja University no longer offers physics-related Master's degree programmes.

According to the Ministry of Education and Science, 2020 data, http://izm.gov.lv/lv/publikacijas-un-statistika/statistika-par-izglitibu/statistika-par-augstako-izglitibu,

only two universities offer a direct Master's degree in Physics: the University of Latvia and DU

Three RTU study programmes can also be counted among similar study programmes (Table 6.1.3.1), while practically all medium and large universities abroad have Master's degree programmes in physics. A full list would not be useful; among the world's top 1000 universities in the physical sciences, about 250 are in the European Union (https://www.timeshighereducation.com, *World University Rankings* 2019 *by subject: physical sciences*).

To get an overview of typical solutions, a comparison with other study programmes provides an overview of the physics Master's level study programmes found in Estonia and Lithuania, as well as the physics degree programmes offered by Lund University, which can be considered as a typical strong foreign European university.

Table 6.1.3.1

List of physics-related study programmes at master's level in Latvia

Masters in Physics				
Programme	Institution	Acad. Year	Total matriculated	Total students
Physics	DU	2018/19	1	2
Physics	UL	2018/19	18	26
Master's degrees in topics close to physics				
Programme	Institution	Acad. Year	Total matriculated	Total students
Materials Science	RTU	2018/19	9	12
Nanotechnology for materials	RTU	2018/19	5	6
Medical engineering and physics	RTU	2018/19	17	22

The graduate labour market consists of:

1. academic research institutions, such as:
    - UL ISSP,
    - UL IA,
    - UL IAPS,
    - UL IP,
    - UL ICP,
    - UL IMM,
    - Research units of the FPMO,
    - VUAS Ventspils International Radio Astronomy Centre,

2. A community of faculty members from the University of Latvia and other universities, involved in university physics teaching,
3. high-tech companies, such as,
    - AS Sidrabe,
    - SIA GroGlass,
    - SAF technique,
    - PAIC Ltd, etc,
4. foreign research institutions and companies
5. direct opportunities for further education, travel and skills development
    - PhD studies at Latvian and foreign universities,
    - obtaining a teaching qualification, e.g. at a university to become a physics teacher.

In summary, after graduation, graduates continue their academic development at PhD level or immediately enter the labour market. Graduates are in high demand for doctoral studies both at the UL and abroad. Finding a job in research or in a high-tech company immediately after a Master's degree is also a safe option, although in many places the priority will be given to the PhD holder. Many graduates find jobs already during their studies, in internships and in the field of Master's thesis development.

Statistics of various kinds show that there is a growing demand for specialists in STEM fields, including the physical sciences.

- "Information report on medium and long-term forecasts of the labour market (2020)" (only in Latvian) by Ministry of Economics shows that 7.0 thousand workers with higher education will be needed in the physical sciences in 2027, as opposed to 5.4 thousand in 2020.
- According to the Latvian National Development Plan for 2021-2027 (National Development Plan of Latvia for 2021-2027 gov.lv)) under the Action Line "Quality, Accessible, Inclusive Education" [163], the share of science, mathematics and information technology graduates in the total number of graduates in higher education should increase from 6.8% in 2018 to 12% in 2027.
- Labour shortages are creating demand for physics graduates. Surveys by the Univaristy of Latvia confirm that a significant number of students gain work experience in their specialisation during their studies (on average at least 90%).

Most of the listed labour markets are also accessible to English-speaking graduates without in-depth Latvian language skills. The only obvious exception for English-speaking graduates is the acquisition of a teaching qualification for employment in Latvia, but it should be noted that this is not a labour market relevant for Masters students, as the acquisition of a teaching qualification takes place outside physics studies and the basic "input channel" is the Bachelor's degree in physics. In the case of an English-only programme, it is expected that a large proportion of graduates will have previously completed a Bachelor's programme in Latvian, so the AMSPP will be able to provide national staff in sectors of the Latvian economy where in-depth knowledge of Latvian is required. In addition, studying in English is considered an advantage for jobs with a high degree of internationalisation, as are most of the categories 1) to 5) listed above.

AMSPP in English has the significant advantage of internationalising the study environment by improving student mobility (specifically inbound, e.g. ERASMUS+), as well as faculty mobility. The requirement to teach in English is a major barrier to attracting visiting professors.

The visually extensive and varied job opportunities are graphically illustrated in Figure 6.1.3.1, which summarises the post-graduation employment pathways of 2010-2015 graduates who have already completed their studies and established their career choices. The visual material shows that the majority of graduates are pursuing their future careers in Latvia (72 out of 102), although

20% are abroad (20 out of 102), which is a significant share. Only 3% of graduates are not working in physics or as professionals in another field. 7% work as teachers in schools. A total of 16 work as specialists outside physics, often in well-known companies (Same mission, CIVITTA, Proof it, LMT, Tieto, etc.). Almost 20% (19) are specialists in the field of physics, often in high-tech companies (Siltronic, LightSpace, Light Guide Optics, SAF Tehnika, Hansa Matrix, Groglass, etc.). More than half (57) choose to continue their academic career in Latvian and foreign universities.

Figure 6.1.3.1. Visualisation of the employment of graduates of the Master of Physics

The study programme is designed to give students the opportunity to specialise in a sub-discipline of physics where we are internationally competitive. The programme will involve leading specialists from research institutes in the field, ensuring specialisation in topics in demand. The graduates' training also allows them to switch flexibly to areas of the labour market where there is no direct specialist training or a shortage of qualified specialists, for example in areas related to big data processing.

The programme cannot be integrated into a broader study programme, as it is designed specifically for the acquisition of knowledge in the field of physical sciences, it includes opportunities for specialisation in Latvia-specific and promising sub-disciplines of physics and interdisciplinary topics such as functional materials, nanomaterials, photonics, numerical modelling, etc. A programme of 80 credits corresponds to a typical European Master's programme in Physics. A reduction in the overall weight of physics would result in a loss of demand as potential students would choose to study elsewhere in Europe. The interdisciplinary aspect is only foreseen to the extent that prior knowledge in other fields of science complements the basic knowledge of physics and creates synergies. In certain cases, with the agreement of the programme director, a more pronounced interdisciplinary specialisation is possible.

The AMSPP will replace the study programmes currently run by two universities. By moving towards licensing, the study programme has a significantly changed concept compared to the existing ones, creating a specialisation-based study programme as a way to adapt more adequately to the requirements of the labour market. At Master's level, physics degree programmes are currently available in Latvia (UL and DU, substitutable programmes), the University of Tartu and Vilnius University. There are differences in the study programmes offered, partly stemming from each country's strengths in physics research. However, the common feature is the tendency to provide national staff in physics, including the background knowledge to continue eduacation in doctoral studies.

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.

The dynamics of the number of AMSPP students is presented in Table 6.1.4.1 for the period from 2011 to the end of 2021.

Table 6.1.4.1

Statistics for Physics MSP students

Data as at 1 October of the reference year	Number of students matriculated in Year 1	Number of students by study year		Learning together	Including for a fee	Number of graduates	Number of exmatriculated (dropout)
		1	2				
2011	30	30	19	49	1	17	8
2012	28	28	23	51	1	16	4
2013	24	24	22	46	1	19	4
2014	26	29	21	50	5	15	9
2015	24	26	16	42	2	17	15
2016	20	21	14	35	1	13	14
2017	16	17	9	26	3	12	14
2018	18	18	8	26	1	5	13
2019	23	25	12	37	3	5	8
2020	22	20	19	39	6	7	14
2021	13	13	13	26	0	18	8

The dynamics of student enrolment in AMSPP is highly dependent on the number of ABSPP (Bachelor) graduates, as shown by the graphs in Figure 6.1.4.1. However, the graph shows deviations of the number of students matriculated in the Master's programme from the trends of the number of Bachelor's graduates, especially in 2016, 2019 and 2020, which confirms that in some years there is a high share of "external" matriculated students coming from other degree programmes and other universities. There has been a decline in matriculated students throughout the reporting period. This may be due to a number of factors, including a drop in the number of AMSPP graduates, financial support for Masters students around 2012 and an overall decrease in the number of potential AMSPP students in Latvia.

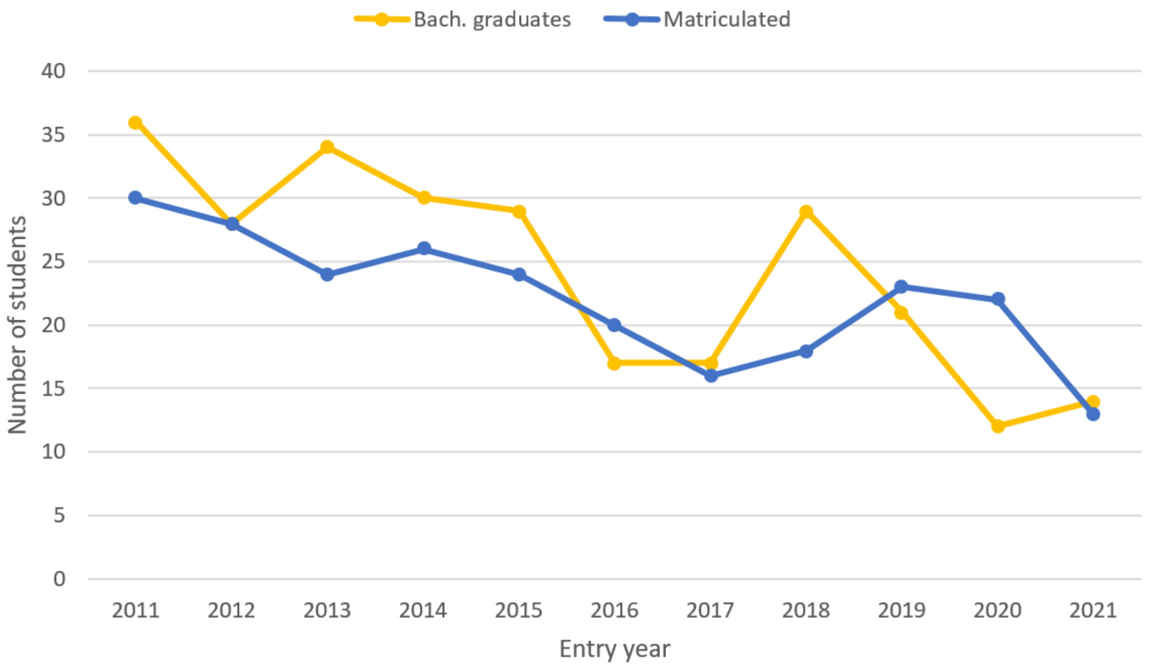


Figure 6.1.4.1. Dependence of AMSPP matriculants on the number of ABSPP graduates

Figure 6.1.4.2 shows important aspects of the dynamics of student numbers, by comparing the number of first, second and graduate students at a single "entry year". This means that the number of students enrolled in a given year is tracked, without taking into account interruptions in study, which can be observed in some cases.

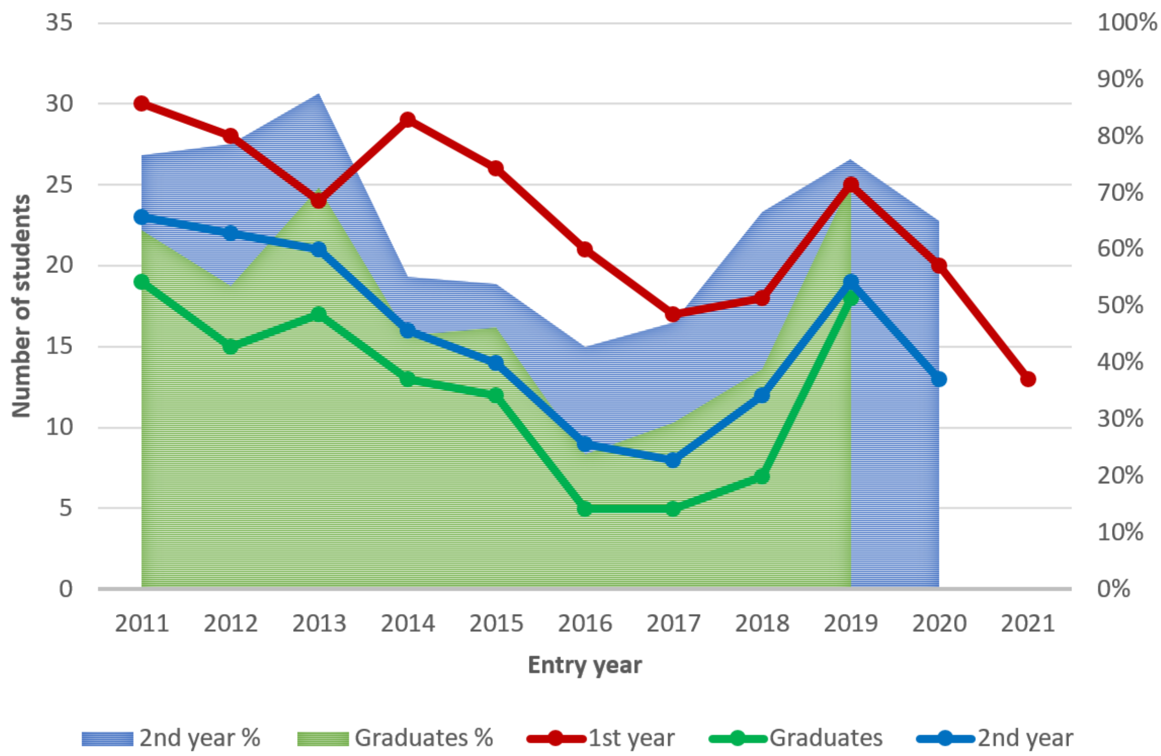


Figure 6.1.4.2. Student dynamics by academic year, tracking students by year of entry

Figure 6.1.4.2 shows the minimum in the number of graduates in 2016-2018. This can be explained by the obsolescence of the study programme concept, which was no longer attractive to students.

The compulsory part of the study programme had a large block of theoretical courses (16 CP) and a large block of laboratory work (12 CP), without elective options, as well as a mathematics block (10 CP). The study programme was designed as a general MSc in Physics with few opportunities for specialisation. The transition to a specialisation-based programme (described in Chapter 6.2.1) allowed to increase and stabilise the number of students again. Despite the Covid-19 pandemic, at least 12 graduates are expected in 2022. An increase in the number of students is also expected after the introduction of the licensed joint Master's programme with Daugavpils University. Note from Figure 6.1.4.2 that student attrition has decreased after 2016, as shown by the number of students in Year 2 and the number of graduates as a percentage of the first year student population.

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).

The joint Master's level study programme "Physics" is the result of cooperation between the University of Latvia and Daugavpils University, which will bring together the teaching staff, experience and infrastructure of both universities to train qualified specialists that Latvia needs. Each of the universities has more than 50 years of experience in training specialists in physics. For several years, UL and DU have been the only universities in Latvia to offer Master's level education in physics. The joint study programme will provide specialists with a Master's degree in physics, specialised in physics sub-disciplines where Latvia has the highest expertise, as well as in interdisciplinary areas related to physics.

In order to make the joint Master's study programme "Physics" (abbreviated as AMSPP) to be the part of the missions of both universities, it is designed as a competitive programme in the Baltic region, based on local world-class research, making the most of the expertise of both universities, teaching staff, researchers, cooperating with research institutes in Latvia and high-tech companies in the implementation of the study programme.

The strategies of both universities have a number of objectives and outcomes that will be stimulated by the new study programme. In particular, the preparation of human resources to meet labour market demand, the increase in the number of graduates with a qualification or degree, the increase in competitiveness, the export of education, the creation of a new STEM programme, the implementation of a joint study programme, the offer of a programme in EU languages, the increase in the number of foreign students, the development of 21st century skills, the involvement of students in research, etc., should be highlighted. In addition, the role of DU in ensuring access to higher education in East Latvia and the presence of a leading research centre should be emphasised.

In addition to the university strategies, the need for a joint study programme (AMSPP) within which to develop certain specialisation options is determined by:

1. demand for specialists in high-tech companies such as AS Sidrabe, *Light Guide Optics International*, *Ceram Optec*, *Regula Baltica*, *Groglass*, *Axon Cable*, *Tet*, *SIA BELAM, CENOS*, *Lightspace Technologies*, *EuroLCDs*, *Baltic Scientific Instruments*, *RD Alfa*, *KEPP EU, UAVFactory, Zippy Vison*, etc., and cooperation between universities and these companies has already been established, thus ensuring synergy between production, science and education for high-tech development;

2. modern premises in the Torņakalns Centre of the University of Latvia in Riga, 3 Jelgavas street and in DU Dauvgavpils, 1 Parades street and 1a Parades street;
3. the state-of-the-art facilities at both universities, created through infrastructure development funds - at UL, significantly upgraded facilities and equipment in several institutes and laboratories, covering a wide range of physics topics, from facilities for characterising material science samples and creating devices, including in cubicles, to composite materials development and test benches, overpressure rooms with additional stabilised optical table systems, atomic, molecular, laser physics studies, sensor-equipped liquid metal circuits for the study of magnetohydrodynamic phenomena and the development of pumps, mixers or other elements, telescopes and laser locators, high-performance computing resources for solving various problems with computer modelling approaches, etc. c., DU has acquired the necessary equipment for the synthesis, research and development of nanomaterials and nanotechnologies such as sensors - therefore the use of scientific laboratories must be efficient and sustainable;
4. The UL and DU have the highly qualified staff needed to implement the AMSPP. (For more details on the teaching staff, see Chapter 6.4);
5. Positive feedback from employers confirms the competence of graduates from all levels of Physics programmes at both universities and the need to attract future AMSPP graduates to newly created jobs;
6. A special synergistic effect of the AMSPP is given by the geographical location of DU, thanks to which, firstly, the attraction of students from the Latgale region is strengthened, secondly, international cross-border initiatives of DU are an additional incentive to attract foreign students, which is also supported by the established Belarusian-Latvian Scientific and Innovative Centre for Strengthening Technologies, whose staff implements research projects and conducts educational work for students in the field of industrial application of laser technologies.

The implementation of the joint AMSPP shall be governed by the Agreement No 7-6/570 of 18 June 2020 "On the Implementation of a Joint Academic Master's Degree Programme in Physics" concluded between UL and DU (hereinafter referred to as the Parties) (the contract and its amendments are added in the section "Other Annexes"). It provides, inter alia, as follows:

1. The strategic functioning of the inter-university AMSPP is determined and the implementation of the AMSPP is monitored by the Joint Programme Board;
2. The Board is responsible for:
    a. establish common requirements for the implementation of the AMSPP: imatriculation requirements, course descriptions, national examinations;
    b. improve the AMSPP quality assurance system;
    c. analyse the AMSPP's financial security and make proposals to improve it;
    d. participate in the evaluation of the teaching staff involved in the implementation of the AMSPP;
    e. keep the Parties' management informed of progress in the implementation of the AMSPP;
3. The Parties shall implement the AMSPP compulsory part (Part A) and restricted choice part (Part B) study courses in a mutually cooperative manner, involving their own and each other's academic staff in the implementation of the study courses;
4. students are admitted under common admission conditions, with the parties determining the number of places for each academic year;
5. Each Party shall independently:
    a. register the data of the affiliated students in the student database of each Party upon receipt of the registration fee;

b. matriculates the enrolled students, in accordance with the terms of the Study Agreement;
c. store and maintain student files and other documents related to their studies;
d. is liable for the obligations incurred by it.

The agreement also defines the financial obligations between UL and DU. Currently, the joint study programme council mentioned in the agreement has already been established and started its work.

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.

Academic Master's study programme "Physics" (joint Master's study programme "Physics" of UL and DU, AMSPP) is designed as:

- inter-university study programme,
- a specialisation-based study programme (as opposed to a general MSc in Physics),
- a study programme with interdisciplinary physics education.

The fields of specialization are determined by both the labour market demand and the possibilities to offer study courses in the topics in which each university - both UL and DU - has internationally competitive research competence.

In line with the concept of the study programme as a specialisation-based programme (as opposed to a general study programme), a small compulsory (A) part of the AMSPP has been created, consisting of 6 compulsory courses (total - 26 CP) that all students are required to take, as well as three additional study courses that some students are required to take. The three additional courses are:

- "Basic Latvian", which foreigners are required to study in English (Article 56 (3)-1) of *Law on Higher Education Institutions*),
- “Civil Protection” and “Environment Protection”, to be taken by students who have not taken them in their previous studies.

The restricted elective (B) part consists of courses corresponding to different specialisations to physics in Latvia, offered by highly qualified specialists working in research institutes and laboratories, as well as in innovative companies. Currently, the study plan includes 57 Part B courses, the number of which depends on the possibilities to provide competitive and high-quality Master's level education in the chosen sub-discipline of physics or in interdisciplinary topics. In order to ensure the sustainability of competitiveness and quality, it is necessary to ensure that the offer of Part B courses is able to keep pace with scientific developments, labour market needs and the availability of specialists. The majority of study courses contribute to the development of transversal competences (soft skills).

The content of the AMSPP is designed in accordance with the specialisation of universities defined in the SAM 8.2.1 project. The following have been taken into account in the development of the programme content:

- Article 55 of the *Law on Higher Education Institutions*. Master's study programme,
- *Regulations of the Study Programmes and Continuing Education Programmes of the University of Latvia* (Senate Decision No 102, 24.04.2017),
- *Regulations on the Opening and Management of Study Directions and Study Programmes at DU* (approved at the Senate meeting of 31 August 2020, Minutes No 7) (available only in Latvian language).

The AMSPP curriculum has a total of 80 CPs, with students studying 20 CPs in each of the 4 semesters. The study plan can be found in Annex 4. The Master's thesis consists of 20 CP. This distribution of credits in the programme is made in accordance with the Cabinet of Ministers Regulation No.240 (13.05.2014) *Regulations on the State Standard of Academic Education* Part III (available only in Latvian language) and Article 57 of *the Law on Higher Education Institutions*, based on the fact that the AMSPP is created as a continuation of 3-year study programmes, including the bachelor study programme "Physics" of the University of Latvia and the bachelor study programme "Physics" of DU.

The exceptions are the already mentioned study courses "Civil Protection" and "Environment Protection", which are taken in addition to the study programme if necessary and thus increase the number of credits to be taken by 1 or 2 CP.

The *Regulation on the National Academic Education Standard* (available only in Latvian language)

- in the compulsory part of the Master's study programme (without the Master's thesis), includes the study of theoretical knowledge in the chosen field of the relevant branch or sub-field of science and the approbation of theoretical knowledge in the aspect of topical problems in the chosen field of the chosen branch or sub-field of science, not less than 24 CP, if the Master's study programme is 80 CP.

This requirement is fulfilled by the compulsory part (A) of the AMSPP, which, excluding the Master's thesis, is 26 CP (28 CP for foreigners). It consists of:

- “Fundamentals of Physics specialisations”, 8 CP,
- “Research laboratory works I” 6 CP,
- “Academic practice of physic's master”, 6 CP,
- “Current topics in physics and astronomy I”, 2 CP,
- “Numerical simulation of physical processes”, 4 CP,
- study course "Basic Latvian", 2 CP, which has to be taken by some students (foreigners).

In addition, AMSPP Part A includes the study course "Master Thesis" (the study course is divided into 2 parts, 4 CP+16 CP), 20 CP.

The results of the compulsory (A) part of the courses contribute to the majority of the study programme outcomes, as illustrated by the mapping of study outcomes, and the internship and master thesis cover a wide variety of topics across all students.

The offer of Part B restricted elective courses is closely related to the term specialisation used in this report, so we explain the use of this term.

Specialisations

In the Master's study programme "Physics", specialisation is understood as a set of study courses in the restricted elective (B) part of the study programme, the completion of which provides the student with knowledge, skills and competence in selected sub-disciplines of physics or in interdisciplinary topics related to physics with high research potential. Specialisation in one of the offered fields enables the preparation of highly qualified physics specialists at Master's level for the Latvian labour market in a specific topic, who are also competitive at international level.

AMSPP specialisations are a combination of research traditions and current scientific trends, which are translated into topical study courses that dynamically follow the latest scientific trends through the collaboration of lecturers and researchers. The FPMO and the DMF and research institutions of DU actively interact with innovative companies in both consultative and applied cooperation, so that the interests of the economic sector are also reflected in the course offerings.

The offer of specialisations is institutionalised in the sense that they are implemented by units with the appropriate competences at UL and DU. The offer includes specialisations:

- Astrophysics
- Atomic, molecular and optical physics,
- Physics of solids and materials,
- The physics of continuous media,
- Physics of technology,
- Theoretical physics.

The specialisation "Astrophysics" has been developed in collaboration with the Institute of Astronomy of the University of Latvia and the Engineering Research Institute Ventspils International Radio Astronomy Centre. The implementation and further maintenance (development and quality assurance) of this specialisation will also be carried out in mutual cooperation, with astrophysicists as elected faculty members and as university lecturers.

The Chair of Experimental Physics oversees the implementation of the study courses of the specialisation "Atomic, Molecular and Optical Physics". In addition to the traditional topics of the field, this strand has a slight emphasis on laser physics and biophotonics. The specialisations reflect the currently internationally recognised research areas at the FPMO Laser Centre, the Institute of Atomic Physics and Spectroscopy, the Institute of Astronomy and elsewhere.

The Chair of Solid State and Material Physics oversees the implementation of the study courses of the specialisation "Physics of Solids and Materials". The courses cover a variety of key technologies, including thin films and coatings, functional materials, nanocomposites. The course offerings have been developed within the H2020 project CAMART2 (CAMART[2] is a Centre of Excellence for Smart Materials Research and Technology Transfer, a Horizon 2020 WIDESPREAD 1-2014: *Teaming* project, awarded by the UL CFI project and funded by the European Commission https://cordis.europa.eu/project/rcn/208418/en) in collaboration with experts from the Royal Institute of Technology, with a total investment of EUR 600 000 in the design and development of the courses. The offer corresponds exactly to the research themes of the Institute of Solid State Physics and its partners.

The Chair of Electrodynamics and Mechanics of Continuous Media supervises the implementation of the study courses of the specialisation "Physics of Continuous Media". The courses cover hydrodynamics and its interaction with electromagnetic fields, as well as mechanics of materials, including polymers and composite materials. A strong emphasis is placed on multiphysics models and the use of numerical modelling. The course content is closely linked to research topics at the Institute of Numerical Modelling at the FPMO, the Institute of Physics at the UL, the Institute of Mechanics of Materials at the UL and at industrial partner companies.

The Faculty of Natural Sciences and Mathematics (FNSM) of DU implements study courses of the specialisation "Physics of Technology". It basically includes courses that will provide students with basic knowledge, skills and competences in technological processes of creation and processing of various materials, including nanomaterials, and structures, robotics and sensor technologies, in accordance with the aim and planned results of the study programme.

The study courses of the specialisation "Physics of Technology" have been developed by the FNSM in cooperation with the researchers of the Centre for Innovative Microscopy of the G. Liberts Institute of Life Sciences and Technologies of DU, taking into account the current research in physics and interdisciplinary fields at DU and the recommendations of the cooperation partners in industrial companies in the selection of study content.

The Chair of Theoretical Physics oversees the implementation of the study courses of the specialisation "Theoretical Physics". The courses provide both basic knowledge and advanced understanding in certain areas, such as numerical methods and soft-medium physics. The range of topics is in line with current research in the Laboratory for Magnetic Soft Materials at the FPMO, the Nanoelectronics Theory Group at the FPMO and theoretical physics groups at other institutions.

The implementation of such a monitoring system ensures that the content of study courses is up-to-date and in line with the needs of the sector, the labour market and current scientific trends. The above-mentioned departments, institutes and the FNSM of DU are obliged to periodically update the content of study courses in accordance with the labour market and scientific development trends, including taking into account student surveys, employers' feedback, proposals of individual teaching staff and scientists.

The representatives of enterprises acting on the Council of the study field Physics, Material Science, Mathematics and Statistics contribute to the observance of the labour market needs by participating in the evaluation of study plans and changes in the study programme, in the discussion and evaluation of annual reviews of study fields and accreditation applications. At the time of the accreditation report (early 2022), the industry companies are represented on the Council by Normunds Bergs (SAF Tehnika, http://saftehnika.com, LETERA, https://www.letera.lv/) and Guntis Mārciņš (Groglass, https://www.groglass.com/). In developing the updated AMSPF content, the study programme concept was presented to LETERA, which provided additional insights for improving its content. In face-to-face discussions with representatives of individual companies, for example, during the visit of representatives of SAF Tehnika to the University of Latvia, the company representatives have pointed out the need to develop IT skills of students. Within the SAM 8.2.2 project, the faculty members of the Department of Physics have been doing internships in companies, studying the skills required by the companies (e.g. I. Krastiņš interned at the start-up company CENOS, https://www.cenos-platform.com/, prof. A. Šarakovskis is scheduled for an internship at SIA Groglass). As a result of employers' recommendations, new courses are included in the study programme and pre-existing courses are improved.

Significant updating of the course content was carried out within the CAMART2 project (https://www.cfi.lu.lv/en/research/projects/horizon-2020/camart2/), creating and improving the courses for the specialisation in solid and materials physics, as described above.

In addition to the specialisations included in the AMSPP, the development of new specialisations and the study of interdisciplinary themes is encouraged and supported by including in Part B relevant courses of study driven by labour market demand and scientific developments. Students are already free to choose their own courses of study, according to their own professional interests or on the basis of recommendations from research supervisors (from the second semester onwards, the student comes into contact with a supervisor, first in an academic placement, then in the Master's thesis) or colleagues.

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).

AMSPP graduates receive a Master of Natural Sciences in Physics. The relevance of the study programme to physics is confirmed by the content of physics in the study courses, the compliance of the study programme results with the EPS (European Physical Society) recommendations, the compliance with the general trends in European specialisation-based physics master studies and the compliance with the Cabinet Regulation No 240 (13.05.2014) *Regulations on State Academic Education Standards* (available only in Latvian language).

The content of the courses is designed by physics majors with excellent teaching and research skills, active research in their field of specialisation and up-to-date knowledge of the latest developments in the field. During their practice and master thesis (6+20=26 CP or 32.5% of the total programme of 80 CP), students acquire scientific expertise in laboratories or companies where they carry out competitive research within the framework of contract work and research projects.

As the content and formal parameters of the study programme are ensured to comply with external requirements, the degree to be awarded to AMSPP graduates corresponds to the Master of Natural Sciences in Physics and can only be obtained by mastering the achievements and insights of the physics sub- and cross-disciplines that constitute the graduate's competence. The link with scientific achievements and knowledge is also set out in Section 6.2.5 elsewhere in the AMSPP profile.

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.

Both oral, written and combined study and assessment methods are used during the study courses and examinations. There is no distinction between the English and Latvian streams.

The study uses a variety of methods to acquire and consolidate knowledge, such as introductory lectures, interactive lectures, summary lectures and problem-oriented lectures. Practitioners, professionals from various institutions are invited to lecture on individual courses in order to promote the unity of theory and practice. Practical exercises, seminars, individual, pair and group work, discussions and project development, study excursions to industry organisations are widely used. Employers are involved in the implementation and development of study courses (invited to lead individual seminar sessions, often organised as exchange visits to workplaces, etc.).

In order to foster the development of students' research competence, students have the opportunity to analyse and study in depth problems of interest to them in the field in successive courses (e.g. "Research Laboratory Works I and II", "Numerical Simulation of Physical Processes", "Academic Practice of Physic's Master", "Master Thesis in Physics I" and "Master Thesis in Physics II"). Senior students are involved in *peer teaching-learning*.

In the seminars, students' speaking, presentation and discussion skills are promoted. This is particularly evident in the courses "Current Topics in Physics and Astronomy I and II", "Numerical Simulation of Physical Processes".

In order for students to achieve the learning outcomes - to acquire and consolidate knowledge, skills and develop competences - the study process is dominated by methods in which student activity plays an important role. The study process uses methods that promote students' communication in performing study tasks, solving real problems in the field, modelling situations. For example, flipped classroom is used, including in combination with other methods.

When implementing a joint study programme, you will be faced with a situation where the students' place of residence and the location of the course do not coincide, and the distance Riga-Daugavpils and the travel costs are not suitable for regular trips several times a week. Consequently, opportunities for remote and hybrid delivery of the course will be exploited. Connecting students remotely using modern IT methods such as MS Teams is a 'well-tested solution over the last two years. Special attention will be paid to the availability of learning materials and remote tutorials. The possibility of 'compressed timetabling' - e.g. completion of a course within 1 month, reducing the time students need to be in another city. Certain study courses (e.g. practice and Master's thesis) can be offered equally at both the UL and the DU. In the implementation of distance and hybrid study courses, the teaching staff should focus more on the use of student-centred methods to ensure high quality of studies.

The physical environment is also gradually changing: classrooms can be easily converted for group work, individual work, and students can use digital technologies. Lecturers mostly use methods that encourage students' active participation, critical thinking and reflection. The e-learning environment will be used to support the learning process and independent study. An e-learning environment (MOODLE) has been created for each course of study, where students have access to lesson materials, assignment descriptions, additional learning materials related to the course topics, as well as study assignments (tests, forums, seminars, conferences, etc.). All mid-term and final examinations, with the reasons for the mark, are recorded and made available to students in the e-learning environment.

The student-centred approach is followed when updating study programmes and their study courses, with special attention paid to the meaningful formulation of study outcomes, thus promoting dialogue between lecturers and students on study content, forms of organisation and methods. Correctly formulated learning outcomes, in turn, promote students' understanding and ownership of their own learning, self-assessment and understanding of the assessment received. In the study process, lecturers use methods, forms of examination and assessment criteria that are appropriate to the aim of the study and the planned study outcomes.

Students receive support and feedback from lecturers during their studies. The assessment criteria for grading are published in advance. Assessment provides an opportunity for students to demonstrate the extent to which they have achieved the expected learning outcomes.

The principles of student-centred education promote student mobility (recognition of study results), and students engage in research and social activities in the community initiated by academic staff, thus gaining significant experience in putting what they have learned in their studies into practice.

Through the internal quality assurance policy, study programmes are implemented in such a way that students are encouraged to actively participate in the development of the study process. Policies and procedures are in place for the submission of student suggestions and complaints and for the handling of student appeals. The results of student surveys are evaluated and taken into account in the development of the study process. Students willingly express their suggestions for the improvement of study programmes and the process in discussions with lecturers, programme directors.

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).

The AMSPP requires that, in addition to theoretical knowledge and skills, students undertake an academic practice in a working environment, the aim of which is to apply, consolidate and enrich the knowledge and skills acquired, thereby developing their professional competence in the field of physics research.

The academic Master's practice in a working environment develops and strengthens the research skills of future physics professionals: a) the ability to independently acquire, select, analyse and critically evaluate information from different sources on the problem under investigation in the context of modern life and sustainable development; apply it in compliance with the principles of scientific ethics; b) learn to work with the equipment and technologies available in research institutions; c) acquire and process data, interpret them, generalise and present results; d) plan their work. This will foster synergies between theory and practice for the development of the student's competence, which is essential for the achievement of the learning outcomes and the objectives of the programme.

The academic practice of the Master of Physics is carried out in accordance with the course description "Academic Practice of Physic's Master" and the practice regulations of the Master's study programme "Physics", which in turn are developed in accordance with :

1. *Regulations of the Study Programmes and Continuing Education Programmes of the University of Latvia* (Decision No 102 of the Senate of the University of Latvia, 24.04.2017);
2. *Regulations on the organisation of internships for students of the University of Latvia* (Order No 1/417 of 25.11.2019).

"Academic Practice of Physic's Master" amounts 6 CP, which corresponds to 240 hours of work at the placement site. The practice is organised in the natural science departments of UL and DU, as well as in other organisations where fundamental or applied research is carried out (UL Institute of Physic, UL Institute of Atomic Physics and Spectroscopy, UL Institute of Chemical Physics, UL Institute of Solid State Physics, Technology Department of DU Institute of Life Sciences and Technologies) or science intensive production (*Light Guide Optics International, Ceram Optec, Tet*, etc.). All research institutions and a large number of high-tech companies also offer internships for English-speaking students, so the English stream is also catered for.

These institutes and institutions carry out research/commercial projects related to the synthesis and research of various new materials and the deployment of smart technologies.

The student chooses the place of the traineeship. The student prepares and concludes agreements with organisations for the provision of the student's practice. The conclusion of agreements and coordination of practice work is carried out by the practice supervisor of the Master's study programme "Physics" in accordance with the practice regulations of the Master's study programme "Physics".

During the practice, the student performs certain tasks: he/she gets acquainted with the structure of a particular institution, the specifics of scientific activity (fundamental, applied research), the organisation of work and with problems of a physical nature relevant to that institution, and prepares and presents the results achieved. The coordination/approval of the practice site and specific tasks of the internship is carried out by the Director of the Master's study programme "Physics" or a teaching staff member involved in the implementation of the programme - practice supervisor appointed by the Director.

The practice is planned in one semester and is organised in accordance with the practice regulations of the Master's study programme "Physics" approved by the University. The specific tasks of “Academic Practice of Physic's Master” are specified in the course description.

The student's practice is supervised/supported by the Director of the Master's degree programme in Physics or a member of the teaching staff involved in the implementation of the programme, or, in the place of practice, by the student's practice supervisor nominated by the head of the institution/company.

During the MSc in Physics academic practice, at least four seminars are scheduled, the main purpose of which is to explain the objectives of the practice, to support students in achieving the intended outcomes and to guide their own performance.

In the introductory seminar, the practice supervisor familiarises students with the aims, objectives, content, general rules and procedures of the practice, the documentation of the practice and the procedures and criteria for the assessment of the practice.

The current practice will focus on sharing student experiences and group learning, as

1) seminars give students the opportunity to share what they have learned and done, to receive support and information from both university staff and other students about current research in Latvia, available equipment and research methods if they are doing their internships in different institutions;

2) The student group is also a peer support and learning group - this exchange can be a valuable professional support for studying and starting a career in an area of interest to the student.

At the end of the practice, the student prepares and submits to the practice supervisor an practice report, reflecting what has been planned and what has been achieved. The current documentation forms for the placement are available in the e-course materials of the course "Academic Practice of Physic's Master". The student's performance, growth and attitude to work are also evaluated by the internship supervisor of the institution or company in the form of an internship supervisor's report.

The final seminar of the practice is the practice defence, where the student presents what he/she has done during the practice, evaluates his/her growth, the acquired/strengthened competences and receives expert feedback on his/her work. The final evaluation of the practice is given by the internship supervisor according to the criteria formulated in the internship regulations and the results achieved in the study course "Academic Practice of Physic's Master".

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.

In the period 2013-2021, 112 Master's thesis topics have been submitted and 108 theses have been defended (a degree in Physics has been awarded), while in two cases no degree has been awarded. There is a high demand for supervising Master's theses, so practically all Master's students are involved in the development of some research project, which ensures the relevance of the research topics in the field and the link with the labour market. The breakdown by institutes and laboratories where theses are developed is as follows: UL IA - 1, UL IAPS - 15, UL ISSP - 43, UL IP - 7, FPMO FD - 11, UL ICP - 5, FPMO LC - 12, UL IMM - 3, FPMO INM - 14, VUAS - 1. UL ISSP provides about one third of the final theses, FPMO units provide a little less than one third (37) of the final theses. The topics of the final theses are approved by the programme director, who traditionally informs the Board of the Physics department about the themes and supervisors of the final theses. If the programme director or the Board of the Physics department has any doubts about the relevance of the topic to the Master's programme or the qualifications of the supervisor, the topic is either not approved or an additional advisor is recruited to supervise the thesis. These are very rare cases. Although the programme being considered for accreditation is licensed in 2021, the requirements for the quality of the Master's thesis have not been reduced and all previous experience is applicable to the new AMSPP.

As already mentioned, all Master's thesis topics are related to scientific research at the faculty and collaborating institutes. The links with active researchers ensure that the themes of the theses are linked to the development of projects on topics of global and Latvian relevance, and the theses are supervised by renowned researchers. This is confirmed by the data in Table 6.2.5.1, which shows that half of all theses are supervised by researchers who have supervised at least 3 final theses in the reporting period, have a high number of publications and a high Hirsch index.

Table 6.2.5.1

The most numerous supervisors of Master's theses (data as of 08.03.2022)

Name Surname	Institution	Number of thesis	SCOPUS h-index	Number of publications
Aivars Vembris	UL ISSP	5	10	60
Andris Jakovičs	FPMO INM	5	18	151

Donatas Erts	UL ICP	4	30	139
Erik Birks	UL ISSP	4	13	66
Ilmārs Grants	UL IP	3	15	52
Jānis Kleperis	UL ISSP	4	14	106
Jānis Spīgulis	UL IAPS	5	20	198
Jānis Virbulis	FPMO INM	4	21	65
Laimonis Začs	FPMO LC Astro	3	11	38
Linards Kalvāns	FPMO LC	3	6	12
Māris Tamanis	FPMO LC	3	22	93
Uldis Rogulis	UL ISSP	5	14	94
Vitauts Tamužs	UL IMM	3	17	52
Vyacheslav Kascheyev	FPMO FD	5	18	45
		56 of 112	16,35	83,6

The titles of the most outstanding final theses of the last 3 years (rated 10) are given as examples of the themes:

- Investigation of electromagnetically excited liquid metal flow for aluminium transport and degassing in a linear channel;
- Synthesis, properties and applications of bismuth and antimony chalcogenide/carbon nanotube heterostructures for flexible thermoelectric devices;
- Development of novel 1D ZNO/PDA core-shell nanostructures with improved structural, electronic, optical and sensing properties;
- Quantitative analysis of europium ion distribution and properties in glass ceramics;
- Calculation of cobalt and iron containing perovskite materials using the AOLK method with

hybrid density functionals;

- High-resolution spectroscopic studies and electronic structure analysis of the A~b complex of the Cs2 molecule;
- High-resolution spectroscopy of pulsating stars near the AMZ peak.

As can be seen, the themes of the works are diversified, with both theoretical and experimental works being outstanding.

The final thesis is assessed by a special Master's Thesis defence committee on a 10-point system. The committee is composed of faculty members with international research experience. The final mark is made up of the following components:

- The quality of the thesis (up-to-date topic, analysis of previous research findings, innovation),
- the author's report (ability to present the research in a scientific, concise and reasoned manner, to formulate conclusions, to indicate possible future research directions),
- answers to the panel's questions and ability to debate.

The student will receive a lower grade if the time spent on the thesis is insufficient, if the student does not independently produce results of scientific value, if the thesis is of poor quality, if the student does not demonstrate a good understanding of the topic.

The student receives a higher mark (9 and 10) for the final thesis if he student shows signs of excellence, e.g. co-authorship of a scientific article or participation in a scientific conference, significant contribution of the results to the development of the thesis site, and in other cases which, in the opinion of the committee, are outstanding.

The panel will therefore assess how well the student has acquired the knowledge and skills required by the AMSPP outcomes, with particular emphasis on the competence required by the programme to carry out independent research, put it in writing and present it to physics professionals.

Overall, the analysis of the 108 marks posted during the reporting period (in addition to the two cases where the work was not allowed to be defended) shows that the average value is 8.54. The distribution of marks by value is shown in Figure 6.2.5.1. There is little fluctuation in the average mark by year, as illustrated in Figure 6.2.5.2, irrespective of the number of papers assessed.

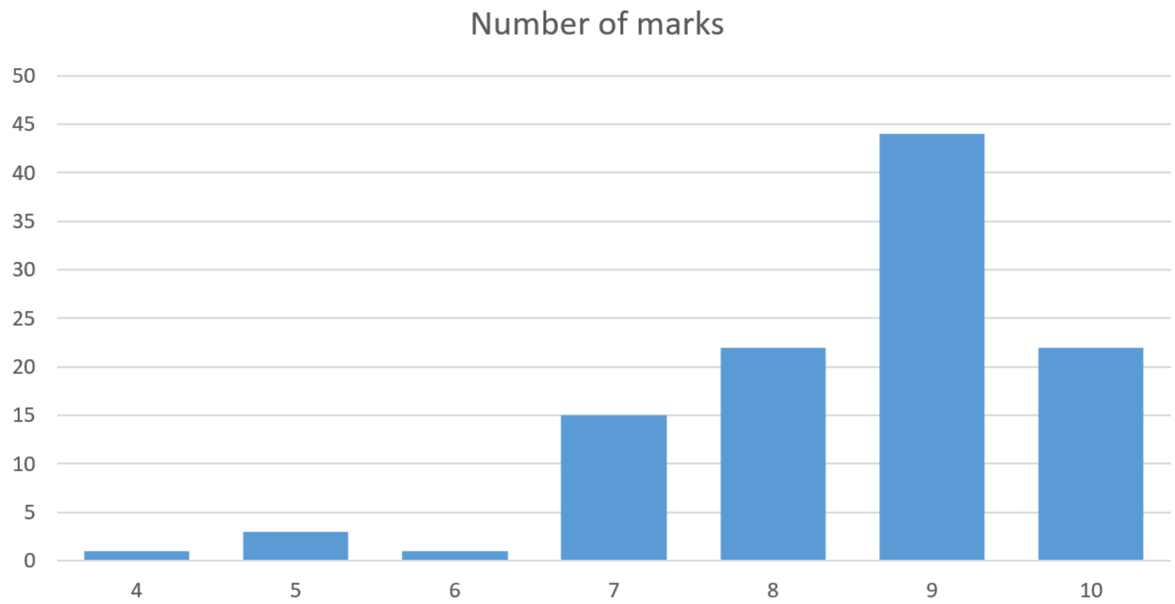


Figure 6.2.5.1. Distribution of final paper marks during the reporting period

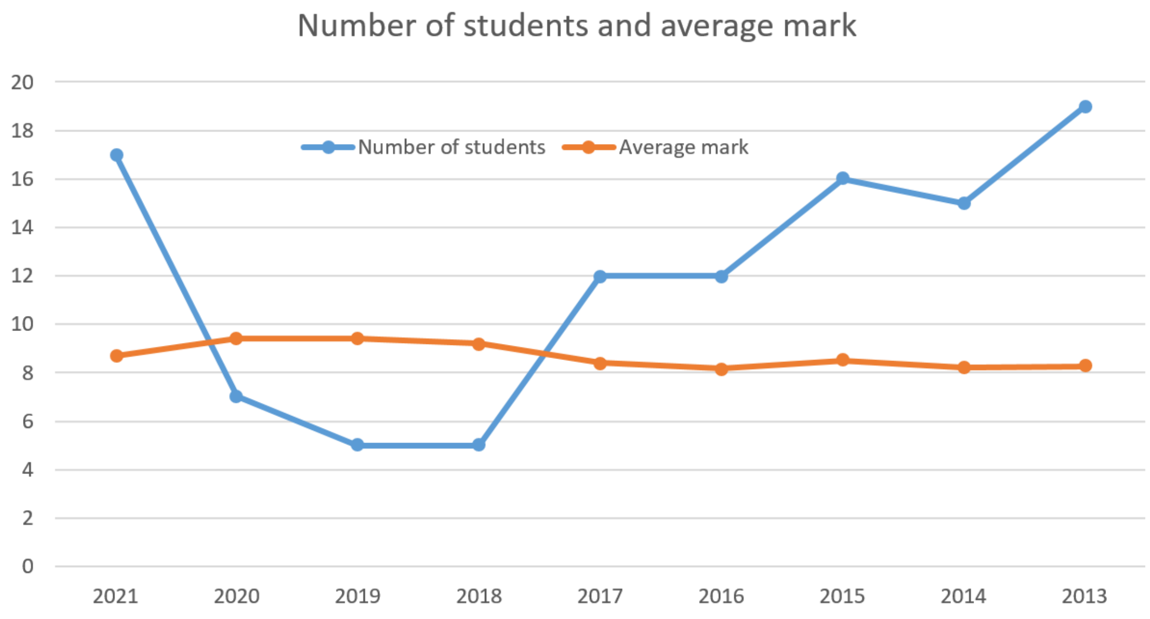


Figure 6.2.5.2. Number of students and average final paper grades during the reporting period

As can be seen, low grades are also given, but the final theses traditionally involve high quality research, reaffirming the relevance of Master's theses in the field. The results of a large number of theses are published as scientific papers in internationally recognised journals. The most frequent grades (from 7 to 10) also confirm the quality of the work, which is not possible without research in a up-to-date topic.

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 Director of the AMSPP is responsible for the implementation of the AMSPP at the University of Latvia, under the direct supervision of the Department of Physics. The following staff provides support for the planning and implementation of the study process at the FPMO:

- Senior Methodologist of the Faculty, which is common to FPMO study programmes, administers student affairs, provides student services, which are the responsibility of the Faculty,
- Specific study issues in the Physics Department are handled by the Senior Methodologist of the FD,
- The senior secretary of the Physics Department manages the records of the Physics Department,
- planning of classes at AMSPP is done by the FD Methodologist,
- The UL Sciences Building has joint IT support, provided by two IT specialists, who service all

the units located in 3 Jelgava street.

The mandatory part of the AMSPP is implemented by the faculty members of the Faculty of Physics, except for the course " Academic Practice of Physic's Master", which is implemented by the DU side within the joint programme. In addition to the FPMO, the implementation of the restricted choice study courses also involves faculty members of the Faculty of Chemistry of the University of Latvia, the Faculty of Computer Science of the University of Latvia, as well as representatives of research institutes (including VUAS), who are employed as FPMO lecturers in the study programme.

The implementation of the AMSPP specialisations is supervised by 5 FD Chairs:

- Chair of Physics of Solids and Materials,
- Chair of Experimental Physics,
- Chair of Electrodynamics and Continuum Mechanics,
- Chair of Physics Education Research,
- Chair of Theoretical Physics.

The staff of the departments is involved in the implementation of specialised AMSPP study courses and actively collaborates with the research institutes of the Faculty of Science on the relevant topics:

- Institute of Astronomy of the University of Latvia,
- Institute of Atomic Physics and Spectroscopy, University of Latvia,
- Institute of Solid State Physics, University of Latvia,
- Institute of Physics at the University of Latvia,
- Institute of Chemical Physics, University of Latvia,
- Institute for Mechanics of Materials, University of Latvia

External partners are Daugavpils University (DU) and some researchers from Ventspils University of Applied Sciences.

DU is represented in the implementation of the AMSPP by two units:

- The chairs of the Faculty of Natural Sciences and Mathematics (FNSM): Chair of Physics and Mathematics and Chair of Informatics,
- The centres of the Technology Department (TD) of the Life Sciences and Technologies Institute (LSTI) of DU: the G. Liberts Centre for Innovative Microscopy and the Belarus-Latvia Science Innovative Reinforcement Technology Centre.

The AMSPP faculty members are involved in research at the FPMO or one of the partners mentioned above. The potential of this research environment in terms of quantitative indicators (number of researchers and funding) far exceeds that of the AMSPP faculty, which is a positive factor for keeping the topics of the compulsory elective courses relevant in the global context and ensuring high quality final theses, a significant part of the results of which can be published in internationally recognised scientific journals. The demand for Masters students as research staff (supply of thesis topics) far exceeds the number of AMSPP graduates, which gives students a good choice of internationally competitive theses.

Within the Faculty, two research structures should be highlighted alongside the department-based research groups:

- FPMO Laser Centre,
- FPMO Institute of Numerical Modelling,

which are comparable in research capacity to the research institutes of the University of Latvia.

In certain situations, additional support for the implementation of the AMSPP can be provided by the Physics Practicum of the FPMO, whose main functions are to provide laboratory work in general physics and radioelectronics.

UL and DU Master's programmes were actively involved in ERASMUS+ mobility, currently 11 ERASMUS+ mobility agreements have been signed for Physics Master's students, UL FPMO:

1. France (2) - Grenoble Polytechnic Institute, P.M. Curie University Paris 6,
2. Lithuania (1) - Vilnius University
3. Finland (1) - University of Oulu,
4. Turkey (1) - Izmir Institute of Technology
5. Germany (4) - University of Bremen, University of Hannover, University of Kaiserslautern, University of Rostock,
6. Sweden (2) - Lund University, Umea University.

UL Library

UL Science Building Library and its user-centred environment provide uninterrupted access to information resources. It is open to UL students and staff 24 hours a day, every day. Detailed information on the resources of the UL Library is provided in Section 2.3.4 of the Description of the Study Area.

Material and technical support for the learning process

- World-class teaching and research facilities at the Academic Centre of the University of Latvia in Riga, 1 and 3 Jelgavas street, and the Institute of Solid State Physics of the University of Latvia in Riga, 8 Kengaraga street;
- Including two computer rooms with at least 30 seats;
- Regular and specialised software including *LabView*, *COMSOL*, *MatLab*, *Mathematica*, *Ansys*, etc;

The study programme will gain synergistic effect through cooperation in the implementation of the programme with the institutes of the University of Latvia, research laboratories of the University of Latvia, using the infrastructure of the institutes for laboratory work and Master's thesis development.

The implementation of mathematical modelling study courses is ensured by the COMSOL licences at the disposal of UL and DU.

The AMSPP has adequate and modern facilities. For detailed information, see Chapter 2.3.2 "Infrastructure and Facilities" of the Description of the Study Programme.

Together, the teaching and research facilities of the two universities (UL and DU) provide a strong and modern support for the implementation of the AMSPP:

- primarily for the final thesis and the implementation of the academic internship;
- the implementation of the courses "Research Laboratory Works I" and "Research Laboratory Works II";
- support for study courses in which laboratory equipment is used as part of the course of study, e.g. "Thin Film Science and Deposition Technologies", " Microscopy and Spectroscopy Characterization Methods ", "Optical and Magnetic Spectroscopy", "Micro and Nanofabrication of Electronic and Photonic Devices ", "Physics of Polymers and Composite Materials", "Microfluidics", "Practical Holographic Systems", "Vacuum Technology", etc.;
- The modern and extensive research infrastructure of the University is highlighted by the list of major facilities and infrastructures at the disposal of its institutes and laboratories,

summarised in Table 6.3.1.1. Their diversity corresponds to and well describes the diversity of specialisations of the AMSPP. These equipment and facilities are mainly used for individual training in the implementation of academic internships and final theses. Some of the equipment is also used for the laboratory work of the courses. Table 6.3.1.2 shows separately the most important equipment used in the laboratory work of the courses "Research Laboratory Works I" and "Research Laboratory Works II" and which is more freely available to students.

Table 6.3.1.1

List of important facilities and infrastructure of the Institutes and Laboratories of the University

Laboratory of Magnetic Soft Materials, FPMO		
1.	Inverted microscope with motorised stage, piezo stage and various cameras	*Leica* DMI3000B & ASI MS-2000 & PI E-710 & *Andor* NEO 5.5, u. c.
2.	Velocity field system for microscopic particle images	*Dantec Dynamics Micro Particle Image Velocimetry system*
3.	Rheometer	*Anton Paar* MCR 502
FPMO Laser Centre		
4.	High-resolution infrared Fourier transform spectrometer	BRUKER IFS-125 HR
5.	Laser Park (Solid State Laser, Ti:sapphire laser, etc.)	*Lighthouse Photonics Sprout-G* 18W, M *squared SolsTiS & others*
6.	Cryostat	*Oxford instruments MicrostatHe*
Institute of Numerical Modelling, FPMO		
7.	High Performance Computing (HPC) cluster	10 *nodes,* 256 CPU *cores,* 2TB RAM*, InfiniBand*
8.	Water vapour permeation detection equipment	GINTRONIC *GraviTest* 6400-50
Institute of Astronomy		
9.	The largest optical telescope in the Baltics	Schmidt telescope, Baldone
10.	Laser locating station	*Satellite laser ranging* (SLR) *system,* Botanical Garden, Riga
Institute of Physics		
11.	Unique liquid metal circuits for magnetohydrodynamics studies	*Sodium facility, Lead-Lithium/Lead-Bismuth facility (*UL IP)
12.	Powerful electromagnet (up to 3T)	GMW, *Dipole Electromagnet* 3473 & *Keysight,* N8757A

13.	Spectrograph with ICCD spectroscopic and imaging detector	*Andor Technlogy Mechelle* 5000 & *iStar* 334 DH334T-18U-E3
Institute of Mechanics of Materials		
14.	Materials testing laboratory (various testing systems)	MTS 809.40, MTS 5T, ZST3, *Zwick/Roell videoXtens* 2-120 HP (UL IMM)
Institute of Atomic Physics and Spectroscopy, University of Latvia		
15.	Optical frequency comb	*Menlo systems optical frequency comb* (UL IAPS)
16.	Different spectrometers	*Horiba* iHR320, *Horiba* 1000 M, *Ocean Optics NirQuest* 512, etc.
17.	Continuous aperture laser	*NKT Photonics, Fianium, Micro supercontinuum laser (400-2000 nm)*
Institute of Chemical Physics		
18.	Chemical vapour deposition system	*EasyTube®* 101 CVD
19.	Atomic force microscope	AFM *Asylum Research* MFP-3D
20.	Signal generation and analysis equipment	*Agilent* N9310A *generator*, *Rohde & Schwarz* ZNB 8 *analyser*
Institute of Solid State Physics, University of Latvia		
21.	Micro- and nanotechnology process networking	650 m2 (ISO *class* 4-8)
22.	Electron microscopes	TEM (FEI *Tecnai* GF20), SEM *(Tescan Lyra)*
23.	Equipment for prototyping microdevices	Electron beam lithography *(Raith eLINE Plus),* Laser engraver *(Heidelberg Instruments µPG 101),* Mask exponent *(Suss Microtec MA/BA6 Gen4),* Rotary disc layer *(Laurell WS-650Mz-23NPPB/UD3)*
24.	Spectroscopic methods	Fourier transform infrared (*Bruker Equinox* 55, *Bruker Vertex* 80v*),* photoluminescence *(Edinburgh Instruments* FLS1000-DD-stm*),* ODMR *(Oxford Instruments;* SM4000-8*), Raman (TriVista* CRS *Confocal Raman Microscope* TR777*),* X-ray (*ThermoFisher ESCALAB Xi), etc.*
25.	Methods for creating thin layers	Atomic Layers *(Veeco ALD Savannah S100),* Printing *(Fujifilm Dimatix Materials Printer DMP-2850),* Multigrid (Sidrabe SAF25/50), Laser *(Twente Solid State Technology* PLD*)*

Table 6.3.1.2

List of major equipment used in the course "Research laboratory work"

No	Name of the installation	Manufacturer, model	Institution

1.	Electromechanical testing machine	*Zwick* 2.5	UL IMM
2.	Kelvin probe system	KP *Technology* SKP5050	UL ISSP
3.	Scanning electron microscope	SEM *Phenom Pro*	UL ISSP
4.	Liquid metal circuit with MHD pump	In-Ga-Sn loop	UL IP
5.	Constant temperature anemometer	*Dantec Dynamics Constant Temperature Anemometer* (CTA)	UL IP
6.	Ultrasonic Doppler cyclosimetry machine	*Signal Processing* DOP2000	UL IP
7.	Scanning electron microscope with nanomanipulator	*Hitachi* S-4800 & *Smaract* 13D	UL ICP
8.	Closed-loop physical property measuring equipment	*Quantum Design DynaCool-9T*	UL ICP
9.	Heat flow measurement equipment	*Taurus* instruments TCA 500-P	UL FPMO INM
10.	Porosimeter	C-Therm TCi	UL FPMO INM

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).

The study programme can be delivered in both Latvian and English. However, it may not be cost-effective to maintain both languages of training at the same time, so the plan is to deliver training in one language, with a switch to English in the coming years. Current legislation allows implementation of a joint study programme in English, while preserving the state budget financing for it. The cost-effectiveness of the study programme is therefore calculated below for the language of instruction in Latvian and the same is applied to the instruction in English. As the calculations in this chapter show, the cost-effectiveness of the study programme is achieved with 23 students. If both the Latvian and English streams are maintained simultaneously in both years of study, then there would be 23 students in each stream.

Programme revenue

To provide the funds needed to implement the AMSPP, UL uses:

1. a state budget grant from the Ministry of Education and Science, set at 4645.8135 EUR for full-time full-time studies for the academic year 2021/2022;
2. the tuition fees, taking into account all the factors set out in the Financial Security section, set for the academic year 2022/2023:
   - for full-time studies EUR 2400 per year
3. There are currently no tuition fees for English-language students, as such studies are planned from 2023/2024.

Taking into account the above, the total budget of the study programme is expected to be 167249,29 EUR, per year, as summarised in Tables 6.3.2.1. and 6.3.2.2.

Table 6.3.2.1

Study programme budget, EUR

Budget transcript	Budget, EUR
Tuition fee revenue	0
State budget grant	167249,29
Total	167249,29

Programme income

Table 6.3.2.2

Annual income forecast of the programme, EUR

Type of study	Number of students	Tuition fees / state subsidy	Total income
PLK (budget)	36	4645,81	167249,286
PLK (max)	0	2000	0
Total			**167249,286**

Programme costs

In order to estimate the amount of funds required for financial support, the UL calculates the cost price for study programmes according to the methodology developed by the UL, which takes into account the costs of study process support described above under study field 2.3.1 Financial support and information on the study programme plan, teaching staff involved, planned number of students, etc., thus ensuring the reliability of the forecasts.

*Programme costs for **full-time studies***

For the calculations, the AMSPP implementers use the 2020/2021 academic year enrolment data - 26 students in the full-time programme, the existing curriculum and the existing structure of the academic staff involved. Taking into account the above, the estimated full-time cost of the programme per student is EUR 4344 per year and the total cost of the programme is EUR 136943 per year. A more detailed percentage breakdown of the costs is shown in Table 6.3.2.3

Table 6.3.2.3

Percentage breakdown of costs in the study programme

Expenditure heading	**% of total**
Teaching staff costs	35,95%
General staff	10,07%
Other costs	0,00%
Infrastructure expenditure	10,63%
Assets and services	5,50%
Indirect costs	37,86%
TOTAL COSTS	**100 %**

Figure 6.3.2.1 shows the cost of the study programme depending on the number of students and compares it with the proposed tuition fees and the state budget subsidy.

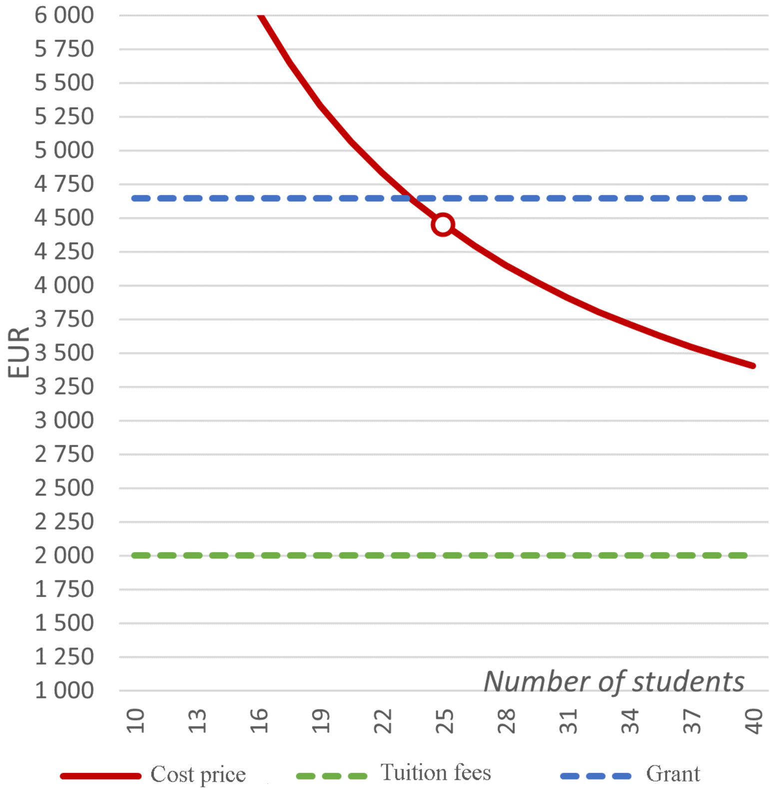


Figure 6.3.2.1. AMSPP's own costs per number of students

According to the calculation, in order for the programme to be cost-effective and to provide students with a high-quality study process, the total number of students on the study budget in all years of study should be at least 23 (intersection of the red and blue lines). However, tuition fees have historically been uniform across the entire Faculty of Arts and do not reflect the real costs of science degree programmes. However, this does not jeopardise the implementation of the AMSPP, as the budget allocation currently covers the costs of implementing the programme and each additional student place (in terms of fee-paying students) is covered by the tuition fee.

Summary of programme revenue and costs

Table 6.3.2.4 summarises the programme income based on the number of students, the government grant and tuition fees, and the programme expenditure for this number of students.

Table 6.3.2.4

Programme result

Type of study	Number of students	Tuition fees / state subsidy	**Total income**	**Total costs**
Full-time studies (budget)	36	4645,81	**167249,29**	**136943**
Full-time studies (personal funding)	0	2000	0	0
Total			**167249,29**	**136943**

Conclusion

The data presented in Table 6.3.2.4 demonstrates that the UL has sufficient resources to implement the AMSPP and ensure its further development. 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 unit. The faculties also receive financial support for programme development from the UL Study Quality Improvement Fund, which is centrally established from the UL budget allocation. Mutual payments with Daugavpils University shall be governed by the "Agreement on the Allocation of Funding and Mutual Payment Procedures" concluded in accordance with the "Agreement on the Implementation of the Joint Master's Degree Programme in Physics" (the Agreement is attached in the section "Other Annexes").

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.

As already mentioned, the content of the new AMSPP is designed with a focus on specialisation opportunities, as opposed to the general Master's programme that existed at the time of the previous accreditation. As a result, the programme has a large number of experts in the field whose main activity is research. *The Law on Higher Education Institutions* (Article 55, paragraph 1, point 3) stipulates that the implementation of the compulsory part and the restricted choice part of academic study programmes shall involve not less than five professors and associate professors in total who have been elected to academic positions at the respective higher education institution. There are 15 professors and associate professors elected by the University, 10 of whom are elected by the FPMO, thus the requirement of *the Law on Higher Education Institutions* is fulfilled (see Table 6.4.1.1).

Table 6.4.1.1

Professors and Associate Professors involved in the implementation of the study programme

N.B.	NAME, first name	Teaching post
1	Asmuss Svetlana	Professor
2	Auziņš Mārcis	Professor
3	Bartkevich Vadim	Professor
4	Cēbers Andrejs	Professor

5	Erts Donāts	Professor
6	Ferber Ruvin	Professor
7	Kashcheyev Vyacheslav	Professor
8	Spygulis Jānis	Professor
9	Valeinis Janis	Professor
10	Barinov Girts	Associate Professor
11	Bērziņš Agris	Associate Professor
12	Lācis Sandris	Associate Professor
13	Anatoly Sharakovsky	Associate Professor
14	Vaivars Guntars	Associate Professor
15	Belov Alexander	Associate Professor

The knowledge of the national language of the academic staff employed in the study programme meets the requirements of the Regulations Regarding the Extent of the Knowledge of the Official Language, the Procedures for Examining the Proficiency in the Official Language and the State Fee for Examining the Proficiency in the Official Language (Cabinet Regulation No 733, 07.07.2009), which allows to teach courses in the national language. All teaching staff also have sufficient qualifications and language skills to deliver lectures in English.

The overall distribution of teaching staff by category (professors, associate professors, assistant professors, lecturers, part-time lecturers) is summarised in Table 6.4.1.2. It should be noted that the workload will also include Part B courses, which are not always offered every year. The actual workload is therefore lower. The large number of professors is also explained by the inclusion of some interdisciplinary courses in the study programme, and by the fact that professors of these courses are elected at other faculties (V. Bartkevičs, D. Erts), as well as mathematics professors (J. Valeinis, S. Asmuss). Associate professors also include representatives of other faculties (A. Bērziņš, G. Vaivars, A. Belovs).

Table 6.4.1.2

Teaching staff workload in 2022 (planned)

Position	Read more	KP, vid	Total CP
Professor	9	4,33	38,97
Associate Professor	6	3,17	19,02
Docents	15	3,73	55,95
Acting Lecturer	1	3	3

University Teacher	27	2,52	68,04

In addition, it should be emphasised that the involvement of outstanding researchers in the implementation of individual study courses allows for the provision of high-quality knowledge, skills and competences in well-developed physics and interdisciplinary fields with international competitiveness in Latvia.

Some of the representatives of the research institutes of the University (who have a larger overall workload) are willing to take up positions in the FPMO:

- from the Institute of Solid State Physics, UL (ISSP) - A. Šarakovskis, A. Antuzevičs, A. Vembris, J. Grūbe;
- from the Institute of Physics, UL (UL IP) - L. Goldšteins, I. Kaldre;
- Spīgulis from the Institute of Atomic Physics and Spectroscopy, UL (UL IAPS);
- Glaskova-Kuzmina from the Institute for Mechanics of Materials, UL (UL IMM);
- Prikulis from the Institute of Chemical Physics, UL(UL ICP).

Scientists with a lower overall workload are in university teaching relationships:

- from the Institute of Solid State Physics, UL (UL ISSP) - G. Mozoļevskis, L. Skuja, Ē. Birks, D. Bocharovs, E. Butanovs, M. Dunce, A. Kuzmins, K. Pudzs, M. Zubkins;
- from the Institute of Physics, UL (UL IP) - T. Beinerts, D. Berenis, N. Jēkabsons, I. Krastiņš;
- from the Institute of Astronomy, UL (UL IA) - *Ganeev*;
- Ciniņš from the Institute of Atomic Physics and Spectroscopy, UL.

Specialists form Ventspils University of Applied Science help to implement Astrophysics specialization.

Overall, the AMSPP faculty combines teaching and research competences at a high level, allowing for competitive specialisation in specific areas. The employability of graduates demonstrates their competitiveness in both the local and international labour market.

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.

The changes in the composition of the teaching staff over the reporting period are illustrated by the analysis of Tables 6.4.2.1 and 6.4.2.2 below.

Table 6.4.2.1

Teaching staff workload in 2012

Position	Count	KP, vid	Total CP
Professor	6	7	42

Associate Professor	5	3,47	17,35
Docent	6	4,11	24,66
Lecturer	3	2,67	8,01
University teacher	3	2	6

The comparison is summarised in Table 6.4.2.2, with plus signs indicating an increase.

Table 6.4.2.2

Changes in teaching workload, difference 2022 minus 2012

Position	Count	KP, vid	Total CP
Professor	3	-2,67	-3,03
Associate Professor	1	-0,3	1,67
Docent	9	-0,38	31,29
Lecturer	-2	0,33	-5,01
University teacher	24	0,52	62,04

As can be seen from the tables, in 2012 the study programme was implemented by a total of 23 teaching staff. In 2022, the study programme will be implemented by 58 teaching staff, which is 35 more than in 2012. This is primarily due to the shift towards a specialisation-based study programme, which involves experts in the field, often only for the delivery of individual study courses without the use of an elected position. Some courses involve more than one faculty member.

There has been a decrease in the number of lecturers, a decrease in the average workload for professors, associate professors and assistant professors, and a significant increase in the number of university teachers. This is a direct consequence of the orientation towards more qualified staff, who also devote a lot of time to research and can therefore ensure an increase in quality by specialising in physics, which is a hot topic in Latvia at the moment, and achieving international competitiveness.

A comparison at the level of specific teaching staff with the situation in 2012 (Table 6.4.2.3) shows that 14 teaching staff are no longer in employment, either because they are over retirement age or, unfortunately, because they have died. In one case, the faculty member left for the private sector. These changes, as Table 6.4.2.3 shows, have been very successfully compensated for by new recruits, and with a closer link to research, which is an important factor for the AMSPP.

Table 6.4.2.3

Teaching staff	2012	2022
Buligins Leonīds	Associate Professor	No
Jakovičs Andris	Associate Professor	No
Lietuvietis Ojārs	Associate Professor	No
Muižnieks Andris	Associate Professor	No
Žagars Juris	Associate Professor	No
Lācis Sandris	Docent	Associate Professor
Driķis Ivars	Docent	Docent
Āboliņš Jānis	Docent	No
Mihails Belovs	Docent	No
Vladimirs Ivins	Docent	No
Rēvalds Valdis	Docent	No
Barinovs Ģirts	Lecturer	Associate Professor
Anatolijs Šarakovskis	Lecturer	Associate Professor
Smotrovs Jānis	Lecturer	No
Krūmiņš Andris	Professor	No
Rogulis Uldis	Professor	No
Auziņš Mārcis	Professor	Professor
Cēbers Andrejs	Professor	Professor
Ferbers Ruvins	Professor	Professor
Spīgulis Jānis	Professor	Professor
Tambergs Juris	University teacher	No
Zīle Edmunds	University teacher	No
Kuzmins Aleksejs	University teacher	University teacher

Overall, the changes in the teaching staff have a number of positive effects on the quality of studies, as listed below.

- There has been a renewal of the teaching staff, including the replacement of some teaching

staff who had received negative feedback in student surveys. The average age has changed from 51 years (in 2012) to 47 years now. Overall, the renewal of teaching staff ensures the sustainable development of the study programme and the inheritance of accumulated experience.
- The workload of some teaching staff has decreased, allowing them to devote more time to scientific activities and class preparation, as a result of which we expect the course content to improve, bringing it closer to modern science.
- The attraction of new researchers to teach the courses contributes to the introduction of new topics, currently relevant in physics, into the courses and final theses.

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).

Cooperation between trainers for the development of the AMSPP takes place at four levels:

- personal contacts
- cooperation within departments (departmental meetings)
- cooperation at FD level (FD Board meetings)
- inter-institutional cooperation, organised by the Director of the study programme and the Head of the FD.

The main organiser of the cooperation is the study programme director (responsible for content) with the support of the FD manager (planning financial resources).

The mandatory (A) part of the AMSPP content was developed through consultation and discussion within the FD Board, involving all FD faculty members, as well as the results of a student survey and discussions with students. This has resulted in Part A, the content of which is aligned with that of the specialisation courses.

The content of the AMSPP Restricted Choce (B) part is mainly the responsibility of the Chairs within which the content of the specialisations is developed and replaced. The Chairs also cooperate with the research institutes of the University, resulting in the development of new courses of study, which are implemented by specialists from the institutes, often using the infrastructure of the institutes for laboratory work. The responsibility of the Chairs lies in the completion of the courses of study and their substantive linking, which results in the provision of study outcomes relevant to the specialisation.

There are also collaborations with external academics who provide interdisciplinary courses of study. These are courses that are taught in several degree programmes and the influence of AMSPP on the content of these courses is weak. Courses of study are selected on the basis of their content, which is decided by other faculties.

After the establishment of the Study Direction Board (SDB), the Physics Study Programme Board (PSPB) lost its role as the body that controlled the content of the courses, including ensuring content linkage. The SDP has now entrusted the control of course content to the Board of the FD. The FD Board reviews all new and substantially changed course content.

The student-teaching staff ratio can be described in different ways. The list of teaching staff for an accredited study programme is used.

Table 6.4.3.1

Teaching staff/student ratio

Number of teaching staff		Number of teaching staff per 1 student		Number of students per 1 faculty member	
		26	40	26	40
Number of teaching staff with VUAS representatives	58	2,23	1,45	0,45	0,69
Number of teaching staff excluding VUAS	51	1,96	1,28	0,51	0,78
PLE (10 CP per semester, 20 CP per year) with Astrophysics	18,5	0,36	0,23	2,81	4,32
PLE (10 CP per semester, 20 CP per year) without Astrophysics	16,3	0,31	0,20	3,19	4,91

Table 6.4.3.1 summarises the different approaches. Firstly, by number of students, either taking 26, which is the autumn 2021 figure, or 40, which is the average of previous years. As teaching staff

are not only employed for this study programme or are only assigned to a specific course, an additional approximation of "PLE - Full Time Equivalent" is proposed, which normalizes the teaching load to 20 CP per year (10 CP per semester).

Additional information is provided by data with or without the Astrophysics specialisation, which has been committed to by FPMO specialists from Ventspils University of Applied Sciences (VUAS) and UL IA. It can be seen that such with/without options significantly change the faculty-student ratio and it should be noted that such calculations do not take into account the additional students attracted by opening a new specialisation.

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	annex_AMSPF_Sample of the diploma and its supplement.pdf	piel_AMSPF_Diploms un pielikumi.pdf
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)	annex_AMSPF_Opinion of the Council of Higher Education.docx	piel_AMSPF_AIP atzinums.edoc
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)	Compatibility of AMSPP with Law of higher education.docx	Kopīgās studiju programmas AMSPF atbilstība Augstskolu li.docx
Statistics on the students in the reporting period	6.5.annex_AMSPF_Statistics on the students in the reporting period.docx	6.5.piel_AMSPF_Statistikas dati par studējošajiem.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	6.6.annex_AMSPF_Compliance with the study programme with the State Education Standard.docx	6.6.piel_AMSPF_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	6.8.annex_AMSPF_Mapping of the study courses.xlsx	6.8.piel_AMSPF_Studiju kursu kartējums.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	6.9.annex_AMSPF_The curriculum of the study programme.docx	6.9.piel_AMSPF_Studiju plāns.docx
Descriptions of the study courses/ modules	6.10.annex_AMSPF_Descriptions of the study courses.docx	6.10.piel_AMSPF_Studiju kursu apraksti.docx
Description of the organisation of the internship of the students (if applicable)	6.11.annex_AMSPF_Description of the organisation of the internship of the students.docx	6.11.piel_AMSPF_Prakses nolikums.pdf
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)	annex_AMSPF_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher Edu.docx	piel_AMSPF_Apliecinājums par akadēmiskā personāla atbilstību augstskolu likuma 55. panta 1.d. 3.p.pdf