CENTRE FOR QUALITY ASSESSMENT IN HIGHER EDUCATION

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# EVALUATION REPORT

# STUDY FIELD OF PHYSICS

at Kaunas University of Technology

**Expert panel:**

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2. **Assoc. Prof. Dr. Mate Csanad,** *academic;*
3. **Prof. Dr. Roger Erb,** *academic;*
4. **Assoc. Prof. Dr. Rynno Lohmus,** *academic;*
5. **Dr. Jonas Berzinš,** *representative of social partners;*
6. **Mr. Dominykas Tvaska,** *students' representative.*

**Evaluation coordinator – *Dr. Domantas Markevičius***

Report language – English



Vilnius
2021

## Study Field Data*

| Title of the study programme | ***Materials Physics and Nanotechnology**** | ***Materials Physics*** |
|---|---|---|
| State code | 6122FC001 | 6213CX001 |
| Type of studies | University studies | University studies |
| Cycle of studies | First | Second |
| Mode of study and duration (in years) | Full-time (4 years) | Full-time (2 years) |
| Credit volume | 240 | 120 |
| Qualification degree and (or) professional qualification | Bachelor of Technology and Physical Sciences (double degree) | Master of Physical Sciences |
| Language of instruction | Lithuanian, English | Lithuanian, English |
| Minimum education required | Secondary education | Higher education |
| Registration date of the study programme | 10/04/2017 | 03/07/2020 |

** two-fields (Physics and Material Technologies) study programme*

# CONTENTS

# I. INTRODUCTION

## 1.1. BACKGROUND OF THE EVALUATION PROCESS

The evaluation of study fields is based on the Methodology of External Evaluation of Study Fields approved by the Director of the Centre for Quality Assessment in Higher Education (hereafter – SKVC) 31 December 2019 Order No. V-149.

The evaluation is intended to help higher education institutions to constantly improve their study process and to inform the public about the quality of studies.

The evaluation process consists of the main following stages: *1) self-evaluation and self-evaluation report prepared by Higher Education Institution (hereafter – HEI); 2) site visit of the expert panel to the higher education institution; 3) production of the external evaluation report (EER) by the expert panel and its publication; 4) follow-up activities.*

On the basis of this external evaluation report of the study field SKVC takes a decision to accredit study field either for 7 years or for 3 years. If the field evaluation is negative then the study field is not accredited.

The study field and cycle are **accredited for 7 years** if all evaluation areas are evaluated as exceptional (5 points), very good (4 points) or good (3 points).

The study field and cycle are **accredited for 3 years** if one of the evaluation areas was evaluated as satisfactory (2 points).

The study field and cycle are **not accredited** if at least one of evaluation areas was evaluated as unsatisfactory (1 point).

## 1.2. EXPERT PANEL

The expert panel was assigned according to the Experts Selection Procedure (hereinafter referred to as the Procedure) as approved by the Director of Centre for Quality Assessment in Higher Education on 31 December 2019 Order No. V-149. The site visit to the HEI was conducted by the panel on *3 December, 2021.* Due to the coronavirus pandemic, the site visit was conducted online using video conferencing tools (Zoom).

**Prof. Dr. Kenneth Peach (panel chairperson),** *Professor Emeritus, Department of Physics, University of Oxford, The United Kingdom;*

**Assoc. Prof. Dr. Máté Csanád,** *Associate Professor, Institute of Physics, Eötvös Loránd University, Hungary*;

**Prof. Dr. Roger Erb,** *Professor for Education of Physics, Faculty of Physics, Goethe-University Frankfurt, Germany;*

**Assoc. Prof. Dr. Rünno Lõhmus,** *Associate Professor in Material Science, Institute of Physics, Faculty of Science and Technology, University of Tartu, Estonia;*

**Dr. Jonas Berzinš (social partner),** *Application Engineer, Department of Scientific Laser Systems, Light Conversion, Lithuania;*

**Mr. Dominykas Tvaska (student representative),** *4th year student of the first cycle study programme "Bioengineering" at Vilnius Tech University, Lithuania.*

## 1.3. GENERAL INFORMATION

The documentation submitted by the HEI follows the outline recommended by SKVC. Along with the self-evaluation report and annexes, the following additional documents have been provided by the HEI before the site visit:

| No. | Name of the document |
|---|---|
| 1. | ADDITIONAL INFORMATION TO SELF-EVALUATION REPORT OF THE STUDY FIELD OF PHYSICS (N003), 26 November 2021 |

## 1.4. BACKGROUND OF THE STUDY FIELD/STUDY FIELD POSITION/STATUS AND SIGNIFICANCE IN THE HEI

Kaunas University of Technology (KTU) has a tradition in technology where the results of fundamental and applied research are integrated into the study process, focusing on innovation development, internationality and interdisciplinary projects. The Department of Physics, part of the Faculty of Mathematics and Natural Sciences, offers several degrees focussed on physics – Applied Physics, Materials and Nanotechnology, and Materials Physics and Nanotechnology (first cycle) and Materials Physics, Medical Physics, Applied Physics and Materials Science (second cycle). Of these, Materials Science closed at the end of academic year 2020/2021, and the Applied Physics and the Materials and Nanotechnology courses will finish at the end of this academic year, and the Medical Physics degree is evaluated separately. A new course (Physics of Technology) is due to start in the academic year 2023/2024.

Physics based industries (PBI) form a significant part of a modern economy, accounting for 5-10% of employment and a significantly higher percentage of contribution to GDP (Gross Domestic Product) and GVA (Gross Value Added) [see for example "The role of physics in supporting economic growth and national productivity", Institute of Physics (2017), and "Influence of physics-based sectors on the economy", IM Magomedov, HA Murzaev, and AM Bagov, International Conference on Economic and Social Trends for Sustainability of Modern Society (2020)]. The KTU study field in physics prepares students at Bachelors and Masters level for careers in PBI with a solid foundation in physics combined with practical experience and transferable skills.

## II. GENERAL ASSESSMENT

*Physics* study field and *first cycle* at Kaunas University of Technology is given **positive** evaluation.

*Study field and cycle assessment in points by evaluation areas*

| No. | Evaluation Area | Evaluation of an Area in points* |
|---|---|---|
| 1. | Intended and achieved learning outcomes and curriculum | 3 |
| 2. | Links between science (art) and studies | 4 |
| 3. | Student admission and support | 3 |
| 4. | Teaching and learning, student performance and graduate employment | 4 |
| 5. | Teaching staff | 4 |
| 6. | Learning facilities and resources | 4 |
| 7. | Study quality management and public information | 4 |
| | **Total:** | **26** |

*1 (unsatisfactory) - the area does not meet the minimum requirements, there are fundamental shortcomings that prevent the implementation of the field studies.
2 (satisfactory) - the area meets the minimum requirements, and there are fundamental shortcomings that need to be eliminated.
3 (good) - the area is being developed systematically, without any fundamental shortcomings.
4 (very good) - the area is evaluated very well in the national context and internationally, without any shortcomings.;
5 (excellent) - the area is evaluated exceptionally well in the national context and internationally.

*Physics* study field and *second cycle* at Kaunas University of Technology is given **positive** evaluation.

*Study field and cycle assessment in points by evaluation areas*

| No. | Evaluation Area | Evaluation of an Area in points* |
|---|---|---|
| 1. | Intended and achieved learning outcomes and curriculum | 3 |
| 2. | Links between science (art) and studies | 4 |
| 3. | Student admission and support | 4 |
| 4. | Teaching and learning, student performance and graduate employment | 4 |
| 5. | Teaching staff | 5 |
| 6. | Learning facilities and resources | 4 |
| 7. | Study quality management and public information | 4 |
| | **Total:** | **28** |

*1 (unsatisfactory) - the area does not meet the minimum requirements, there are fundamental shortcomings that prevent the implementation of the field studies.
2 (satisfactory) - the area meets the minimum requirements, and there are fundamental shortcomings that need to be eliminated.
3 (good) - the area is being developed systematically, without any fundamental shortcomings.
4 (very good) - the area is evaluated very well in the national context and internationally, without any shortcomings.;
5 (excellent) - the area is evaluated exceptionally well in the national context and internationally.

# III. STUDY FIELD ANALYSIS

## 3.1. INTENDED AND ACHIEVED LEARNING OUTCOMES AND CURRICULUM

***Study aims, outcomes and content shall be assessed in accordance with the following indicators:***

### *3.1.1. Evaluation of the conformity of the aims and outcomes of the field and cycle study programmes to the needs of the society and/or the labour market*

As the SER states, innovation is one of the main factors accelerating the development of the Lithuanian economy. Applied physics research, and materials science within it has a great importance in many areas of innovation, as reflected by various European and Lithuanian strategy plans (note e.g., "Lithuania 2030"). This is reflected by the Physics field study programmes of the Kaunas University of Technology. It is beyond doubt that specialists with a physics background will be sought after in the near and mid-term future. In particular, according to Sodra data (c.f. SER, Table 1.1) the number of employees of Lithuanian companies working with physical and material production technologies rose by 6% from 2019 to 2020 alone. The first and second cycle programs of the Kaunas University of Technology reflect this need for people trained in physics and materials science. While the "Applied Physics" first cycle study programme and the "Materials and Nanotechnologies" first cycle study programme are set to close in 2022 (last students will graduate in 2022), a new first cycle programme, "Physics of Technology" was initiated. Unfortunately, this now cannot start before 2023. Meanwhile, "Materials Physics and Nanotechnology" continues to take students. As for second cycle study programs, the "Applied Physics" and "Materials Science" study programs also finish in 2021 and 2022. As of now, the "Materials Physics" is the main program which launched in 2020 and continues the first cycle programs mentioned above, combining the most important features of the previous two programs. There is furthermore a program in medical technology, called "Medical Physics", in the study field of Medical Technology.

The aims and outcomes of the field and cycle study programmes appear to conform to the needs of the society, based on the SER and the site visit. On the other hand, the declining number of students on the first cycle study programmes and the need to close some of these programmes shows that in fact there is an imperfect conformity between the study programmes and the needs of the society and the labour market. Furthermore, it was apparent that no major companies were present at the site visit's appropriate panel meeting, and overall it seemed that more communication between the HEI and the labour market entities would be beneficial.

### *3.1.2. Evaluation of the conformity of the field and cycle study programme aims and outcomes with the mission, objectives of activities and strategy of the HEI*

The mission of the Kaunas University of Technology states that the university should provide "research-based studies at international level; to develop and to transfer knowledge and

innovative technologies for sustainable development of the State and development of innovations; to create an open creative environment which inspires talents and leaders". The study programs, in accordance with this mission, focus on the application of fundamental knowledge on physics and technologies based on physics, for example to solve engineering problems. As the SER states, the study outcomes are coordinated with strategies of the university, considering the opinion of social partners as well.

It is beyond doubt that study goals (listed e.g., in Table 1.3. of the SER) are in accordance with the objectives and the strategy of the Kaunas University of Technology. On the other hand, the coordination of the study programme aims and outcomes with the social partners could be improved. The panel found it good that there are courses in English as well, in parallel to the courses taught in Lithuanian.

On the other hand, to achieve optimal outcomes of the study programme, conform with the mission of the HEI, one needs to ensure (maybe via quality assurance processes) that everyone can listen to courses in a language where she or he is fully capable of grasping the sometimes complicated mathematical and physical chains of thoughts. It is especially complicated to organise courses in two languages when the student numbers are small.

The expert panel notes that further internationalisation could make the study programmes more conform with the mission and strategy of the HEI, and apparently an effort is being made to do so. This must be done in a way that the level of international students conforms to that of the Lithuanian students, so that there is an added benefit to this for everyone involved. The background checks (first cycle) and interviews (second cycle) may serve this purpose well.

### *3.1.3. Evaluation of the compliance of the field and cycle study programme with legal requirements*

Descriptions of study programs are prepared in accordance with the Law on Higher Education and Research, Lithuanian Qualifications Framework, The Descriptor of Study Cycles, Description of General Requirements for the Provision of Studies approved by the Minister of Education and Science on December 30, 2016 (hereafter - General Requirements for the Provision of Studies), as well as various regulations of the Kaunas University of Technology. One may also note that both the first and second cycle study programs correspond to the Descriptor of the Field of Study in Physics approved by the Minister of Education, Science and Sports of the Republic of Lithuania on 16 November 2020 by order No. V-176, and they also comply with the General Requirements for the Provision of Studies.

The SER points out, and it is important to note, that the materials science programs (both first and second cycle) are interdisciplinary, therefore their aims and results reflect the competencies and aims of both physics and materials technology.

One particular aspect detailed by the SER is the ratio of lecturers of various programs who are researchers/scientists; as well as credit count (ECTS) related technical requirements (see

table 1.4. of the SER). More than 50% of lecturers are researchers in all study programs, and more than 80% of second cycle lecturers have a scientific degree.

Note furthermore that learning outcomes, number of credits, and scope of contact work are reviewed once every 1-3 years.

Clearly the first and second cycle Physics field study programs of the Kaunas University of Technology meet the requirements of both national and international legal acts, as proven by the SER and some of the specific details mentioned above in the factual situation description.

### *3.1.4. Evaluation of compatibility of aims, learning outcomes, teaching/learning and assessment methods of the field and cycle study programmes*

The aim of the first cycle physics program is for the students to acquire detailed knowledge in the field of physical science, and technologies, as well as to be able to apply this knowledge in solving problems in basic and applied science. The study program reflects this by starting with introductory subjects and reviewing the most important subfields of classical physics in the first years, then moving on to more advanced topics, and finishing with project works. At the same time, the second cycle physics programme aims to provide detailed knowledge in general physics, and more specific subject areas such as laser and plasma physics (Applied Physics) or material technologies (Materials Physics).

Learning outcomes for the study field programmes of both cycles are grouped as knowledge and its application (A), research abilities (B), special abilities (C), social skills (D) and personal skills (E). It is then identified which course contributes to which of these outcomes, detailed in terms of description of the expected learning outcomes of several groups of subjects.

The study programs are described in detail in the SER, what the set-up of the curriculum is, how subjects follow each other. These are following international standards.

One may note that teamwork competencies form an important part of (especially second cycle) study programs.

It is furthermore stated in the SER that contact hours account for about 44% of the total study time, and individual work accounts for about 56%.

The teaching, learning and assessment methods seem to be compatible with the aims and learning outcomes of the study programmes. The outcomes are acquired in a well balanced mixture of subjects and learning methods. One thing the panel noted for the first cycle study programmes was the small amount of physics subjects and objectives in the first semester. This is due to regulations and the need for introduction into specialisations, although the panel would suggest to look into this matter in further detail.

### *3.1.5. Evaluation of the totality of the field and cycle study programme subjects/modules, which ensures consistent development of competences of students*

The structure of the study programs is detailed both in the SER and in its Annexes.

As stated, the "Materials Physics and Nanotechnology" program is the only interdisciplinary study program in Lithuania merging physical and technological science topics. Credit counts (ECTS) are evenly distributed between physics, technology and general competencies. In accordance with that, students are required from at least the 3rd year on to apply their acquired knowledge.

The second cycle "Materials Physics" program is set up in such a way that students learn the application of advanced subjects such as plasma technologies, precision technologies, and functional materials, hence they can conduct basic or applied research based on their competencies.

In the "Applied Physics" second cycle program, students can choose from alternatives of competencies in each semester, in the form of modules (in the second and third semester).

Both the SER and the site visit confirm that the study programmes offer the consistent totality of the field subjects to students and the consistent development of competences is ensured. The panel believes that both the first and the second cycle programmes offer various basic and advanced level subjects, hence their competencies and knowledge is expected to be adequate at graduation.

### *3.1.6. Evaluation of opportunities for students to personalise the structure of field study programmes according to their personal learning objectives and intended learning outcomes*

In the first cycle studies, students can personalise their studies by:

- choosing "levelling" courses in various subjects (mathematics, physics and others as well);
- choosing general courses to develop a reflexive understanding of social, economic, cultural and environmental contexts, such as philosophy, language and others;
- choosing study programme alternatives for additional competencies;
- and of course also choosing an individual thesis topic.

Second cycle studies are even more prone to personalization, based on two possible program paths, as well as study field module alternatives and optional modules.

In a quantitative assessment of the first cycle programs, one may determine that "Materials Physics and Nanotechnology" contains 30 ECTS electives (based on Annex 2 of the SER), while "Applied Physics" contains 50% more elective courses.

Similarly, for the second cycle programs one may deduce similar trends. "Materials Physics" contains 6 ECTS alternatives, while "Applied Physics" has 30 optional subjects and competence electives.

Based on the factual situation described in the SER and the discussions with students and lecturers during the site visit, the panel concludes that there are adequate opportunities for students to personalise their studies according to their own objectives and intended learning

outcomes. This seems to be true both for first and second cycle programmes, i.e. in the entirety of the physics study field.

### *3.1.7. Evaluation of compliance of final theses with the field and cycle requirements*

The preparation and defence of final degree projects are regulated by KTU Guidelines for the Preparation and Defence of Final Degree Projects. Topics can be chosen freely, as long as there is an agreement between the student and the advisor. The list of possible topics, including ones offered by researchers, industry representatives, is approved by an appropriate committee, ensuring academic freedom. A correspondingly diverse set of final theses was attached to the SER, showing high quality work by the students.

It is important to note that the university library organises training to achieve theses that are of high quality from all possible aspects. Furthermore, the level of language correctness is reviewed by university linguists.

The final thesis project work is reviewed and later on defended in a public meeting, in front of competent scientists of the field. The final project evaluation is based on three components: reviewer grade, project evaluation and defence evaluation.

Final theses comply with the field and cycle requirements. Thesis preparation procedures ensure that an interesting and relevant topic of scientific interest can be chosen by students, and that the prepared final theses are of high quality, both academically and formally. The final theses attached to the SER appear to be of good quality. One may note that while there is a significant level of internationalisation at the HEI, most of the theses, even the master level ones, are in Lithuanian. This is good from a point of view of maintaining a high level of Lithuanian physics terminology, but maybe there could be more theses in English as well.

***Strengths and weaknesses of this evaluation area:***

***(1) Strengths:***

1. Organisation of studies in such a way that many courses are offered in English as well.
2. Courses are organised in person even when the number of students registered for that given course is quite low.
3. The study programmes are quite practically oriented.

***(2) Weaknesses:***

1. Apparently in many subfields the number of students is quite low, even to the level that some study programmes had to be shut down.
2. Lack of physics subjects in the first semester(s) in the first cycle study programme may cause some students to lose interest in the programme.

## 3.2. LINKS BETWEEN SCIENCE (ART) AND STUDIES

***Links between science (art) and study activities shall be assessed in accordance with the following indicators:***

### *3.2.1. Evaluation of the sufficiency of the science (applied science, art) activities implemented by the HEI for the field of research (art) related to the field of study*

There are 3 R&D&I priorities in the KTU: transformation of industry, digital transformation, smart cities and resilient communities that integrate university activities in all fields of study and science and innovation. Natural science's most linked topics are the following: technologies for a sustainable future (artificial intelligence and robotics; chemical and environmental technologies; electronics and electrical engineering; functional materials and technologies; mechanical and transportation engineering; construction technologies). Research performed in KTU is directly linked with the above mentioned topics.

In 2018, KTU Physics related science aspects were evaluated on a 5 point scale by a Research and Higher Education Monitoring and Analysis Centre (MOSTA). Unit on a five-point scale, namely, ranging from excellent [5] to poor [1] or no R&D [0]. The evaluation period was 2013–2017. KTU received 3 points during this evaluation.

The evaluation outlined several aspects:

- There are several ongoing projects, some of which at an international level;
- There is a certain publishing activity in journals with impact factor (IF) in the range 2 to 5 and published by international prestigious publishing houses, which is a good sign proving the progress that occurred during recent years. However, despite their high IF, these journals are not characterized as the leading ones. Therefore, there is a need to focus on high impact papers in the leading journals. The topics tackled belong mainly to applied Physics, with a minor impact in theoretical Physics.
- The particular number of staff of the group would allow them to have a larger spectrum of interests, and to include more theoretical aspects of Physics. The training of young students would also benefit from this widening of interests.
- There are a fair number of conference presentations, which are oral; hence, they may have some impact greater than posters.
- This confirms that the research carried out is high-level and recognized at national level.

According to assessments of the Research Council of Lithuania (LMT), KTU is in 3rd place among research centers and research institutes in Lithuania.

There are several research groups actively working in the field of physics at KTU: Formation, research and application of multifunctional thin structures and nanocomposites, Research of non-equilibrium heterogeneous processes, Radiation and medical physics, Applied optics and photonics. Research in the field of applied physics is carried out by KTU research institutes: Institute of Materials Science, Prof. K. Baršauskas Ultrasound Research Institute.

During the period 2014-2019, 258 articles (186 with impact index) in peer-reviewed scientific journals in the field of physics were published. Also, 58 research projects were executed.

There is a fruitful scientific international collaboration around the world (Sweden, Japan, USA, etc).

Beside the collaboration with universities and science centers, there is also collaboration with companies (UAB Ortho Baltic, UAB Holtida, UAB Axioma Metering, etc.). This confirms the good collaboration potential of KTU.

### *3.2.2. Evaluation of the link between the content of studies and the latest developments in science, art and technology*

Physics-related course contents are linked to the science performed in KTU. Students are encouraged to start their scientific activity in an early stage of studies. Physics lecturers integrate the results of the latest research of their current and global researchers into the content of study modules; the main sources of literature of the modules are not older than 5 years. Students have access to the scientific labs to perform their research and course work. Final thesis topics are mostly related to supervisor research interests. There are examples where the bachelor thesis topic is directly linked to the scientific projects. E.g. bachelor's thesis “Modelling of Diffusion of Oxygen Atoms by Solid Electrolyte Crystallites” was carried out by integrating research with an ongoing research project financed by the European Regional Development Fund.

### *3.2.3. Evaluation of conditions for students to get involved in scientific (applied science, art) activities consistent with their study cycle*

KTU provides students an opportunity to get involved in scientific activities through semester projects, research projects, final bachelor's and master's projects. There exists also an academic mentoring system. Typically, 10-15% of all faculty students work with research mentors every year. In 2019-2021, 13% of undergraduate students in “Applied Physics”, 6% of undergraduate students in “Materials Physics and Nanotechnology”, and 38% of “Materials Physics” graduate students had an academic mentor. Students also have the possibility to participate in Lithuanian Research Council summer internship projects. In the last three years, 16 summer internship projects in the field of physics have been completed.

There exists different opportunities for students to get involved in scientific activities. However, the student's involvement process to the research activities could be started just after the enrollment.

### *Strengths and weaknesses of this evaluation area:*

#### *(1) Strengths:*

1. Many high level scientific publications.
2. Teaching integrated scientific labs.

#### *(2) Weaknesses:*

1. Science linkage to studies could start earlier – in the first semester.

## 3.3. STUDENT ADMISSION AND SUPPORT

***Student admission and support shall be evaluated according to the following indicators:***

*3.3.1. Evaluation of the suitability and publicity of student selection and admission criteria and process*

Admission to first-cycle studies of the Physics study field is carried out during the General Admission period in accordance with legal acts and procedures of Lithuania and KTU. They define requirements for admission, the composition of the admission grade and the methodology for its calculation. Procedure also foresees particular cases when additional points may be added to the admission grade. Information about study programmes as well as admission requirements is publicly available on KTU websites as well as other places and is widely publicised (Association of Lithuanian Higher Education Institutions, various publications, live Facebook events, etc.).

Citizens of foreign countries that are not members of the European Union and the European Economic Area are admitted to first-cycle non-state-funded study places by means of a competition. KTU International Studies Office is responsible for the transfer (conversion) of grades, if a different assessment system than the one used in the Lithuanian education system is applied in the documents of the acquired education.

According to admission statistics, KTU study programmes were chosen by 20.79% of applicants to a physics programme in 2017, 22.45% in 2018, 15.05% in 2019, and 11.85% in 2020. The admission to the first cycle study programmes in the field of physics at KTU data indicate that the students whose first choice was studies in the field of physics at KTU in their submitted applications dominate among the ones who signed the study agreement.

The data show that some of the admitted persons had the highest possible state exam scores. The lowest scores in 2017-2018 were for entrants to non-state-funded places and foreign students.

Admission to second-cycle studies of the Physics study field is carried out in accordance with legal acts and procedures of Lithuania and KTU. The state budget funds allocated for studies are attributed to the persons who collect the highest competitive score at the time of admission. The competitive score consists of:

- the weighted average of the assessments of the subjects listed in the Annex to the diploma of first cycle studies or integrated studies (weighting coefficient - 0.7);
- evaluation of scientific activities (scientific publications, reports in scientific conferences, participation in exhibitions, etc.) in a ten-point system (weighting coefficient - 0.2);
- evaluation of motivation in a ten-point system (weighting factor - 0.1).

The main admission requirement for foreign nationals entering non-state-funded study programmes in the second-cycle study programmes in the field of physics is a bachelor's degree in the field of physical, technological or biomedical sciences. Additional requirements -

the weighted average of the bachelor's degree is at least 60% and the English language level is IELTS ≥ 6.0, TOEFL ≥ 85, CEFR ≥ C1 or previous studies completed in English.

The number of students admitted to KTU in the field of physics covered 25% in 2017, 17.07% in 2018, and 17.5% in 2020 of all students entering second cycle physics studies at Lithuanian universities. This shows that KTU's second cycle studies in physics have their own stable market in Lithuania. Among the persons who signed a study agreement with the university, the first choices prevail. The high cost of graduate studies has led to the demand for only state-funded places. State-funded master's degree places were 100% occupied in 2017-2018.

Data show that motivated bachelor students who had scientific publications and carried out other activities during the study years chose to continue physics studies in the second cycle. The lowest competitive scores are related to the admission of foreign students from non-EU countries.

Admission process of KTU is well in line with national and university legislation. As the number of students admitted to the first cycle is steadily decreasing and admission to the "Applied Physics" study programme was suspended in 2019 and 2020 (as the number of invited students did not meet the new profitability criteria), ways to ensure long term profitability should be considered.

### *3.3.2. Evaluation of the procedure of recognition of foreign qualifications, partial studies and prior non-formal and informal learning and its application*

As described in the SER (p. 35), the study modules of a student seeking to take into account the results of previous formal learning are credited after assessing their compliance with the formal requirements of the study programme. No more than 75% of the volume of the same study programme can be credited. The creditable part may contain the learning outcomes of another study cycle or another type of higher education institution. The student's optional modules are credited without restriction, and the final project is not creditable.

The University applies the assessment of non-formal and informal learning outcomes and the recognition of competencies, according to which acquired non-formal competencies can be assessed and recognized as learning outcomes. Upon proving that he has the knowledge, abilities and skills described in the results of the study subject, the student is awarded credits for the relevant study subject. In such cases, no more than 50% of the volume of the study programme to be studied may be credited, and the final project may not be credited.

Considering that during the last three years no procedures of recognition of competences acquired informally and/or through self-education were initiated, the expert panel would suggest reviewing these procedures and determine why there were no applicants.

### *3.3.3. Evaluation of conditions for ensuring academic mobility of students.*

Erasmus+ programme is available for part-time studies in all EU countries, as well as the United Kingdom, Turkey, Iceland, Norway, Liechtenstein, Northern Macedonia, Serbia,

Azerbaijan, Israel, Kazakhstan, Ukraine, the USA, South Korea, Mexico, Ecuador, etc. The minimum duration of these studies is 3 months. Students can also go on exchange studies of 1-2 semesters duration or summer / winter programmes abroad under bilateral cooperation and student exchange agreements signed by KTU and university partners. KTU students can also go for exchange studies under NORDTEK, State Scholarships or other programmes.

Internships under the Erasmus+ can be carried out in all companies, training and research centres, and various organisations that operate in countries participating in the Erasmus+ programme. The minimum duration of this internship is 3 months. KTU students can also go on internships under other internship programmes (internships in Lithuanian schools, Lithuanian centres and Lithuanian communities, Vulcanus in Japan, etc.), and to take part in short-term internships in the BALTECH consortium.

The University has registered the "KTU DISCOVERED International Student Exchange" trademark, which is used to promote various mobility opportunities for KTU students. Information about them is published on the ktu.edu website, University newsletters, other publications and events. Each academic year, many different events are organised at the University and faculty level to promote mobility programs such as "Go Abroad Fair", "How to find an internship abroad", etc.

Every year, 2-7 full-time foreign students are admitted per study program and 1-3 KTU students take the opportunity to study part-time abroad. In recent years, the number of outgoing students is decreasing as no students went abroad in 2019/2020 and 2020/2021 academic years.

During the site visit, the University and study field administration admitted that the number of students going abroad for part-time studies and internships is low, but no concrete plan to resolve this issue was discussed. The expert panel suggested investigating the reasons for these low numbers and creating a plan to counter these negative trends.

### *3.3.4. Assessment of the suitability, adequacy and effectiveness of the academic, financial, social, psychological and personal support provided to the students of the field*

KTU provides comprehensive academic support for students. GUIDed mentoring programme focuses on an educational partnership between a mentor with more experience and competencies, who is able to inspire, encourage and provide a motivated person with all the necessary support, and a student who seeks to adopt the mentor's experience and apply the acquired knowledge in the future. GIFTed Talent Academy provides opportunities for talented KTU students to develop and realise their skills in science and business by participating in enhanced level lectures.

Teachers have set times for individual consultations, which are visible to students in the KTU Academic Information System. The Study Centre of the Faculty of Mathematics and Natural Sciences (FMNS) together with the FMNS Mentoring Programme Coordinator organises additional academic support "SOS Help" for students who have more difficulty with special study programme modules.

The University offers the following opportunities for financial support and promotion: a) University talent scholarships are awarded to the most active students who have achieved exceptional study, science, art results, are engaged in active extracurricular activities in the fields of business, innovation and social activities; b) nominal scholarships of patrons (sponsors) and companies are provided to well-achieved and active university students; c) for active after-school activities (participation in the activities of student organisations, art groups or sports teams, volunteering, fostering the well-being of the University, etc.) one-time incentive scholarships may be awarded.

Other financial support consists of: funds for international research events to support the international activities of the university community, benefits for tuition fees, reduced fee for accommodation in a dormitory, a priority place in it, a one-time social scholarship and state social support. Students with disabilities can receive targeted benefits to meet special needs. All information related to the financial support opportunities, conditions, and requirements for the submission of documents offered by KTU is published on the KTU website, in the section "Finance" for students, and is described in the internal documents of the University.

KTU promotes students' social life and offers to participate in non-formal education programme activities: WANTed, GIFTed, GUIDed, UNITed and INSPIRed. Students are encouraged to spend their free time using the services of the KTU Sports and Wellness Center. During their studies, students have the opportunity to join and operate in the open Kaunas Startup Space, which unites innovation-creating teams.

Students with special needs are provided with study, infrastructure adaptation, financial, psychological, and other assistance. The University aims to provide comprehensive psychological and personal assistance to the student through the appointment of tutors and mentors, providing access to psychologists, a chaplain, a pastoral coordinator, or a personal health care facility free of charge. KTU Student Information and Services Center employs 2 psychologists, offers free psychologist services: individual and group consultations and classes, stress management, relaxation classes, and a separate art therapy group.

Academic, financial, social, psychological and personal student support in KTU is extensive, it comprises a well put together and comprehensive system. During the site visit, the students complimented this system and found no faults in it.

### *3.3.5. Evaluation of the sufficiency of study information and student counselling*

Those admitted to the study programme are introduced to the first steps by providing them with a memorandum and communicating by email. One week before the start of studies, students participate in the "Introductory Week" event, during which they are introduced to the study procedure, information systems used, study plan procedures, academic schedules, scholarships, library services, opportunities to go abroad, mentoring programme, faculty student representation activities, etc.

The first study semester includes a study subject (module) "Introduction to the specialty" for students, which presents peculiarities of the study field, content of the study programme, aspirations, programme's logic, career opportunities, etc.

Student counselling and academic and other support is ongoing. Information and documents relevant to students are presented on the KTU student intranet in Office365, Academic Information System (AIS), etc. AIS has a "one-window" system where students can get all the answers to their questions in one place.

Information about studies is available on the KTU student intranet. Employees of the Faculty Study Centre and the Department of Student Affairs and the Department of Studies advise on the organisation of studies, tuition fees and support. Study Programme Manager advises on the issues of setting up an individual study plan, implementation of modules, selection of the final project topic or internship company, crediting of learning outcomes and recognition of competencies.

During the site visit, students complimented "Introduction to the specialty" study subject as they saw what they can do after graduating and it gave them the motivation to study. The expert panel would recommend revising the "Introductory Week" as some students argued that most of the information could be found in other places and agreed that it was more important for international students.

***Strengths and weaknesses of this evaluation area:***

***(1) Strengths:***

1. Students have ample opportunities to engage in activities offered in extracurricular and non-formal education programmes.
2. Students are provided with extensive and comprehensive academic, financial, social, personal, and psychological support.
3. There is a well thought through process of checking international applicants and later on ensuring that their study level is on par with the Lithuanian students.

***(2) Weaknesses:***

1. No concrete plan to combat the steadily declining number of admitted students to the first cycle.
2. No concrete plan to increase students' interest in Erasmus+ studies and internships abroad.

## 3.4. TEACHING AND LEARNING, STUDENT PERFORMANCE AND GRADUATE EMPLOYMENT

***Studying, student performance and graduate employment shall be evaluated according to the following indicators:***

*3.4.1. Evaluation of the teaching and learning process that enables to take into account the needs of the students and enable them to achieve the intended learning outcomes*

The study programs offer a wide range of teaching and learning methods, including such rather well known ones like lectures and those which allow collaborative work between the students. The faculty emphasises methods which improve immersive learning through a large identification with the given tasks. Examples for particular formats are consulting seminars and creative workshops. Also, opportunities to reflect on their own work and on their progress are provided for the students. It is worth mentioning that students have the opportunity to participate in a product development project (SER, point 172). This includes competency-based learning and problem solving, is developing teamwork, and is of course a good occasion to prepare them for the job market. However, the faculty needs to be considerate to communicate that the study programs are research-oriented as well and not simply aligned along the demands of possible employers. Uncertainty about this question may be increased by the fact that physics courses are few at the beginning of the programs, which was mentioned (during the site visit) by the group of social partners as well.

The SER (point 178) clearly defines the types of independent work that the students are assigned to. This is good preparation both for the work of the teachers and to inform the students as well. Table 4.1 gives an overview of the criteria that should be used to evaluate the students' assessments in general. This, on the one hand, is very helpful to get reliable examinations, and works against arbitrariness, which is of course very important. On the other hand, the whole feedback system is based on these well formalised processes, this may leave just little space for other, more personal feedback. However, the students and the alumni expressed that the staff is always eager to get into discussions with them. The faculty claims a culture of an open office.

The first-cycle programs end with a final internship and the integrated final project (SER, point 181). It is not quite clearly explained in the SER what tasks are usually connected with this part of the study program, especially at the end where the bachelors' final project is also expected, but the discussion during the site-visit clarified that this is an important, appreciated and quite excellent part of the study program.

Both the explanation in the SER and the contributions of the people during the site-visit made clear that the faculty is deeply interested in the success of their students. The faculty needs to keep under attention that even an applied physics program should start with a reasonable amount of physics.

### *3.4.2. Evaluation of conditions ensuring access to study for socially vulnerable groups and students with special needs*

There are several measures to ensure successful studies for students even with a large variety of those who attend. This is a signal for the relevance of this topic given by the university and also by the faculty which describes these tasks in the SER. However, the measures themselves refer more to the effort of the university and less to those of the faculty. The university admits itself to the "right to work and study in an environment that promotes respect for the dignity of every person", which is of course a good basis, but it is less said how this can be gained in a

single case (SER, point 189). During the site-visit, the faculty explained that there is content about these topics in the course "Introduction to speciality", as well as in other courses.

Students with special needs are recognized by the Study Center of the Faculty of Mathematics and Natural Sciences. Teachers are informed by this center if particular measures (like the adaptation of an assessment) are necessary. However, it is little said what in detail these measures could be. Just one student with special needs is in undergraduate studies at the moment (SER, point 192).

There are just few measures to deal with this task in a structured process but the faculty is in tight discussion with the students and this takes care of finding solutions, particularly if the number of students is low.

### *3.4.3. Evaluation of the systematic nature of the monitoring of student study progress and feedback to students to promote self-assessment and subsequent planning of study progress*

The university asks frequently for monitoring reports concerning the progress of the students. These reports include indicators for the progress, number of retakes, reasons for terminations and so on (SER, point 195). Students' achievements are registered by the Study Programme Manager in the AIS (SER, point 196). Teachers then have the opportunity to mark students who do not make the expected progress (SER, point 198), which fulfils the purpose that not a single student runs into danger to get out of sight, but may overemphasise such technical solutions at the same time. This approach seems to be complemented by a combination of opportunities for self-assessments and individual counselling as well. For that reason, the teachers try to get in discussion with the students as mentioned above, but the complete set of measures should have been described in the SER in a slightly better manner.

Students usually get feedback throughout the learning outcome, for example in examinations (SER, point 200). They are encouraged to give feedback in the form of comments and suggestions during discussions and surveys (SER, point 205). The mechanism of an anonyme course-evaluation could be improved because it is not used in all courses (as mentioned during the site-visit).

To sum up, the students seem to be well supervised. The mechanism of an anonymous course-evaluation could be improved. More data about drop-out rates and the average study duration would be helpful.

### *3.4.4. Evaluation of employability of graduates and graduate career tracking in the study field.*

The careers of the graduates are evaluated continuously. Data about employment is requested after 6, 12 and 36 months after graduation, provided by a state information center and exploited by the Career Management Information System (SER, point 206). Information on the average income of the graduates is collected by the Graduate Career Monitoring Tool of the Government Strategic Analysis Center (Strata) (SER, point 207). The employment rate is high, 90% of the students with a Bachelor's degree and all of them with a Master's degree hold

highly qualified positions (SER, point 210). Tables 4.2-4.9 show the employment rates for the different study programs in detail.

Reliable data is provided by these sources and for that reason the faculty is well informed about the success of its graduates, which is a feedback for the study programs as well.

### *3.4.5. Evaluation of the implementation of policies to ensure academic integrity, tolerance and non-discrimination*

The students are told to follow the rules about academic discipline and other legal acts of the University. By signing the study agreement, the students declare their readiness. However, it seems to be difficult for beginners to get an overview about all the academic habits. The students are provided with additional material and guidelines for that reason as well. It might be reasonable to prepare the students not just by providing them with papers but in the lessons themselves, as it is already implemented for the topics mentioned in 3.4.2.

Also, the staff is aware of following these guidelines of the University.

The faculty seems to be well prepared for the relevant tasks.

### *3.4.6. Evaluation of the effectiveness of the application of procedures for the submission and examination of appeals and complaints regarding the study process within the field studies*

The University offers a process which can be followed if somebody wants to make complaints. Cases of discrimination, harassment, violations of equal opportunities etc. will be brought to the Universities' Equal Opportunities Commission (SER, point 225).

During the analysed period, only one case was pursued until a penalty, in the wake of an academic dishonesty of a student (SER, point 227).

To sum up, the necessary processes are well organised.

### ***Strengths and weaknesses of this evaluation area:***

### ***(1) Strengths:***

1. Well-formulated information about assessments are available.
2. A well organised feedback process is implemented.
3. The faculty and particularly the teachers are highly interested in the students and their progress.

### ***(2) Weaknesses:***

1. The faculty needs to keep under attention that any kind of physics programs should start with a reasonable amount of physics.
2. The mechanism of an anonymous course-evaluation could be improved because it is not used in all courses.
3. More data about drop-out rates and the average study duration would be helpful for the faculty to enhance its study programs.

## 3.5. TEACHING STAFF

***Study field teaching staff shall be evaluated in accordance with the following indicators:***

*3.5.1. Evaluation of the adequacy of the number, qualification and competence (scientific, didactic, professional) of teaching staff within a field study programme(s) at the HEI in order to achieve the learning outcomes*

KTU teaching staff of the study programmes in the field of Physics meets the General Requirements for the Provision of Studies and the Descriptor of the Study Field of Physics. All pedagogical staff hiring is based on a competitive system. Every 5 years, lecturers are attested according to the KTU legal documents. Pedagogical and scientific competences are evaluated in several aspects. For successful passing, lecturers should have following competences/track records: organization and implementation of studies, conducting research and application of research results in studies, accumulation of scientific knowledge, development of study process and creative activities, fostering culture, participation in other activities relevant to the University and its departments (SER, page 59).

From all teaching staff with doctoral degrees, 16% are professors, 56% - associate professors and 28% - lecturers. KTU has a career model that encourages academic staff to constantly improve their qualifications. As a result, the number of associate professors and professors has increased during the analysed period. KTU provides possibilities for lecturers to improve their academic and scientific qualifications annually.

The average ratio of the number of teachers and students in the Physics related field in KTU is 0.20 teacher / student. There are also lecturers from industry who are integrated into the teaching of study modules. Number of teachers with industry background has increased from 12 to 16 over the last 3 years at the Department of Physics.

It would be beneficial to engage more part time industrial background teaching staff among the personnel in a first cycle studies to have a more tight link with practical applications.

There is a clear system in implementing Language Policy approved by the KTU Rector's order No. A-258 on 10 June 2016, which aims to ensure that academic and administrative staff have at least the competencies of an advanced (B2) English user, and teachers who teach in English should correspond to C1 level. KTU also pays attention to the quality of using correct Lithuanian language during the study process.

For a first cycle study program, it is important to have a clear vision of the future career. If the career is planned in the high tech industry sector, it would be beneficial to have lecturers from companies. This also would strengthen knowledge transfer from industry to research and vice versa. The second cycle study program is well focussed on physics topics with a strong application potential and relevance to the local employment market.

Teaching staff corresponds well in all analyzed aspects. However, the engagement of lecturers with an industrial background could create a better link between science and applications.

### *3.5.2. Evaluation of conditions for ensuring teaching staffs' academic mobility*

KTU teaching staff are encouraged to use Erasmus+ mobility for teaching and training programmes. This programme is designed to promote academic personnel mobility and ensure the University's cooperation with research and study institutions around the world.

These kinds of activities are bilateral. Also, foreign scientists/lecturers have the opportunity to visit KTU. At the moment, there are partner organizations, beside EU countries, also from the United Kingdom, Norway, Turkey, Iceland, Liechtenstein, Northern Macedonia, with whom cooperation agreements have been signed.

Knowledge obtained from teaching staff mobility is transferred to the students. International visits also support the application of new pedagogical methods, cooperation between science and study institutions; encourage teachers to expand and enrich the choice and content of their courses; and promote mutual exchanges of students and teachers. Above mentioned aspects of teachers' mobility were confirmed during the site visit

Secondments can last from 2 days to 2 months. For teaching visits, there is a requirement to teach at least 8 academic hours. Selections for Erasmus+ visits are carried out four times a year.

During the last 3 years, the mobility number of lecturers and corresponding percentage to the total number of lecturers was - 16 (26%) departed and 21 (34%) lecturers arrived at the Faculty of Mathematics and Natural Sciences. 8 (33%) lecturers of the Department of Physics departed for mobility visits and 9 (37%) lecturers arrived at the Department of Physics.

Academic mobility is at a good level and corresponds well with other activities.

### *3.5.3. Evaluation of the conditions to improve the competences of the teaching staff*

In KTU, there is support for the continuous implementation of high-level scientific activities of teachers and the improvement of professional and didactic qualification. KTU has approved the Procedure for Improving Teachers' Didactic Competences, where conditions and methods for improving didactic competencies are described. Teaching staff can improve their didactic competencies with the help of the EDU Lab Teaching and Learning Competences Center, which has operated for five years.

There are also specific courses for improving didactic methods like: design-based thinking, problem-based and project-based training, etc. In case of need, consultation with EDU_Lab experts is also possible. EDU_Lab personnel organize study programme elaboration training and perform study programme analyses with Study Programme Committee members and lecturers. Input about lecturers' missing competences are gained from the students' feedback surveys.

Beside improving their teaching competences, teachers constantly improve their scientific competence by participating in national and international scientific and scientific-practical conferences, research internships, long-term trainings, seminars in Lithuania and abroad.

Knowledge obtained from internships, courses, conferences is related to the taught study modules, as well as ensures professional development in the fields of professional and scientific interests. Participation in national and international programs improve their qualifications in their fields of research.

Site visit confirmed that all conditions for teachers to improve their competences exist at a very good level. Teaching personnel have participated in many courses provided by KTU EDU lab.

***Strengths and weaknesses of this evaluation area:***

***(1) Strengths:***

1. Motivated scientific staff with a proper scientific track record.
2. Teaching staff regularly pass self-improvement courses.

***(2) Weaknesses:***

1. No teaching representatives from industry/companies.

## 3.6. LEARNING FACILITIES AND RESOURCES

***Study field learning facilities and resources should be evaluated according to the following criteria:***

*3.6.1. Evaluation of the suitability and adequacy of the physical, informational and financial resources of the field studies to ensure an effective learning process*

Currently, the Faculty of Mathematics and Natural Sciences contains 13 auditoriums with a total of 510 workplaces. All auditoriums have been refurbished in the last 5 years. In addition, the Faculty has two well-equipped computer classes. The infrastructure is well-adapted for people with disabilities. This is strengthened by the project “Thresholds” which focuses on the accessibility of KTU premises, facilities, and equipment for people with special needs.

The Faculty possesses 5 teaching laboratories dedicated to fundamental physics and uses the Physics Laboratory Center with 18 laboratories for the needs of more extensive laboratory work and research projects; this includes (but is not limited to) Radiation Detector Laboratory, Laboratory of Physical Modelling, and so on. In addition, part of the laboratory work takes place at the KTU Institute of Materials Science and Lithuanian Energy Institute.

Students can also access Microsoft Office software, programming, and mathematics software such as Matlab, Statistica, etc. Furthermore, design and engineering software such as Autodesk Inventor, Solidworks are also accessible for the students.

Reacting to the pandemic, the Faculty has prepared video presentations on different physics experiments. They also have 4 large auditoriums for hybrid teaching. They have used the Moodle system before the pandemic, thus this helped them to react well and extend the online material in the process.

Finally, the University offers access to electronic databases, which are accessible via VPN from home computers. It acquires about 13000 new publications each year and orders new books according to the applications of lecturers.

The University resources seem to be sufficient for the current number of physics students. In addition, students are able to use state-of-the-art scientific equipment for their laboratory work. However, according to students, not all textbooks are available in electronic versions; thus, there is some room for improvement. Also, despite lectures being mostly in English, laboratory manuals and also videos created during the pandemic were not translated into English.

#### *3.6.2. Evaluation of the planning and upgrading of resources needed to carry out the field studies*

The University is constantly investing into the renewal of its infrastructure and implementing several projects at the moment of external evaluation. The Faculty is also investing into physics-related facilities; they have conducted a plan for several laboratory refurbishment and computer classes upgrade for the year 2021. In addition, social partners contribute to the resources by donations of equipment or services.

The resources are being taken care of annually; though, the plan for physics-related resources is quite abstract. Also, a strategic approach could be made in case of collaboration with social partners.

***Strengths and weaknesses of this evaluation area:***

***(1) Strengths:***

1. Students' access to scientific equipment of the University, KTU Institute of Materials Science and Lithuanian Energy Institute.
2. Sufficient amount of auditorium spaces and computer classes.
3. Solid reaction to pandemic situation, preparation of equipment and online material.

***(2) Weaknesses:***

1. The plan for physics-related resources is quite abstract.
2. Not all laboratory manuals and videos are translated into English.
3. Not all textbooks are available in the electronic format.

## 3.7. STUDY QUALITY MANAGEMENT AND PUBLIC INFORMATION

***Study quality management and publicity shall be evaluated according to the following indicators:***

#### *3.7.1. Evaluation of the effectiveness of the internal quality assurance system of the studies*

The quality assurance system follows national and international guidelines and conforms to the relevant regulations. The quality assurance scheme is overseen by the Vice-Rector for Studies and supervised by senior University committees. The Faculty Council, consisting of faculty researchers, students of the study programmes, and social partners, makes resolutions

on the most important issues of the organization of studies of the faculty, research, reports annually on current and planned study programmes, approves the modules' structure, discusses the perspectives of the study programmes, receives feedback from social stakeholders, and proposes the composition of the study programme committee of the field to the Rector of the University. The Faculty Council and the Dean of the Faculty ensure the implementation of the University's research and study policy. The first- and second-cycle courses in Physics are coordinated by the Faculty of Mathematical and Natural Sciences, and each study programme has a Study Programme Committee (SPC), whose membership is proposed by the Faculty Council and approved by the Rector. The SPC includes at least 3 social partners from business (industrialists and employers), at least 3 students, and at least 5 lecturers working in the fields of physics and materials technology. The SPC organizes at least one meeting with market representatives to ensure that the programmes meet their expectations and needs. The SPC coordinates the implementation, improvement, and quality assurance of the study programme, reviews the goals and results of the study programme based on the needs of the country, region, employers, labour market, students, and takes account of economic development, business environment prospects, European Union strategic goals, high international qualification requirements for physics and materials technology specialists. The Committee receives feedback and assessments from students, faculty and researchers, administrative staff, alumni, employers, and social partners.

The internal quality assurance system is robust, and takes account of the feedback from the principal stakeholders. There is overlap between the roles of the Faculty Council and the Study Programme Committees. The study field is undergoing significant changes, with some of the existing courses coming to an end when the current students graduate next year, and a new course ("Physics of Technology") is due to start in 2023/4.

### *3.7.2. Evaluation of the effectiveness of the involvement of stakeholders (students and other stakeholders) in internal quality assurance*

There are regular meetings with stakeholders (students, graduates, employers) to discuss the courses and competencies and to gather advice and comments on the quality of studies. External stakeholders are involved in thesis defences and provide comments and conclusions on the quality of the work done. Stakeholders are involved in all processes of study programme development, quality assessment and quality improvement according to their level of competence. Alumni share their knowledge and experience with the academic community (career mentoring, reading lectures and reports, support for young talent, etc.). Students participate at all levels of decision-making and are members of Committees at all levels of the University.

The contributions of the teaching staff and the students are very good, through formal meetings and surveys, and the informal and regular feedback between students and teaching staff is excellent, partly as a result of the small class sizes. There is good involvement from the local research institutes, and with the locally employed alumni. However, the connection with local and national industry does not seem to be as effective as it should be.

### *3.7.3. Evaluation of the collection, use and publication of information on studies, their evaluation and improvement processes and outcomes*

The effectiveness of the teaching programme is evaluated using feedback and assessments from students, faculty and researchers, administrative staff, alumni, employers, and social partners, using roundtable discussions, evaluation of study subjects (modules) and lecturers, evaluation of study programme quality, evaluation of compulsory practice, evaluation of alternatives (MA +), evaluation of final qualification project preparation and defence, and student surveys. Each academic year, study programmes and their constituent subjects (modules), their coherence and content are reviewed, taking into account stakeholder observations. Each semester, the results of the feedback are presented to the Rectorate and the KTU Student Union, and later discussed in the meetings of deans of the faculties and the SPC. Teachers can express their remarks and suggestions during surveys, faculty meetings, and preparation of the annual report on the activities of the faculty. The University website publishes information on study programmes submitted for admission, admission requirements for entrants, tuition fees, learning outcomes (and their links with study and assessment methods), structure of study programmes, accreditation data, acquired qualifications and career opportunities, study subject (module) programmes, values of study programmes, guest lecturers, options for additional competencies.

These procedures work well, and the close and frequent interactions between the teaching staff and students mean that there is continuous collection of feedback and improvement. The results are discussed in the SPC and Faculty Council.

### *3.7.4. Evaluation of the opinion of the field students (collected in the ways and by the means chosen by the SKVC or the HEI) about the quality of the studies at the HEI*

Student surveys are organized after each semester, during which students evaluate the content of the study subject, teaching methodology, teachers' competence and submit their suggestions. An in-depth analysis of the survey results obtained during the feedback is performed. The University also conducts a “Student Voice” survey, which asks for opinions on the quality of teaching, the quality of the study programme organization, the quality of study centers, the social environment, the University environment and facilities, additional services and leisure activities offered. Students have the opportunity to express their opinion anonymously about the quality of the individual study module of the study programme during the survey of study modules and teachers and have the opportunity twice a year (Autumn and Spring) to contribute to the improvement of the quality of studies. Every semester, in March and October, an assessment of the quality of the mid-semester study modules (e-survey and round table discussions) is organized. The student survey is conducted by the student representative office and submitted to the faculty administration. Students are involved in the governing bodies of the University and faculty at all levels and in the existing commissions (council, senate, study programme committees, various commissions). KTU Faculty of Mathematics and Natural Sciences Student Union FUMSA represents students' needs and helps to solve study-related issues.

The small class sizes and the close interaction between the students and the teaching staff mean that the opinions of the students are collected and acted upon continuously. The formal ways of gathering information and feedback are appropriate and well used.

### *Strengths and weaknesses of this evaluation area:*

#### *(1) Strengths:*

1. The close and frequent interaction between teaching staff and students.
2. The connection with the local research institutes.
3. The connection with alumni, especially those working in local industries.

#### *(2) Weaknesses:*

1. The relationship with local and national industries is not as strong as it should be.

## IV. EXAMPLES OF EXCELLENCE

Firstly, the Panel were very impressed with the exceptional engagement and enthusiasm of both the teaching faculty and the students, and the quality of the interaction between them. The commitment of the teaching faculty to continuous professional development was impressive, and the students were very appreciative of the teaching staff efforts.

Secondly, students have ample opportunities to engage in activities offered in extracurricular and non-formal education programmes, and are provided with extensive and comprehensive academic, financial, social, personal, and psychological support. The integration of the non-Lithuanian students into the program, and these were much appreciated by the students.

Thirdly, there was a high-quality outreach program, especially to schools.

Finally, the final year design project provided excellent opportunities for student development and gave a very good introduction to collaborative project work.

# V. RECOMMENDATIONS

| Evaluation Area | Recommendations for the Evaluation Area (study cycle) |
|---|---|
| Intended and achieved learning outcomes and curriculum | 1.1 Strive for further internationalisation of the study programme, while also ensuring a high quality education.<br>1.2 Ensure that physics subjects are offered from the first semester on, so that students do not lose interest in the programme. |
| Links between science (art) and studies | 2.1 Research possibilities should be introduced earlier to the first cycle study program students. |
| Student admission and support | 3.1 Create a plan to combat the steadily declining number of admitted students to the first cycle.<br>3.2 Create a plan to increase students' interest in Erasmus+ studies and internships abroad. |
| Teaching and learning, student performance and graduate employment | 4.1 The faculty needs to keep under attention that all physics programs should start with a reasonable amount of physics.<br>4.2 Review the mechanisms for anonymous course evaluation and ensure that it is consistently applied to all courses. |
| Teaching staff | 5.1 The University should consider the part time engagement of persons working in the high tech industry among teaching personnel for supporting applications related knowledge transfer. |
| Learning facilities and resources | 6.1 Develop a concrete plan for the development of physics resources.<br>6.2 Ensure that all laboratory manuals and videos are available in English. |
| Study quality management and public information | 7.1 Consider how to strengthen the connection with local and national industry. |

# VI. SUMMARY

**Main positive and negative quality aspects of each evaluation area of the study field of Physics at Kaunas University of Technology:**

*Intended and Achieved Learning Outcomes and Curriculum*

The basic study programs at both first and second cycle level are well-structured and consistent with international standards, with a strong emphasis on study in English. The degrees have a strong applied element, and the inclusion of appropriate internships and the product design study is excellent. There are no serious weaknesses, but the class sizes are small and the connection to the industrial social partners needs strengthening.

*Links between Science (Art) and Studies*

The main strengths are that the teaching and research are well connected, and the teaching faculty are productive scientifically. There are no serious weaknesses, although the linkage to the science could profitably start earlier in the fist-cycle course.

*Student Admission and Support*

The main positive aspects are the high quality of the students and their strong engagement with the program. They have ample opportunities for personal development in formal and informal activities, and have access to comprehensive support structures, including for international students. The main weakness is the steady decline in the number of students, and the relatively weak engagement of the first-cycle students in, for example, Erasmus.

*Teaching and Learning, Student Performance and Graduate Employment*

The courses are generally well-structured with excellent information about contents and assessments. The feedback system is appropriate and effective and, mainly because of the small class sizes, frequent and direct, with a strong interest of the teaching faculty in the students and their progress. There are no serious weaknesses, but the basic physics content of the courses needs to be maintained, the anonymous feedback could be further developed and more statistics on drop-out rates and reasons and study durations could be provided.

*Teaching Staff*

The teaching faculty are very highly motivated, and their commitment to self-improvement and career development is exemplary. More use could be made of teaching representatives from industry.

*Learning Facilities and Resources*

The students have access to excellent scientific equipment, inside the University and in external scientific institutes. There is excellent classroom space, and a solid reaction to the pandemic. There is a need for a physics-related resource plan to be developed further.

*Study Quality Management and Public Information*

There is very close and frequent interaction between the teaching faculty and students, and good connections with local research institutes and alumni. However, the relationship with local and national industries is not as strong as it should be.

**Expert panel chairperson signature:**