



STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

VILNIAUS UNIVERSITETO
STUDIJŲ PROGRAMOS *Lazerinė technologija (valstybinis kodas –
621J50003)*
VERTINIMO IŠVADOS

EVALUATION REPORT
OF *Laser Technology (state code - 621J50003)*
STUDY PROGRAMME
at VILNIUS UNIVERSITY

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DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	<i>Lazerinė Technologija</i>
Valstybinis kodas	621J50003
Studijų sritis	Technologijos mokslai
Studijų kryptis	Medžiagų technologijos
Studijų programos rūšis	Universitetinės studijos
Studijų pakopa	Antra
Studijų forma (trukmė metais)	Nuolatinės (2)
Studijų programos apimtis kreditais	120
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Medžiagų technologijų Magistras
Studijų programos įregistravimo data	2007

INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	<i>Laser Technology</i>
State code	621J50003
Study area	Technological Sciences
Study field	Materials Technologies
Type of the study programme	University Studies
Study cycle	Second
Study mode (length in years)	Full-time (2)
Volume of the study programme in credits	120
Degree and (or) professional qualifications awarded	Master of Materials Technology
Date of registration of the study programme	2007

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The Centre for Quality Assessment in Higher Education

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I. INTRODUCTION

1.1. Background of the evaluation process

The evaluation of on-going study programmes is based on the **Methodology for evaluation of Higher Education study programmes**, approved by Order No 1-01-162 of 20 December 2010 of the Director of the Centre for Quality Assessment in Higher Education (hereafter – SKVC).

The evaluation is intended to help higher education institutions to constantly improve their study programmes 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) visit of the review team at the higher education institution; 3) production of the evaluation report by the review team and its publication; 4) follow-up activities.*

On the basis of external evaluation report of the study programme SKVC takes a decision to accredit study programme either for 6 years or for 3 years. If the programme evaluation is negative such a programme is not accredited.

The programme is **accredited for 6 years** if all evaluation areas are evaluated as “very good” (4 points) or “good” (3 points).

The programme is **accredited for 3 years** if none of the areas was evaluated as “unsatisfactory” (1 point) and at least one evaluation area was evaluated as “satisfactory” (2 points).

The programme **is not accredited** if at least one of evaluation areas was evaluated as "unsatisfactory" (1 point).

1.2. General

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

No.	Name of the document
1.	The list of final thesis and marks - year 2015
2.	The table of admitted and graduated students in 2013/2015 and 2014/2016

1.3. Background of the HEI/Faculty/Study field/ Additional information

Vilnius University (VU) belongs to the group of classical, wide profile universities. The University consists of 23 academic stem units and other units of equal status. These include 12

faculties and 2 institutes involved in the education of students. The Faculty of Physics is comprised of 7 departments and is involved in nine master study programmes.

The duration of master studies is 2 years. In 2010-2014, the Physics Faculty admitted a yearly number of 87 to 100 students, the total number of master students of both years taken together varied from 170 to 190.

The speciality of quantum electronics in the Physics Faculty was introduced in 1974, when the Department of Astronomy and Quantum Electronics was established. The first graduates - Vilnius University quantum electronics specialists - received their diplomas in 1975. In 1983 the Laser Research Centre (LRC) was established and united the scientific infrastructure and provided laboratory access for scientific research and studies. In 1988 the Department of Quantum Electronics was reorganised as a separate entity. In 1994 the Laser Physics and Optical Technologies master programme was introduced and the first bachelor graduates of the Physics Faculty were educated.

At the present there are two master study programs in Lithuania aiming at the preparation of specialists in laser physics and laser technologies. The first programme is the previously mentioned “Laser Physics and Optical Technologies” attributed to physical sciences, and the second is “Laser Technology” attributed to technology sciences.

The programme “Laser Technology” at the Physics Faculty of Vilnius University was proposed in 2006 during implementation of the EU project “Preparation of Highest Level Specialists in Laser and Optical Technologies” according to BPD 2.5 action “Increase of the Quality of Human Resources in Science and Innovation” which started on 02 March 2005. The Laser Technology master programme was introduced in 2007 (first graduation in 2009).

The existing master programmes were not sufficiently oriented to technological laser applications, especially in interdisciplinary fields. There were no study programmes in Lithuania oriented to industrial laser application. The initiation of the programme “Laser Technology” was tightly related to the emerging trends in the development of Lithuanian laser companies.

1.4. The Review Team

The review team was completed according *Description of experts' recruitment*, approved by order No. 1-01-151 of Acting Director of the Centre for Quality Assessment in Higher Education. The Review Visit to HEI was conducted by the team on 26/05/2016.

1. **Prof. dr. Laurens Katgerman (team leader)** *Delft University of Technology, Professor Emeritus, The Netherlands.*
2. **Prof. dr. Janis Spigulis**, *University of Latvia, Professor of Physics Department, Head of Biophotonics Laboratory at Institute of Atomic Physics and Spectroscopy, Latvia.*
3. **Prof. dr. Andres Öpik**, *Tallinn University of Technology, Vice Dean of the Faculty of Chemical and Materials Technology, professor of physical chemistry, Estonia.*
4. **Dr. Denis Guilhot**, *The Institute of Photonic Sciences, Knowledge and Technology Transfer Programme Manager, Spain.*
5. **Dr. Sergejus Orlovas**, *Centre for Physical Sciences and Technology, Principal Research Fellow, Lithuania.*
6. **Dr. Milena Medineckienė**, *doctoral student of KTH Royal Institute of Technology (Lietuva, Švedija).*

The review team would like to thank the Centre for Quality Assessment in Higher Education (SKVC) in Lithuania and, most especially, to Rasa Paurytė for all the support given before and throughout the visit to Lithuania.

II. PROGRAMME ANALYSIS

2.1. Programme aims and learning outcomes

As stated in the Self Evaluation Report (p7), the aims and learning outcomes of the program were established according to decision No. 535 of May 4, 2010 of the Government of the Republic of Lithuania “On Approval of the Description of Lithuanian Qualifications Structure”, according to decree No. V-826 of June 3, 2010 of the Minister of Science and Education of the Republic of Lithuania “On Approval of Description of General Requirements for Master Studies”, and according to decree No. V-2212 of November 21, 2011 “On Approval of the Description of Study Cycles”.

The key aims of the study program include:

- Training of high international-level laser technology specialists with master degree
- Ability to develop and apply new modern technologies
- Generation of new ideas for effective industrial, economical and expertise activity
- Increase of international competitiveness of Lithuanian industry

This leads to learning outcomes clearly stated on pages 7 and 8, with students able to:

- Develop and apply new laser systems and technologies for material processing,
- Develop and apply modern technologies of processing optical components,

- Work in laser industrial companies, generate and implement innovative ideas,
- Communicate with providers and customers in Lithuanian and English languages,
- Accomplish experimental fundamental research in research institutions,
- Generate ideas for the creation of new competitive products,
- Implement innovative projects and contribute to strengthening the Lithuanian position in the high technology sector,
- Implement independent applied research work,
- Continue doctoral studies in Lithuanian and foreign universities.

All information related to studies at Vilnius university is easily available online through the webpage (<http://www.vu.lt/en/studies>) and all necessary information regarding the course can be found in Lithuanian at the following webpage:

[https://is.vu.lt/pls/pub/public_ni\\$www_prog_app.show?m=psa&p_k=lt&p_fm=1&p_apr=1205](https://is.vu.lt/pls/pub/public_ni$www_prog_app.show?m=psa&p_k=lt&p_fm=1&p_apr=1205) including the aims and learning outcomes.

As stated in the Self Evaluation Report (p.6), the study programme was initiated in 2006 during the implementation of the EU project “preparation of highest level specialists in Laser and Optical Technologies” in order to increase the quality of human resources in science and innovation. Previously, no higher study program was oriented towards the training of specialists in industrial laser application. The close relation maintained ever since with relevant social partners provides a good, up-to-date feedback regarding the employment situation both in the academic and industrial sector, as well as the professional requirements from potential employers. Local research centres, laser and optics companies need qualified employees, mainly at master level, in order to develop high level research and high tech products that can be competitive in the global market.

Additional sources of information were provided during meetings with social partners, students and alumni. It was revealed that programme aims are in line with learning outcomes and factual situation in the labour market. Most of the students are employed by social partners. However, the team of experts was informed by social partners that the programme aims require slight improvements in order to fully meet their needs, in particular training in project management skills would be most appreciated by both students and employers, as would some extra, more specific knowledge in laser-matter interaction, optics design and modelling.

All formal requirements and needs are in large successfully catered for by this study program as demonstrated by social partners’ feedback and the professional situation of the graduates of this study program.

According to feedback received during the visit, the interaction with social partners could benefit from being slightly improved.

The type and level of qualifications offered is largely consistent with a high-level master's degree qualification as can be demonstrated by the impressive amount of publications obtained by the students during the course of the program, as well as the quality of the laboratories and companies in which the internships are undertaken. The high rate of employment of the graduates, as demonstrated in table 5.6, is another proof of this quality, as well as the positive evaluation of the graduates by their employers as stated in points 72 and 73 (p.26 of the Self Evaluation Report), and demonstrated during the evaluation process.

The study program is called Laser Technology and leads to a degree of Master of Material Technology. The aims and learning outcomes are largely consistent with the type and level of studies, as well as the course program and content. The technological content is high, the study program is formally assigned to the study area of Technology Science and the study field of Material Technology. However, the technological part of the programme is slightly underrepresented in the aims and learning outcomes, which are slightly more oriented into fundamental research. This can be observed in some of the study object descriptors. Therefore the content, learning outcomes and qualifications at the present time do not fully cover the name of the programme and underrepresent its technological aspect.

2.2. Curriculum design

The level of qualifications offered is regulated in agreement with decision No. 535 of the 4th of May 2010 of the Government of the Republic of Lithuania "On Approval of the Description of Lithuanian Qualifications Structure", according to decree No. V-826 of the 3rd of June 2010 of the Minister of Science and Education of the Republic of Lithuania "On Approval of Description of General Requirements for Master Studies", and according to decree No. V-2212 of the 21st of November 2011 "On Approval of the Description of Study Cycles".

This study program complies in all points with the legal requirements for the second cycle of higher education. It comprises 17 courses, 15 of which are compulsory, plus a Master's scientific research work extended over the last three semesters of the study programme.

The minimum amount of autonomous work in one module is 53% although it represents an average of 71.5% across the whole study programme, including the scientific research work. 500h of lecture hours are delivered in this study program, complemented by 142 hours of seminars and workshops and 126 hours of laboratory work. Some room for improvement has been identified in the definition of the autonomous work and the communication around it, in

order to ensure that everyone involved is aware of the expected proportion of this work, and its intrinsic nature. The regular monitoring of these individual studies could be improved, although it has to be acknowledged that it is controlled via the organisation of assessment and seminars.

The study subjects are evenly distributed along the programme and allow for progressive learning and improvement of capabilities, from fundamentals and basics of science to more specific knowledge regarding technological characteristics of laser technology. The course units are complementary to allow the development of the necessary competences for a technological researcher. A scientific research program adequately spread over three semester, for a better repartition of the amount of work, complements this teaching, adding scientific research knowledge to the curriculum of the graduates. The themes are detailed in “Table 2.1: Study plan of Laser Technology study programme”, on page 8 of the Self Evaluation Report. The themes are not repetitive across the semesters and modules, also a high number of modules are common to other programs, as reported in section 22 of the Self Evaluation Report, page 8.

The program aims at training laser technologists and providing them with the theoretical and practical knowledge necessary in order to perform successfully in their future professional career, applying and creating modern laser and optical technologies. The content of the modules is consistent with the type of the studies and includes an optional industrial module on Electronics and Photonics Market or Market for the Research and Production, which complements adequately the scientific part of the studies. According to “Table 2.1: Study plan of Laser Technology study programme”, on page 8 of the Self Evaluation Report, the following subjects (number of credits in brackets) are taught:

1st semester – Laser Techniques (6), Interaction of Laser Radiation with Matter (6), Optical Information Processing (6), Nonlinear optics (6), Advanced engineering Materials and their manufacturing technologies (6);

2nd semester – Time resolved laser spectrometry (6), Laser technology (6), Optical systems (4), Ultrashort pulse optics (6);

3rd semester – Technological equipment for laser processing (5), Technology of optics and laser related components (5), Fibre physics and technology (4), and an optional course, either Electronics and Photonics Market or Market for the Research and Production (4);

In addition, the scientific research work accounts for 8 credits in the second semester, 12 in the third semester and represents the totality of the fourth semester, accounting for 30 credits. This work placement is performed in majority in industrial companies, as fits such a technological

study programs, although students interested in pursuing their studies through a PhD are offered the possibility to enter a research laboratory.

However, the programme belongs to the technological field and some additional attention should be paid to study objects, practice, semester and final projects. For example, an important study module “Interaction of Laser Radiation with Matter” could be more oriented to technological applications rather than understanding of fundamentals. Industrial and technological partners should be more involved in the management of study modules, practice and projects. For example, the study module “Optical Information Processing” could greatly benefit from inclusion of some basics of optical system modelling. The study module “Optical systems” mentions that “Students will learn to apply digital computational methods for system design, performance evaluation and optimization using commercial software such as OSLO or ZEMAX”, though students are actually taught to use only “OSLO”. During the meeting with students, it was revealed that they are not taught to use “ZEMAX”. Moreover, stakeholders have expressed their wish to include more hours of practice with “ZEMAX”, which is an industry standard among laser companies in Lithuania. In conclusion, modelling of optical systems and technological aspects of laser-matter interaction were among improvements required both by students and social partners.

The main technical learning outcomes are oriented towards material processing, technologies for processing optical components and accomplish research. In general, subjects/modules are appropriate for the achievement of the intended learning outcomes. With subjects such as Laser Techniques, Interaction of Laser Radiation with Matter, Advanced Engineering Materials and their Manufacturing Technologies, Laser Technology, Optical Systems, Technological Equipment for Laser Processing and Fibre Physics and Technology, the scientific relevance of the curriculum and its technological are, in general, demonstrated.

The scope of the programme is sufficient to ensure learning outcomes although, considering the industrial nature of the degree, and, as identified during the visit of the review panel, training in project management skills would be beneficial to both students and employers, as would some extra, more specific knowledge in laser-matter interaction, optics design and modelling. The emphasis should remain on applied subjects related to devices rather than fundamentals and materials, which is what is most appreciated from this program. As identified during the visit of the review panel, the scope of the programme could benefit from stronger ties with social partners at research institutions and industry.

The courses content is definitely in line with the latest achievements in science and technology and it is updated yearly by the teaching team. However, an analysis of study module programmes (SMP), which were provided in Annex, has revealed a high number of outdated text books and scarce number of most recent English literature in the field of laser technology. An introduction of new laboratory work and seminar subjects related to the development of the academic team's own research is also introduced by the teaching team on yearly basis. These laboratory work and seminars allow the students to get in practical contact with the latest achievement in their field of learning through research and presentation of their own work as well as through participation and exposure to their peers'. The subjects of most of the Master's final thesis reflect the emphasis placed on solving current state-of-the-art issues of the field of research, as is confirmed by the high level and quantity of publications in which students participate as first or co-authors.

2.3. Teaching staff

The Quantum Electronics Department, as part of the Faculty of Physics, is in charge of this study programme. The courses are given by a team of 11 teachers, complying with the staff legal requirements, as stated in table 3.3 on page 15 of the Self Evaluation Report.

All of the teachers have a scientific degree, for a requirement of 80%. More than 60% (79% in this case) of the teachers' research field correspond with their course unit. Moreover, 45% of the teachers are professors, for a legal requirement of 20%. Also, the head of the final thesis committee is appointed from a different institution and has no direct relation with the Faculty of Physics. Finally, the teachers are employed for a duration of 5 years by the open tender procedure, for which the candidates have to comply with the legal requirements set forth by the decree N° SK-2010-5-34 of the 23rd of February 2010.

The adequacy of the research team is demonstrated by both their CV and the correlation between their teaching subject and scientific activities. However, little information is provided regarding their pedagogical skills and evaluation of such. The team consists of 11 teachers, 5 of which are professors, 4 associate professors and 2 lecturers with a doctorate in the corresponding field. The number of published papers presented by the teachers, in total as well as over the last 5 years, demonstrates the high level of the research performed by the teaching team. The participation in projects, both at a national and international level, and the number of doctoral students supervised, going from 2 to 5 depending on the professor, are also very correct. The citation indices range mainly from 66 to 2548, which is very good. Only one of the teachers has lower overall numbers regarding the research results but his participation in the program was justified during the evaluation meetings by the very singular knowledge he brings to the program.

There is a ratio of approximately 2 students for 1 professor (depending on the year of the study program) and the teachers perform 48 to 160 contact hours within the program, with a maximum of 386 teaching contact hours for one of the professors. This amount is considered very reasonable, as the teachers all participate in teaching, but also in master's thesis research projects and course papers. There is opportunities for direct communication between the teachers and the students and time for both formal and informal consultations with an open door system.

The contract duration of each teacher through the open tender procedure is of 5 years, ensuring a regular evaluation of the qualification of the teaching team. Moreover, there has not been teacher's ageing issues so far as younger staff member's involvement has increased. The average age of the teachers is 43.5 years. The study program committee is aware of the difficulty of orienting young researchers towards teaching activities because of relatively low salaries and the importance of research and involvement in projects towards the evaluation of a scientist.

The higher education institution provides a very good environment for the professional development of the teaching staff in most of the aspects related with scientific work. The ecosystem and support regarding projects, participation to international conferences and short exchanges with foreign institutions is to be acknowledged. Increased teachers' internationalisation could be improved and an institutional sabbatical leave programme suggested in order to increase mobility and internationalisation of the teachers and increase the contact with different, updated, modern teaching methods. Although participation in the SPD measure 2.5 project "Training of Highest Qualification Professionals in Laser and Optical Technologies" is a great step, opportunities for pedagogical training could be further promoted in order to improve the teaching skills of the teaching team.

Further improvements could be introduced at university level by organising a proper rotation of the teaching staff and by enabling teachers to share their academic workload with colleagues.

The relevance of the research performed by the teaching team in relation with the study program is optimum, with most of the teachers reporting in national and international conferences and exhibiting a high level, competitive at international level. Also, participation in local and international research projects further demonstrates the high research level of the teaching staff.

However the programme management should consider ways to improve technological aspects of the programme by strengthening direct links to industrial partners in laser companies during the study process.

2.4. Facilities and learning resources

As reported in the Self Evaluation Report (p.18, paragraph 45), the bulk of the teaching activities of this study program take place in room 306 of the Laser Research Centre building, its size being suitable for groups of about 14 students, the typical size for one year of the Laser Technology master programme. Additional lecture rooms 211, 516 or 511 of the Physics Faculty are also used in certain cases. For laboratory works, other dedicated spaces are available, such as the laser physics teaching laboratory n° 522 of the Physics Faculty, the laser technologies and optical materials teaching laboratories and the three scientific laboratories 108, 109 and 110 in the Laser Research Centre. All rooms are suitably equipped with air conditioning, digital display systems and new scientific equipment. Numerical simulations and CAD projects are performed in a multimedia laboratory equipped with stationary computers and adequate program licences. Finally, a self-study room has been assigned to students close to the lecture room, approximately 25 square meters big, and more self-study rooms can be found in the Laser Research centre facilities, as well as in the modern library.

EU structural funds, High Technologies Expansion Programmes and international project funds such as the SPD measure 2.5 project “Training of Highest Qualification Professionals in Laser and Optical Technologies” and the SPD measure 1.5 project “Development of the National Laser Science and Technology Centre”, as well as LaMeTech Infrastructure, Development of Laser Facility NAGLIS and Sunrise Valley project, have been attributed since 2007 and dedicated to upgrading the laboratories as well as research and teaching equipment.

As stated in the Self Evaluation Report (p.19), the following equipment has been purchased, amongst other:

- laser and other scientific equipment
- equipment for laser microprocessing
- characterisation of optical coatings and fibre optic lasers
- Libra femtosecond laser comple
- 5-axis positioning complex for microprocessing
- specialised modelling software for laser and optical systems
- laser emission power and energy measurement equipment
- scientific equipment and materials
- software packages LASCAD and WINLASE

The involvement of the social partners is also worth noting, along with their participation in the program through their donation of equipment for the program. For instance, Light Conversion provided optical equipment for educational purposes and Ekspla both a nanosecond and a picosecond laser.

Unfortunately, during the meeting with students and social partners the review panel has witnessed, that some software packages are unavailable for students. Especially worth noting is absence of such programmes like MatLab, AutoCad, ZEMAX. Both proficiency and expertise in those software packages is highly valued by stakeholders. The programme management and university administration should take appropriate actions and improve accessibility of industrially recognised software.

As stated in the Self Evaluation Report (p.25), about 60% of the graduates find employment related to their field and level of studies. Most of these students realise their internship at social partners' premises, in particular at Altechna, Eksma, Ekspla, Light Conversion, Optida, Optolita, Standa, Teravil and VTMI Centre for Physical Sciences and Technology, which generally become their employer. The students who perform the final thesis in an external institution have both an industrial advisor and a consultant from the university, to ensure that both industrial and academic requirements are completed. Although the Self Evaluation Report states (p. 12) that students practice in the industry is hindered by the administrative burden, the social partners congratulate the Faculty on the simplicity of the process.

The social partners would like to propose more practice for students and do not do so only because they do not have the capacity to provide more training, suggesting that the faculty should increase contacts and collaboration with non-local companies.

The university has a very complete modern National Open Access Scholarly Communication and Information Centre (<http://www.mkic.mb.vu.lt/en/>) library, located on the campus, which students, teachers and employees can access. This facility provides them with a library fund of more than 45,000 documents, as well as computer classrooms and personal studies rooms. A number of international databases related to the programme courses are also available, such as IEEE/IEL, Science Direct, Springer, AIP journals, APS journals, IOP Science, Nature, SPIE Digital Library and Web of Science. Some important journals are not accessible, such as Nature Photonics and Nature Physics, but these can be accessed using the personal subscription of the Quantum Electronics Department teachers, as stated in the Self Evaluation Report (p.22). The students can connect from the campus or also from their homes by using the University supplied VPN service.

The acquisition of new teaching material has been focussed towards references in English language, in particular through the implementation of the SPD measure 2.5 project “Training of Highest Qualification Professionals in Laser and Optical Technologies”, through which more than 300 books and references were acquired for laser physics, optical technologies and laser applications (SER, p.20). For most references, only one copy was purchased although in the case of the most widely used books, more than one copy was purchased so various students can consult them in parallel.

Teachers from the study programme have also published textbooks and laboratory works instructions of the course units of the Laser Technology programme courses, although in Lithuanian language. Electronic handouts of the lecture slides are not always accessible.

An online course management environment such as MOODLE, providing a virtual learning platform with all uploaded course materials, virtual classrooms and teachers interaction, although it has to be noted that students can currently access all course material on the teachers webpage.

2.5. Study process and students’ performance assessment

Graduates of the first cycle physical and technological sciences university studies are admissible to the second-cycle Laser Technology study programme, providing they possess a bachelor’s qualification degree in these research areas. In the case of graduates from other research areas wishing to enter this study program, they are required to attend the required study programme introductory courses and present a thesis on a topic in physical or technological sciences research areas. If these requirements are fulfilled, a competitive process is entered in which applicants are rated according to their diploma and supplement. Their score is calculated from the results in General Physics, Calculus, Quantum Mechanics, Statistical Physics, the entrance examination, additional scores for research production, and an assessment of the Bachelor thesis, as detailed in the Self Evaluation Report (p.22). The maximum score being 60, the students admitted through the history of the program have obtained scores in the range 29-42 and 91% of them have completed it, demonstrating that this criterion is well-founded.

The number of candidates is usually much larger than the number of admitted students, although it is not the first choice for the vast majority of them, probably due to the use of the “Technology” term in the name of the program, or for historical reasons, such as the previous existence of the “Laser Physics and Optical Technologies” program. Nevertheless, yearly, between 7 and 14 students are admitted.

The organization of the study process follows the main guidelines for studies in Vilnius University. Practical classes allow for the comprehension of the knowledge delivered during the

lectures and the laboratory work permit the development of technical knowledge and know-how that the students will need during their work life.

Numerous ways are being used to encourage the participation of the students in research and scientific activities. Students participate in laboratory activity practices organised by the Lithuanian Ministry of Education and Sciences, high scientific and technological programmes organised by the Quantum Electronics Department, Laser Research Centre and industrial partners, and in scientific conferences in which the students can present their research. They are also encouraged to participate in scientific seminars organised by the Department and in doctoral thesis defence processes. Finally, an important part of the curriculum (51 credits out of 120) is attributed to research, including bibliography work, formulation of the theme, objective and tasks of the research, planning experiments, performing them, processing and summarising the data, preparing and presenting results, the preliminary part being performed in the second and third semester, and the final master thesis in the last semester. The actual involvement of the students can be confirmed by the high number of publications in which one or more students participate, as detailed in Table 5.4 of the Self Evaluation Report (p.24), and also by the fact that, even if the program is mainly oriented towards industry, about 30% of the students go on to study a doctorate degree.

The current strategy of the University and the Faculty is more focussed towards internationalisation than it used to be and study programmes in English language have been launched, and new joint programs are being considered. This could solve the problem stated in the Self Evaluation Report (p.25), that foreign students do not join the study programme because it is not proposed in English language, but that it is not offered in English language because no foreign students join the programme.

The number of students participating in mobility programs has increased in the last few years, although it is still far from being the majority of them. The Faculty and Department encourage them to participate in Erasmus programme and such mobility programmes. A majority of the students claims to be interested but to be limited by the need to work during their studies. Nevertheless, the social partners, as employers, value the internationalisation of the students and are open to facilitating their participation.

The Vilnius University has a dedicated information system, which sends information to the students about pre-planned events, from seminars to exams and timetables, which they can also access and where the relevant information is stored. Most of the course information is also

available through the webpage of the Department (<http://www.lasercenter.vu.lt/en/>), the program ([https://is.vu.lt/pls/pub/public_ni\\$www_prog_app.show?m=psa&p_k=lt&p_fm=1&p_apr=1205](https://is.vu.lt/pls/pub/public_ni$www_prog_app.show?m=psa&p_k=lt&p_fm=1&p_apr=1205)), and teachers.

At the beginning of the year, an introductory meeting is organised, during which the head of the department presents the program and facilities. The Self Evaluation Report also stated (p.27) the existence of a student representation office with student members of the Council of the Faculty of Physics, Programme Study Committee, Appeals Board, Labour Dispute Board and the Performance Evaluation Committee. The review panel recommends improving the communication regarding the existence of these representatives and helping identifying them as most stakeholders were not aware of these representatives.

It has to be noted that all representative bodies expressed their satisfaction regarding the communication with both the administrative and teaching staff, and acknowledge the good communication and information availability regarding academic issues but also social support such as scholarships and mobility opportunities for instance.

The assessment of student's performance at VU (including this programme) is clear, adequate and publicly available. The review panel would like to point out the issue of grading all final thesis with either a 9 or a 10 out of 10, and recommends using more dispersion, whilst acknowledging the difficulty of implementation of such a change. Also, the number of credits awarded for the research work and research project (2nd, 3rd semester) have to be precisely evaluated and justified in order to avoid the risks of double-crediting some of the final thesis work. Finally, it is worth improving knowledge amongst the students of the number of credits associated to the personal work.

No information regarding the professional activity of 6% of the students was available, which is a reasonable amount of uncertainty. Of the graduates that replied to the survey, 30% are pursuing their studies at doctorate level, most of them in Lithuania, although about 5% of the graduates continue research activities in foreign institutions (SER p.25). About 64% of the graduates state that they work in the industry, 44% in a Lithuanian laser or optical technological company such as Ekspla, Altechna and Light Conversion, most of them having worked at their current employer during the course of the master study programme.

It has to be noted that the vast majority of the graduates are employed and that their employers declare themselves very happy with the performance of the graduates from the Laser Technology master study programme.

2.6. Programme management

The study programme management is properly identified within the Self Evaluation Report (p.26). The Study Programme Committee is well balanced, being composed of members from the departments of the Faculty of Physics, student body and representatives of the social partners. It is composed of 6 members.

The responsibilities are also clearly allocated, the unit descriptions being confirmed by the Study Programme Committee and proposed to the Faculty Council for approval, the Head of the Department being in charge of informing the Study Programme Committee of any shortcomings brought to his attention. The course of the programme is administered by the Dean's office. Finally, specific programme administration issues can be discussed during more general Dean's office weekly meetings, with an average two to three such occurrences a year.

Some room for improvement was identified in the regularity of the study programme committee meetings. According to the interviews, the committee meets once or twice a year. It could be useful to organise more frequent meetings, with an increased involvement of students' and social partners' representatives, in order to regularly take into account stakeholders' feedback and implement improvements. The involvement of social partners in the Self Evaluation team could be considered.

The information and feedback on the implementation of the programme is provided through direct contact between the students and the teaching team but mainly through a survey process. The survey process has been changed recently, moved online and made compulsory, blocking access to the online facilities until it is completed. A survey is completed every term, although one can wonder whether the input is reliable as the survey is seen as an impediment blocking the connection rather than an opportunity to be heard and improve the program. These surveys are organised by the VU Quality Management Centre and provide each student with an opportunity to express an opinion about the subject studied, and each teachers with student opinion on the delivered course.

Every teacher can review the information provided by the surveys although it has to be noted that the students do not get access to these results and consider that they do not know how this information is used or their feedback taken into account.

Also, concern was expressed during the visit regarding a decrease in the satisfaction ratio in Autumn 2013-2014 and the number of graduates in 2010 but these data were not taken into account in order to improve the program but rather dismissed as singularities.

The outcome of the students' surveys is detailed in Table 6.1 of the Self Evaluation Report and is overall very positive, as was the evaluation of the programme during the on-site visit. Nevertheless, the few occurrences in which the satisfaction percentages are lower are not considered as valuable information of possible improvements to be applied but dismissed as singularities.

Another evaluation indicator of the programme is the total evaluation average (TEA), provided by the VU Quality Management Centre. It takes into account the statement of students regarding aspects of the programmes of the university such as quality of contents and quality of delivery. The Laser Technology study programme usually presents a TEA indicator between 4.5 and 4.88 out of a maximum possible score of 5.

Although not in a structured manner, social partners are also involved in the evaluation process through informal conversations and meetings, which has to be encouraged.

All relevant stakeholders are involved in the evaluation process of the Master study programme and in the study programme committee. However, the stakeholders who have no formal ties with Committees or Council are slightly underrepresented and participate in a formal way, also through participation in various meetings. More personal contacts of stakeholders with lecturers and stronger informal involvement in the evaluation and processes related to the improvement of the programme would be of great importance.

The internal quality assessment system of the university is based on student's feedback collection and analysis, as described in SER, and its implementation of the total evaluation average (TEA) seems to be working. Problems concerning academic honesty of students were identified and acted upon, through the implementation of the "Don't cheat" campaign, organised together with the Student Representation Office, and the use of a plagiarism control software to verify the authenticity of student papers.

Finally, the scientific work subjects are formulated each year and address current research topics so there are almost no previous works on the same topic and the probability of plagiarism is thus minimised.

2.7. Examples of excellence *

The very high level of the research performed at the institution and the number of publication in which students of the Laser Technology study programme participate has to be acknowledged as it is outstanding.

III. RECOMMENDATIONS

1. Consider revising the percentage of autonomous learning and improve its monitoring to ensure double-crediting does not occur.
2. Improve the communication regarding the autonomous learning and the credits associated to ensure students are aware of their relevance and organisation.
3. Expand the distribution of the final thesis notes as they are currently binary: 9 or 10.
4. Improve the student survey protocol, feedback and influence on future modifications.
5. Increase internationalisation of the programme through an increased use of the English language and the promotion of exchanges, both amongst students and teachers.

At university level, the review panel would like to suggest the implementation of a learning platform system such as Moodle.

At a national level, the increase in scholarships, both in number and amount, especially in the case of social scholarships, is recommended, to avoid the extra pressure of employment over the students during the course of their studies, which also has a limiting factor towards their mobility.

IV. SUMMARY

The program exhibits a number of positive quality aspects, including in particular an outstanding level of research. The related facilities are very impressive and definitely adapted to this type of study programs, probably amongst the best in Europe.

The high level of collaboration with the industrial partners maintained through this programme is also worth noting and most of the internships are pursued in this environment. This is an invaluable asset for the students graduating from this Master programme and gives them great employment opportunities related to their field of study.

The employment rate of the graduates in the industry is a clear indicator of the relevance of this study programme for the students.

Nevertheless, a few points are worth improving, in the opinion of the Review Team. Mastering the English language and having experience of the international research ecosystem or industrial market is increasingly important for a successful professional career and is also important to the employers, as stated during the on-site meetings. The Review Team cannot stress enough how beneficial it would be for the international aspects of the programme to be improved, as much regarding the exchanges as the language, and the opportunities for the teachers to apply for sabbatical leaves.

Another improvement regards the grading system of the final Master thesis. This could be revised in order to allow marks other than 9 and 10, providing a better ranking and more accurate evaluation of the work performed by the students during their research projects.

Also, the course management could benefit of using a virtual desktop environment as for instance Moodle.

Finally, the curriculum could be improved by increasing the industry related subject (especially project management, market and industrial skills).

V. GENERAL ASSESSMENT

The study programme Laser Technology (state code – 621J50003) at Vilnius University is given **positive** evaluation.

Study programme assessment in points by evaluation areas.

No.	Evaluation Area	Evaluation of an area in points*
1.	Programme aims and learning outcomes	4
2.	Curriculum design	3
3.	Teaching staff	4
4.	Facilities and learning resources	4
5.	Study process and students' performance assessment	3
6.	Programme management	3
	Total:	21

*1 (unsatisfactory) - there are essential shortcomings that must be eliminated;

2 (satisfactory) - meets the established minimum requirements, needs improvement;

3 (good) - the field develops systematically, has distinctive features;

4 (very good) - the field is exceptionally good.

Grupės vadovas: Team leader:	Prof. Dr. Laurens Katgerman
Grupės nariai: Team members:	Prof. dr. Andres Öpik
	Prof. Dr. Janis Spigulis
	Dr. Denis Guilhot
	Dr. Sergejus Orlovas
	Dr. Milena Medineckienė

**VILNIAUS UNIVERSITETO ANTROSIOS PAKOPOS STUDIJŲ PROGRAMOS
LAZERINĖ TECHNOLOGIJA (VALSTYBINIS KODAS – 621J50003) 2016-08-19
EKSPERTINIO VERTINIMO IŠVADŲ NR. SV4-191 IŠRAŠAS**

<...>

VI. APIBENDRINAMASIS ĮVERTINIMAS

Vilniaus universiteto studijų programa *Lazerinė technologija* (valstybinis kodas – 621J50003) vertinama **teigiamai**.

Eil. Nr.	Vertinimo sritis	Srities įvertinimas, balais*
1.	Programos tikslai ir numatomi studijų rezultatai	4
2.	Programos sandara	3
3.	Personalas	4
4.	Materialieji ištekliai	4
5.	Studijų eiga ir jos vertinimas	3
6.	Programos vadyba	3
	Iš viso:	21

* 1 - Nepatenkinamai (yra esminių trūkumų, kuriuos būtina pašalinti)

2 - Patenkinamai (tenkina minimalius reikalavimus, reikia tobulinti)

3 - Gerai (sistemiškai plėtojama sritis, turi savitų bruožų)

4 - Labai gerai (sritis yra išskirtinė)

<...>

2.7. Išskirtinės kokybės pavyzdžiai (geroji praktika)*

Reikia pripažinti itin aukštą institucijoje vykdomų tyrimų lygį ir publikacijų, kurių bendraautorai yra Lazerinės technologijos studijų programos studentai, skaičių, nes šie aspektai yra išskirtiniai.

<...>

IV. SANTRAUKA

Studijų programa pasižymi ne vienu teigiamu kokybės aspektu, iš kurių pažymėtinas išskirtinis tyrimų lygis. Susijusi materialioji bazė išpūdinga ir akivaizdžiai pritaikyta šiam studijų programų tipui. Tai bene viena geriausių materialiuųjų bazių Europoje.

Taip pat verta pažymėti studijų programos išlaikomą aukštą bendradarbiavimo su pramonės partneriais lygį; dauguma praktikų vyksta tokioje aplinkoje. Tai suteikia neįkainojamą

pranašumą šią magistro studijų programą baigiantiems studentams ir atveria jiems puikias įsidarbinimo šioje srityje galimybes.

Absolventų įsidarbinimo pramonės sektoriuje rodiklis akivaizdžiai įrodo šios studijų programos tinkamumą studentams.

Vis dėlto, ekspertų nuomone, keletą aspektų reikėtų gerinti. Puikios anglų kalbos žinios ir tarptautinių tyrimų ekosistemos ar pramonės rinkos patirtis tampa vis svarbesnės, siekiant sėkmingos profesinės karjeros, taip pat yra svarbios darbdaviams, kaip buvo minėta susitikimų metu. Ekspertų grupė negali nepabrėžti, kaip svarbu pagerinti studijų programos tarptautiškumo aspektus – mainų programų ir kalbos mokėjimo, ir suteikti dėstytojams galimybes teikti prašymus mokslininko kūrybinėms atostogoms.

Taip pat reikėtų tobulinti baigiamųjų magistro darbų vertinimo sistemą. Ją reikėtų peržiūrėti, kad darbai nebūtų vertinami vien tik dviem pažymiais: 9 ir 10, siekiant geresnio reitingavimo ir tikslesnio studentų darbo vykdant tiriamuosius projektus vertinimo.

Taip pat kalbant apie studijų programos vadybą, praverstų įdiegti virtualią mokymosi aplinką, pavyzdžiui, *Moodle*.

Galiausiai, studijų turinį galima pagerinti didinant su pramone susijusių dalykų (ypač projektų valdymo, rinkos ir pramonės įgūdžių) skaičių.

<...>

III. REKOMENDACIJOS

1. Peržiūrėti savarankiško mokymosi krūvio dalį ir gerinti jo kontrolę, siekiant išvengti dvigubo kreditų skyrimo.

2. Gerinti komunikaciją dėl savarankiško mokymosi ir susijusių kreditų, siekiant, kad studentai suprastų jų svarbą ir organizavimą.

3. Išplėsti baigiamųjų darbų įvertinimo intervalą, nes šiuo metu jie vertinami tik dviem pažymiais: 9 arba 10.

4. Gerinti studentų apklausų procesą, grįžtamąjį ryšį ir jo įtaką būsimiems pokyčiams.

5. Didinti studijų programos tarptautiškumą daugiau vartojant anglų kalbą ir skatinant studentų ir dėstytojų mainus.

Universiteto lygiu ekspertų grupė rekomenduoja įdiegti mokymosi platformą, pvz., *Moodle*.

Šalies lygiu rekomenduojama didinti stipendijas (tiek skiriamų stipendijų skaičių, tiek jų dydį), ypač socialines stipendijas, siekiant išvengti papildomo studentų patiriamo spaudimo dėl darbo studijuojant, nes tai taip pat yra jų judumą ribojantis veiksnys.

<...>

Paslaugos teikėjas patvirtina, jog yra susipažinęs su Lietuvos Respublikos baudžiamojo kodekso 235 straipsnio, numatančio atsakomybę už melagingą ar žinomai neteisingai atliktą vertimą, reikalavimais.

Vertėjos rekvizitai (vardas, pavardė, parašas)