



STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Kauno technologijos universiteto

***TAIKOMOSIOS FIZIKOS STUDIJŲ PROGRAMOS***  
**(621F30005)**

**VERTINIMO IŠVADOS**

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**EVALUATION REPORT**  
**OF APPLIED PHYSICS (621F30005)**  
**STUDY PROGRAMME**  
at Kaunas University of Technology

Grupės vadovas:  
Team leader:

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Išvados parengtos anglų kalba  
Report language - English

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## DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	<i>Taikomoji fizika</i>
Valstybinis kodas	621F30005
Studijų sritis	Fizinių mokslų
Studijų kryptis	Fizika
Studijų programos rūšis	Universitetinės studijos
Studijų pakopa	Antroji
Studijų forma (trukmė metais)	Nuolatinė (2)
Studijų programos apimtis kreditais	120
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Fizikos magistras
Studijų programos įregistravimo data	1997 gegužės 19 d.

## INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	<i>Applied Physics</i>
State code	621F30005
Study area	Physical Sciences
Study field	Physics
Kind 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 Physics
Date of registration of the study programme	19 May, 1997

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## I. INTRODUCTION

The procedures of the external evaluation of Kaunas University of Technology (hereafter – KTU) Master’s study programme in *Applied Physics* (hereafter – *AP*) were initiated by the Centre for Quality Assessment in Higher Education of Lithuania nominating the external evaluation peer group formed by the head, professor Sven Anders Flodström, professor Bernard Remaud, professor Adam Kiss, dr. Artūras Acus, dr. Irmantas Kašalynas, and Paulius Simanavičius, students’ representative.

For the evaluation the following documents have been considered:

1. Law on Higher Education and Research of Republic of Lithuania;
2. Procedure of the External Evaluation and Accreditation of Study Programmes;
3. General Requirements of the Second Degree Study Programmes;
4. Methodology for Evaluation of Higher Education Study Programmes.

The basis for the evaluation of the study programme was the Self-Evaluation Report (hereafter, SER), its annexes and the site visit of the experts’ team to KTU on 21 of May 2013. The visit incorporated all required meetings with different groups: the administrative staff, staff responsible for preparing the self-evaluation documents, teaching staff, students of all years of study, graduates and employers. The expert group evaluated various support services (classrooms, laboratories, library, computer facilities), examined students’ final works, and various other materials. After the expert group discussions and additional preparations of conclusions and remarks, introductory general conclusions of the visit were presented. After the visit, the group met to discuss and agree the content of the report, which represents the expert team consensual views.

KTU Master’s study programme in *AP* is implemented at the Department of Physics of the Faculty of Fundamental Sciences. Master’s *AP* study programme recruits about 8 students each year. Most of the Master’s *AP* study programme entrants are graduated in Bachelor’s study programme in *Applied Physics* at KTU. This tendency appears, because of the reason, that it is highly unusual to Bachelor of Physics graduate directly enter into the labour market. In practise this means that the study time for becoming a working physicist is 6 years or more. This is quite a long time compared to the practices in Europe.

In experts point of view, Master's *AP* study programme is being applied by being broad mainly from a solid-state physics perspective and that learning way of physics related to analytical thinking is enough. It would be useful the mentioned concept to revise. More attention to the labour market competition would force a more clear idea about the usefulness of Master's *Applied Physics* graduates in comparison with Master's, who are graduated in engineering. Allotting Master's study programme to a more narrow area of application or by new ways of working with analysis of large-scale physical systems with computational methods are examples of new possible ways.

However Master's study programme in *AP* is embedded in a high academic quality culture preparing graduates, who are, in an opinion of experts, very competitive in European perspective. This should be the basis for a much higher inwards and outwards mobility than observed.

## II. PROGRAMME ANALYSIS

### 1. Programme aims and learning outcomes

One of the main objectives of the Bologna process for higher education is to substitute the design of the curriculum. The traditional programme based approach is replaced by the approach based on the intended learning outcomes, i.e. a shift from the input-based to an output-based approach or the way of thinking.

The study programme aims as stated in the SER, are to prepare the creative physics graduates of broad erudition with actual knowledge in physics and its application and be able to explore, simulate and responsibly apply it in the new situations, to evaluate decisions, and to pick out the best, so developing their personal career in the chosen area, also to be able to be competent partners in joint projects with the other academic specialists. The essence is, that those aims could be perceived as an extension of those of the Bachelor's study programme in *Applied Physics* at KTU aims, keeping the same wide scientific scope and reinforcing the scientific orientation. Taking into account the mentioned scientific orientation of the study programme, the aims are quite well defined and clear.

Concerning the study programme intended learning outcomes (LO's), experts' team noticed, that study programme managers are implementing LO's approach properly, however further efforts should be paid seeking to assess, if the intended learning outcomes are achieved. In the SER are showed real and convincing efforts to define the intended learning outcomes according to five axes: knowledge (A), research abilities (B), subject specific abilities (C), social abilities (D) and personal abilities (E). The links between study programme intended learning outcomes and study subjects are set properly, but it seems, that this information lacks further reflection, especially concerning the clearer assessment methods, if the intended learning outcomes were achieved. For example, the intended learning outcomes linked to the social and personal skills appear as linked with the big part of the study subjects, but barely one could imagine in which way students can follow their progress and be evaluated on these study subjects and how this evaluation is taken into account for their final grades. In comparison to the Bachelor in *Applied Physics* at KTU, which is mainly a doorway to the Master's in *AP* study programme, the Master's studies open the labour market to the graduates, but this orientation towards the profession is not very clearly visible in the intended learning outcomes, despite of the fact, that not a majority of Master's in *AP* graduates apply for PhD studies.

Overall, the study programme aims and intended learning outcomes are coherent with the level, study field and qualification offered (Master in Physics). At the same time in experts' team

opinion, Study Programme Committee with the help of social stakeholders should continue their efforts to reexamine the intended learning outcomes from the output-based approach, taking into account the fact, that most graduates are directly employed in industry, also pay attention to the defining the clearer assessment methods of the intended learning outcomes achievement, especially considering those, which are not directly linked to the scientific matters.

The aims and LO's of the study programme are published on the KTU website and thus are open and available.

## ***2. Curriculum design***

The curriculum design of the Master's in *AP* study programme matches the legal acts requirements set for the second cycle studies: study programme duration is two years (120 ECTS credits), 60 ECTS credits are allocated to core and compulsory subjects, 30 ECTS credits – to research projects and optional study subjects, 30 ECTS credits – to final degree project. Number of study subjects per semester is not more than 5. Such study programme structure supports the achievement of the intended learning outcomes.

The information provided in SER and the discussion with the students has shown that the study subjects are evenly distributed. The students also mentioned that the study programme could be amended by including more practical work inside and outside of the higher education institution. At the same time the students claimed that they do not noticed any repetitions or non-understandable parts in the curriculum. Experts' team also would like to highlight the need of improvement of computer modelling and simulation part in the curriculum.

The content of the courses is consistent with the study field and degree awarded. In experts' team opinion, the Masters' study programme in *AP* is from several perspectives a continuation of the Bachelor's studies in *Applied Physics* at KTU, while the Master's study programme could be more specialised.

The content and methods of the courses are appropriate for the achievement of the specialized intended learning outcomes. However, further efforts should be made to a better assessment of the generic skills achievement. For that reason the experts' team supports the intended action of study programme staff to invite the business representatives to teach study subjects.

### **3. Staff**

The teaching staff of Master's in *AP* study programme consists of: 8 professors, 5 associate professors and 1 PhD student. The number of publications of staff is 116 scientific papers published in ISI journals during the period 2008-2013. About 95% of study subjects are delivered by professors and associated professors. During the site visit, experts collected enough evidence about staff qualification, their scientific research activity, participation in conferences and various courses seeking to improve their teaching skills, which appears to be more than sufficient to successfully implement the Master's in *Applied Physics* study programme.

In the SER is provided the age profile of the academic staff, which is quite well balanced: there are 4 lecturers up to 40 years, 3 lecturers 40-50 years, 3 lecturers 50-65, 4 over 65. Seeking to ensure long-term stability of the Master's study programme implementation, the attention to the preparation of new generation of lecturers should be paid.

In the SER is listed the number of staff's strengths and weaknesses, which is commendable from the study programme administrators perspective (unfortunately actions to improve situation are provided in a very general character and lacks prioritization, schedules and quantitative information on the desired improvement). As weaknesses are listed low numbers of teachers participation in international exchange programmes, also not sufficient participation in international and industrial research programmes. This case could have an impact on Master's students mobility, which is quite low – just two students in a period of 2008/2012 used the possibility to go abroad (in the period 2012/2013 the number of students participated in mobility programmes was 9, but experts' team could not perceive it as the stable ongoing tendency for the future yet). Experts' team would like to pay attention, that students' and teachers' mobility could not be directly related to declared network of 18 agreements, the reason for that is the information received during the visit, that there are 4 suggested positions in the ERASMUS exchange programme. Moreover the more obvious reason for low students' mobility exists – full-time employment. The experts' team seems that this problem, could not be solved just at the university level, but requires a careful examination of the Lithuanian higher education financing system.

### **4. Facilities and learning resources**

In the SER available material resources and facilities needed to implement Master's study programme in *AP* are described in a very detailed way: there are 8 modern auditoriums (450 total number of workplaces), 18 laboratories (specified by modules and used for practical and research work), 2 computer classrooms (42 working places), library (27 working places, also students



have possibility to use Central Library of KTU) and databases (there are 54 subscribed databases). The visit to KTU confirmed high quality of material resources and that those are appropriately used.

The experimental equipment for research used in *AP* Master's studies is modern and of highest standards: plasma and plasma chemical etching equipment; magnetron and arc coating systems; equipment for electron-beam evaporation; equipment for thermal evaporation; equipment for processes of diffusion and oxidation; laser interferometer system; X-ray diffractometer; optical microscope; ellipsometer; microspectrometer; Raman spectrometer. During the site visit expensive and top-notch experimental equipment within thin film, nanophysics and surface analysis at Lithuanian Energy Institute was shown (common value of which exceeds 15.000.000 Lt). Many second cycle students in their preparation of thesis use those experimental facilities. This adds a very important international research dimension to their Master thesis.

Students do have possibilities for individual work at the Faculty of Fundamental Sciences building, including 27 working places (10 of them are computerized). As well students have a possibility to use reading rooms of the Central Library with 174 working places (32 of them are computerized). During the site visit it was found out that students do use resources provided by the library and use computerized working places for their studies. However it should be noted, that the full-time job students have a little bit restricted access to the resources and the attention to this issue should be paid.

Requisite study material can be found on the KTU website <http://www.ebooks.ktu.lt> (open access for KTU students). The teaching staff has prepared 17 textbooks in 2008-2012 period, it is a unique resource for the implementation of the study programme.

The university provides access to databases both for lecturers and students not only from KTU computers, but also from their personal computers. It is worth to note that KTU had found resources not only for hardware and software updates (1.3 million litas), but also had invested over 100 000 litas for purchasing software licenses over the last 5 years. Legal and IPR rules were applied strictly.

### ***5. Study process and student assessment***

The admission to the Master's in *AP* study programme is carried out according to the "Admission rules of KTU to the second cycle of studies". The admission requirements to the study programme are based on a being awarded Bachelor's Degree in Physics and then a

competition among eligible candidates. The number of admitted students has doubled in the last 5 years being 6 in 2008 and 14 in 2012. These numbers are strongly dependent on the numbers of graduates from the Bachelor's in *Applied Physics* study programme at KTU, as many of them apply for Master's studies in *Applied Physics* at the same university. The highest and the lowest points of admitted students have remained practically the same during the last five years period (5,02-4,75).

According to the SER provided data, the majority of the accepted students manage successfully the Master's study programme and just a few of students quit. However, the number of the graduates has shown a slight decrease over the five years period.

The study process is properly organized. Because of the low number of students, the study process is conducted in interpersonal way and an academic atmosphere. On the other hand, it is pity that according to the student statements most of them have full-time jobs besides the studies. This prevents them from devoting their full-time and intellectual capacity to the study programme. It is commendable, that individual study plans are worked out on the basis of the curriculum with personal involvement of the students. This safeguard and ensures the adequate development of the study programme.

The experts' team has not noticed any problems with the examination schedules. These are prepared in a common work between the professors and students. This is also true for the knowledge, understanding, competences, for exercises and for laboratory work reports. In the higher semesters, the students prepare summaries about their work, which are appropriately discussed in in-group meetings with their supervisors. All these together, help to reach the intended learning outcomes. In general, the assessment system of the performance of the students' is adequate and publicly available.

The students of Master's study programme take part in research activities during their studies: students prepare their final degree projects, participates in research work of the Department of Physics, take part at the exhibition of young researchers "Technorama" organized by the KTU (3 students participated during evaluation period) and make presentations at the conferences "Radiation Interaction with Material and Its Use in Technologies" (7 students during evaluation period), "Medical Physics in the Baltic States" (1 student during evaluation period).

KTU helps all students to create connections with the labour market for graduates. Career Centre of the KTU is a good and appropriate tool for that. Besides the periodical seminars organized by KTU Career Center, Department of Physics also periodically organizes the seminars where representatives of different companies: UAB „Accel elektronika“, UAB „Technologija“, UAB „Renerga“, UAB „Grida LAB“, UAB „Norta“, VATESI, „Optida“, UAB „EuroParama“, UPS, UAB „Baltec CNC Technologies“, Protech (Applied Research Institute for Prospective Technologies), MET (Modernios E-Technologijos), UAB Litnobiles, UAB Elinta introduce the possibilities to get the practice place and introduce the job opportunities for the *AP* study programme students. The discussion with the social partners has shown that the majority of the Master's graduates in *AP* study programme used the opportunities of employment, which were offered to them.

The social help is given to the students according to the rules and procedures of KTU. There was no sign of an incorrect procedure or any case in this field. The students, who wish it, get dormitories, access sport and cultural activities.

## ***6. Programme management***

The main bodies responsible for the management of *AP* study programme and internal quality assurance are: Faculty of Fundamental Sciences Council (accepts the decisions on the most important issues about studies organization, science and other questions, relating the Faculty, discuss and present Faculty's study programmes to the Senate for approval), Dean and Vice-Deans of the Faculty (coordinate the activities of the Faculty departments, organize the study process and Faculty research activities, continuously improve their quality, implement Senate and Faculty Council resolutions, and the Rector's orders), Study Programme Committee (Study Programme Committee is responsible for all Faculty of Fundamental Sciences' study programmes; prepares and develops study programmes, ensures the quality of implementation, coordinates the work of the departments involved in the preparation of study programmes, provides proposals for the improvement of existing programmes or new preparation to the Faculty Council in collaboration with the departments, the Senate and the Academic Cultural Committee, with the regard to their proposals), also the Head of the Department of Physics and study programme coordinator. The administrative bodies, who are directly responsible for the proper study programme implementation and it's development are study programme coordinator and the head of the Department of Physics. It is necessary to mention, that the process of the

study programme administration and its internal quality assurance is reflected in academic information system operating in ORACLE environment from 2003 (according to SER, regularly updated information system provides the sequence of decisions on study programme quality assurance, programme review and approval process describing the latest normative documents).

Leadership at the Department of Physics is strong and creates a sense of ownership of the study programme. During the visit it became clear, that the Head of the Physics Department really cares about the quality of *AP* study programme. All those elements leads to the transparent responsibilities for decisions and monitoring of the implementation of the study programme.

The notion of internal quality assurance, its assessment and the relation with the intended learning outcomes must involve main social stakeholders: study programme management, teaching staff, students, graduates and employers:

1. Concerning the study programme management, *AP* curriculum is annually revised, while study subjects by Study Programme Committee are certified every three years;
2. The teachers are responsible for the study subject quality. Every teacher submits proposals related to their respective study subject update at the meetings of the Department;
3. Students' representatives participate at the meetings of KTU Senate, Faculty Council and Study Programme Committee. Each semester students have a possibility to express their opinion answering questionnaires (prepared by Studies Office) about the studies quality. Long-term results of the surveys are used by Study Programme Committee for study subjects certification, attestation and competition commission, lecturers performance assessment;
4. Relationship with alumni is held either directly or through the Faculty of Fundamental Sciences Students' Representatives (alumni are invited to the annual ongoing Faculty Days and other events of the Faculty of Fundamental Sciences) or through KTU graduates association "Alumni";
5. Social partners participate in study programme implementation and improvement of studies quality by sharing practical experiences in delivering lectures and during the students' practices.

Master's study programme in *AP* is characterized by relatively few students and a relatively high number of qualified and experienced teachers, almost all having a PhD and a scientific production. This creates a strong positive academic quality culture fostering the students as individuals and their appreciation of high quality in an academic sense. However it is not a very

dynamic process and lacks an external perspective of the study programme. As though, it is highly recommended to provide the questionnaires about the studies quality to students, alumni and social partners periodically and create more formalized feedback system. Also experts' team suggests not just to name the weaknesses of the study programme (as it was done in SER), but provide clear means supported by numbers, which exclude the possibility to observe achieved progress both as an internal guidance and for future expert teams.

### **III. RECOMMENDATIONS**

1. To set clearer intended learning outcomes assessment methods. Exceptional attention should be paid to the assessment, if the intended learning outcomes linked to social and personal abilities were achieved.
2. To strengthen the part of computational physics in the curriculum.
3. To reconsider the concept of the study programme with the orientation not just to academical career, but also to the needs of the labour market.
4. To increase the mobility numbers by teachers and students. Foreign guest lecturers, as well as students could help in keeping an active European network.
5. To create more formalized feedback (concerning the main social stakeholders) system in studies quality assurance.
6. New ways to communicate with non-academic organizations and companies should be considered.

## IV. SUMMARY

The main strengths of *Applied Physics* Master's study programme:

- High academic quality culture;
- Motivated students;
- Qualified and devoted academic staff;
- Exceptionally good material resources;
- Strong leadership.

The main weaknesses of *Applied Physics* Master's study programme:

- The lack of clear assessment methods of the intended learning outcomes linked with social and personal abilities;
- Not sufficient attention paid to the labour market needs;
- Low teachers and students mobility numbers;
- Lack of the formalized feedback system from the main social stakeholders.

## V. GENERAL ASSESSMENT

The study programme *Applied Physics* (state code – 621F30005) at Kaunas University of Technology is given **positive** evaluation.

*Study programme assessment in points by evaluation areas.*

No.	Evaluation Area	Evaluation Area in Points*
1.	Programme aims and learning outcomes	3
2.	Curriculum design	3
3.	Staff	3
4.	Material resources	4
5.	Study process and assessment (student admission, study process student support, achievement assessment)	3
6.	Programme management (programme administration, internal quality assurance)	3
	<b>Total:</b>	<b>19</b>

\*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.

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**KAUNO TECHNOLOGIJOS UNIVERSITETO ANTROSIOS PAKOPOS STUDIJŲ PROGRAMOS *TAIKOMOJI FIZIKA* (VALSTYBINIS KODAS – 621F30005) 2013-09-03 EKSPERTINIO VERTINIMO IŠVADŲ NR. SV4-304 IŠRAŠAS**

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## V. APIBENDRINAMASIS ĮVERTINIMAS

Kauno technologijos universiteto studijų programa *Taikomoji fizika* (valstybinis kodas – 621F30005) vertinama **teigiamai**.

Eil. Nr.	Vertinimo sritis	Srities įvertinimas, balais*
1.	Programos tikslai ir numatomi studijų rezultatai	3
2.	Programos sandara	3
3.	Personalas	3
4.	Materialieji ištekliai	4
5.	Studijų eiga ir jos vertinimas	3
6.	Programos vadyba	3
	<b>Iš viso:</b>	<b>19</b>

\* 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)

## IV. SANTRAUKA

Pagrindinės *Taikomosios fizikos* magistrantūros studijų programos stiprybės:

- Aukšta kokybės kultūra;
- Motyvuoti studentai;
- Kvalifikuotas ir atsidavęs akademinis personalas;
- Išskirtinai geri materialieji ištekliai;
- Stipri lyderystė.

Pagrindinės *Taikomosios fizikos* magistrantūros studijų programos silpnybės:

- Nepakankamai aiškūs su socialiniais ir asmeniniais gebėjimais susijusių numatomų studijų rezultatų pasiekimo vertinimo metodai;
- Nepakankamas dėmesys darbo rinkos poreikiams;

- Negausus dėstytojų ir studentų dalyvavimas judumo programose;
- Formalaus grįžtamojo ryšio iš pagrindinių socialinių dalininkų trūkumas.

### III. REKOMENDACIJOS

1. Nustatyti aiškesnius numatomų studijų rezultatų vertinimo metodus. Taip pat labai svarbu įvertinti, ar pasiekti su socialiniais ir asmeniniais gebėjimas susiję numatomi studijų rezultatai.
2. Studijų programoje daugiau dėmesio reikėtų skirti skaičiavimams fizikoje.
3. Peržiūrėti studijų programos koncepciją orientuojant studijų programą ne tik į akademinę karjerą, bet ir į darbo rinkos poreikius.
4. Padidinti judumo programose dalyvaujančių dėstytojų ir studentų skaičių. Iš užsienio atvykstantys dėstytojai, taip pat studentai galėtų prisidėti prie aktyvaus Europos mainų tinklo plėtojimo.
5. Siekiant užtikrinti studijų kokybę, sukurti formalią grįžtamojo ryšio (su pagrindiniais socialiniais dalininkais) sistemą.
6. Reikėtų apsvarstyti naujus bendradarbiavimo su neakademiniomis organizacijomis bei verslo įmonėmis būdus.

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Paslaugos teikėjas patvirtina, jog yra susipažinęs su Lietuvos Respublikos baudžiamojo kodekso<sup>1</sup> 235 straipsnio, numatančio atsakomybę už melagingą ar žinomai neteisingai atliktą vertimą, reikalavimais.

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<sup>1</sup> Žin., 2002, Nr.37-1341.