



STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Vilniaus universiteto

***MEDŽIAGOTYROS IR PUSLAIDININKIŲ FIZIKOS  
PROGRAMOS (621F30003)***

**VERTINIMO IŠVADOS**

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**PRELIMINARY EVALUATION REPORT OF  
*MATERIALS SCIENCE AND SEMICONDUCTOR  
PHYSICS***

**STUDY PROGRAMME (621F30003)**

at Vilnius University

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Išvados parengtos anglų kalba  
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Vilnius  
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## DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	<i>Medžiagotyra ir puslaidininkių fizika</i>
Valstybinis kodas	621F30003
Studijų sritis	Fiziniai mokslai
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	1997-05-19

## INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme:	<i>Materials Science and Semiconductor Physics</i>
State code	621F30003
Study area	Physical sciences
Study field	Physics
Kind of the study programme	University studies
Study cycle	Second cycle
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	1997-05-19

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The Centre for Quality Assessment in Higher Education

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## I. INTRODUCTION

The Evaluation Report was prepared about the Study Programme of *Materials Science and Semiconductor Physics* at Vilnius University (hereinafter VU). This second cycle programme is in the Study area of Physical Sciences, its study field is Physics and the qualification degree given is Master of Physics. The programme was registered on 19-05-1997. The members of the Expert Team, who are responsible for the Evaluation Report, were selected and appointed by the Centre for Quality Assessment in Higher Education of Lithuania. The personal composition of the Team can be seen on the introductory page of the Evaluation Report.

The study programme is one of the nine second cycle programmes in Physics at the Faculty of Physics at Vilnius University. This programme is an important member of the second cycle programme family because its topics deal with one of the fields of physics, which shows a steady and fast development since decades. Therefore the *Materials Science and Semiconductor Physics* belong to the core of front-line of today's science. In addition, there is an increased attention to technologies and industry of photovoltaic solar cells. In Lithuania the preparation of graduates in the field of solar energy has a special interest.

The Evaluation Report has been prepared on the basis of the study of the Self Assessment Report and with the help of a series of group discussions with different teams of related people on the 9<sup>th</sup> of October 2013. There was a discussion (already on the 8<sup>th</sup> of October) with the administration staff, during which all responsible partners were present from the side of the Faculty of Physics. A meeting was organized with the staff responsible for preparation of Self Assessment Report (the prominent members of the staff were there). Then the Expert Team had a meeting with the teaching staff (6 people, about half of the teachers were present) and with the students (8 students, about one third of all the students of the programme were there). The Expert Team - already on the 8<sup>th</sup> of October - visited the auditoriums, libraries, teaching laboratories used in the educational process. The experts had possibility to familiarize with the thesis materials of the graduates of the programme. It was followed by meeting with alumni (5 persons came) and with a discussion with social partners, where 5 persons in managerial position participated. The site visit was concluded by a discussion with the partners responsible for the master degree study programme *Materials Science and Semiconductor Physics*.

All these steps of the evaluation process took place without any disturbing effects, fully according to the rules of the Centre for Quality Assessment in Higher Education of Lithuania. The Expert Team evaluated all the gathered information in closed section. The Evaluation Report of *Materials Science and Semiconductor Physics* was accepted by all members of the Expert Team with a one vote will.

## II. PROGRAMME ANALYSIS

### ***1. Programme aims and learning outcomes***

The following aims are being pursued while preparing, implementing and improving this study programme:

1. To prepare highly-qualified specialists, able to analyze scientific, technological and production issues, to reveal and formulate the major aspects of these issues, to assess and select solution methods and make general conclusions while working at research laboratories, high technology companies, and organizations associated with electronics and optoelectronics industry and its management at technological level.

2. To introduce MSc students to the current scientific and technological development, to prepare them for the implementation of scientific achievements and high technologies in Lithuania.
3. To prepare high-level physicists for PhD studies

The Experts Team notes that the aims and learning outcomes of the study programme are clear, self-consistent and comply with legal, scientific and pedagogical requirements; they are also publically accessible.

Even though the external comprehensive assessment, carried out in 2005, did not mention any essential drawbacks, the Expert Team welcomes some considerable improvements, taking into account the current trends in materials science and semiconductor physics and recent rapid changes in Lithuania's high technology industry. In particular, a considerable number of the graduates (a) continue their research in PhD studies either in Lithuania or abroad; (b) successfully entered into the labor market thanks to a rapid development of industry of photovoltaic solar cells and systems. These trends have an essential influence on the further adaptation of the study programme towards continued research and targeted applications. In addition, new courses have been introduced and the content of several courses has been modified to provide the students with more in-depth knowledge and skills in the field of solar energy and related technology. Finally, the Expert Team finds quite logic that the summary of the Self Assessment Report was discussed between the Study Programme Committee and at the Semiconductor Physics Department.

In conclusion, the Expert Team only encourages the Study Programme Committee to continue observing the development of related high-technology industries, facilitate staff and student interaction with these applied institutes/industries, seek for formal cooperation and exchange of joint research projects. In addition, the Expert Team also recognizes that the modern experimental base in semiconductor technology that is recently being developed at Vilnius University will create better conditions for the application-oriented research, will further increase the interest of industrial companies, will motivate the students in solving practical problems and lead to potential job opportunities in the future.

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

The curriculum design is composed in such a way that the students would be introduced to the latest concepts and theoretical models, learn how to use modern modelling and calculation methods, acquire skills to perform targeted experiments, analyse and summarise their results, be introduced to the latest technologies and technical equipment, get the understanding of the relationship between science and application. A significant part of the programme is dedicated to the experimental work both in educational and scientific laboratories, especially by encouraging the students to become involved in scientific research. Both compulsory and optional course units as well as practical tasks are oriented to this activity. Students are encouraged to take part in research work as early as in their first semesters of studies, providing course papers and laboratory tasks in research laboratories. In the second year of studies specialization practical activity is introduced and a lot of time is dedicated for final thesis preparation.

The content of the programme and the sequence of the course units are planned allowing students gradually acquiring basic knowledge, experimental and analytical skills, as well as synthetic and assessment skill in two main directions:

- 1) electrical and optical properties of materials, physical basics of electronic and optoelectronic devices, modern electronic and optoelectronic devices,
- 2) semiconductor materials and their nanostructures, technologies of material production and processing, new materials and technologies.

While choosing optional subjects, the students have a possibility to focus on the desirable direction related to their final thesis. The choice corresponds to a top-level research performed on these directions in Lithuania. The field of electronics and nanotechnology has been developed not only at the Faculty of Physics at Vilnius University, but also at the Institute of Applied Research, other Lithuanian universities, at the Institutes of Semiconductor Physics and Physics of the Center for Physical and Technological Sciences. These fields are related to the large potential of Lithuanian industry in the branch of electronics and nanotechnology. Only highly qualified specialists who are able to analyse and assess, can initiate and develop this potential. Thus, in the fourth semester of studies the students are encouraged to take part in research seminars; they are introduced to electronics, optoelectronics, the peculiarities of high technology market in Lithuania and in the world. The programme also contains certain courses improving the students' basic preparation in physics, necessary to master special courses at a higher level. All above-mentioned aspects ensure the balanced and well-spread distribution of lectures. With this, the Expert Team confirms the fulfillment of legal requirements of the study programme.

The study subjects and modules are well designed and divided rationally between semesters. The overall list of courses is relevant to the study programme and there are no repetitive courses. The levels of the courses correspond to the study programme level. The scope of the programme covers mostly learning outcomes. Most of the study programs aims are covered within the courses.

Another issue is related to the final theses. In most cases the thesis composition was not clearly presented. Only about 10% of briefly examined thesis abstracts clearly presented the aim of the study, e.g. started with a sentence: "*The aim of current work is..*". Others just described the activities and measurements results. Therefore, Expert Team recommends explaining more in detail to the students the final thesis composition style and format. As it is related to the final aim of the study programme (*to prepare high-level physicists for PhD studies*), there should be probably an additional mandatory course about composing scientific reports and thesis documents.

Another issue is with achieving professional knowledge in English. In communication with Expert Team students expressed their will to have more seminars presented by foreign scientists to engage more updated knowledge's and therefore improve their scientific English. The Expert Team encourages study programme leaders to find more lecturers from abroad. One of the strongest aspects in this particular study programme is well-motivated lecturers with strong scientific background. It is not typical that study programme lector is also active in teaching and same time successful in high-level science. Most of lectures have related scientific interests and therefore there is a direct link between course content and latest achievements in science.

Students also expressed their will to concentrate weekly based lectures in two days to have more consistent time in scientific labs. Another potential improvement issue is tightening relationships with industrial partners. There are several companies producing and developing products linked to solar cell technology. Therefore it is highly recommended to strengthen such contacts and facilitate students practice places.

### **3. Staff**

The teaching staff is optimal for this study programme. The Semiconductor Physics Department is in charge of teaching the main courses related to materials science and semiconductors physics. Currently there are 10 professors, 6 associate professors and 3 lecturers, all of them having a PhD academic degree. Most of them are only part-time employees at the Semiconductor Physics Department and also work on scientific research, mostly at the Institute of Applied Research. It enables the teachers to combine teaching with active scientific work, and provides the students with an opportunity to receive the newest knowledge and carry out

research in modern scientific laboratories. The lecturer workload is almost equally shared by teaching and scientific work.

The lecturers from the Department of Solid-State Electronics and the Department of Radiophysics also participate in implementation of the study programme. Some course units of the Programme are taught by the professors working at the Institute of Semiconductor Physics of the Center for Physical and Technological Sciences, where they offer laboratory work for the students. As many as 9 out of 10 professors teaching at the programme are laureates of the Lithuanian National Scientific Award. The average age of the teaching personnel is sustainable as it currently is around 56. This is not critical. However, Expert Team recommends to prepare an advanced recruitment plan for new staff in order to guarantee the programme sustainability. Most of the teachers working at this programme do active research work, participate at scientific conferences and publish results of their research in scientific journals.

On average, one teacher (together with co-authors) annually publishes two articles in scientific research journals, included into Institute of Scientific Information database. All teachers are experts in their field and that ensures the teaching quality. Many lecturers have outstanding H-index that also secures the teaching content quality and allows presenting the latest scientific achievements. Teaching staff is financially encouraged to publish articles by being offered salary bonuses. The majority of the programme's lecturers have experience in working at prestigious European and US universities, have constant and productive academic contacts with foreign scientists, have learned how scientific results and innovations are implemented in the countries where these processes are more advanced than in Lithuania.

The average contact workload of the teachers who work in *Materials Science and Semiconductor Physics* second cycle study programme depends on the number of the course units chosen. The average contact workload for one lecturer is approximately 40 contact hours. The workload for one full-time lecturer is 2 students from *Materials Science and Semiconductor Physics* study programme. The teachers also supervise the students' research work, course papers and final theses, check the students' tests. The teachers' work in research and methodological projects is directly related to their qualification improvement. The results of the projects are continuously being used to update the contents of the course moduls. This is especially relevant for course moduls related to materials science and semiconductors physics, since innovations in these areas emerge every year, and the students have to be aware of them. The level of the teachers' qualification is also raised during internships, participation at international conferences and analysing research publications. Seven teachers have taken part in various internships in foreign research and study institutions throughout the last 5 years. All the teachers of *Materials Science and Semiconductor Physics* study programme deliver reports in research conferences in Lithuania and abroad, which also stands as a way to raise teachers' qualification level. As many as 8 teachers have participated in various qualification level raising courses in Lithuania and abroad since 2007.

During the site visit, students expressed their will to have more lectures in English. This could help them into entering to the real scientific work and practice their scientific English. Expert Team recommends inviting more foreign lectors to improve this aspect.

Faculty administration is also active in recruitment of new teaching personnel. Among the PhD students, who have defended their thesis in the faculty, the best ones are invited to teach.

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

The premises for studies are adequate both in their size and quality. The lectures, seminars and workshops of the *Materials Science and Semiconductor Physics* study programme take place in VU the Faculty of Physics in room with 30 seating places. Despite the fact that this room is also used for students of other programmes, place is sufficient. Laboratory works take

place in three teaching laboratories and nine scientific laboratories with working places installed for educational laboratory works. The teaching laboratories are constantly renewed and equipped with new scientific devices by using EU structural funds, National complex programme. Laboratory and computer equipment are adequate. Equipment for the studies is modern and constantly being updated. The yearly allocation of LTL 8000 is given for materials needed for the completion of laboratory works as well as for the small-scale renovation of those works. The current facilities are sufficient to prepare MSc students of *Materials Science and Semiconductor Physics* study programme. The students of the *Materials Science and Semiconductor Physics* programme carry out scientific practice and write their final theses not only at VU Semiconductor Physics Department but also in the Institute of Applied Research, and the Center for Physical Sciences and Technology. Some of them perform their practice in manufacturing companies ("Vilniaus Ventos puslaidininkiai", "Brolis Semiconductors", etc.), where the students are later frequently employed. In Sauletekis Valley project large investments are provided for the development of the semiconductor technologies. It is an opportunity for students not only to complete the characterization works, but also to produce the materials on their own, as well as structures and device prototypes, which will encourage them to implement the scientific ideas in practice.

Teaching materials are adequate and accessible. There is quite long list of textbooks published by teachers of this programme (using EU structural funds). The teachers of the department have uploaded visual aids and synopses as well as laboratory work descriptions of most of the study courses' lectures on the website of the Semiconductor Physics Department. VU Library subscribes over 50 global databases which make it possible for the University library users to read different scientific magazine articles. VU library is modern, computerized with free internet places and free WiFi connections and easily accessible for students. VU library subscribes a number of databases related to the subject-matter of laser physics and optical technology study programme. Study literature is added to the library funds every year. New books are purchased in VU library according to teachers' recommendations. The students can also connect to the subscribed databases from their homes by using the University supplied VPN (Virtual Private Network) service.

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

Persons who graduate from the first cycle physical, technological and biomedical university studies and holders of BSc qualification degree of these research areas can be admitted to the second cycle *Materials Science and Semiconductor Physics* study programme. Bachelor graduates in other research areas are admitted only if they attend the required introductory courses of the study programme and present a thesis on the topic of physical or technological research areas. So, the admission requirements are well-founded.

The organisation of the study process ensures an adequate provision of the programme and the achievement of the learning outcomes. The ratios of time in first three semesters are about: for lectures 30%, workshops 10% and autonomous work 60%. The fourth semester is entirely dedicated for thesis preparation by autonomous work.

Students are encouraged to participate in research activities. In order to encourage the MA students' scientific research the Institute of Applied Research established the Scholarship of acad. J. Viščas for students, who most successfully work in the scientific laboratories. According to IAS Council approved regulations, the special committee selects the master students for this scholarship twice a year. Scientific achievements, financial support from other sources and recommendations of the scientific supervisors are taken into account while allotting the scholarship. The maximum sum of scholarship is LTL 550 per month. Many of the master students have scientific publications by the end of their studies.



Students have opportunities to participate in student mobility programmes, but only a limited number of students of the programme actually do so. The Expert Team suggests that the mobility of students as well as teachers of the *Materials Science and Semiconductor Physics* study programme should be enhanced in the future.

The higher education institution ensures an adequate level of academic and social support. Some students receive encouragement scholarships for study results. Previously as many as 30% of students would receive scholarships. Since 2009, after the change in the procedures of financing, approximately 14% of the students receive scholarships. There are two types of scholarships – regular (195 Lt) and increased (325 Lt). Social scholarships can be allocated to students, who undergo substantial financial hardships. These scholarships are distributed by Students' Representation Office.

The assessment system of students' performance is clear, adequate and publicly available. Accumulative assessment system applies to most course units. Assessments for tests during the semester constitute about 30-40% of the final assessment. Assessment for laboratory work makes up about 10% of the final evaluation. The weight of the final test is approximately 50-60% of the final evaluation. Specific assessment methods of each course unit are outlined in course unit descriptions. The entire last study term is devoted to MSc final thesis preparation and writing under supervision of a staff member.

Professional activities of the majority of graduates meet the programme providers' expectations. More than 60% of the graduates of this programme continue their education in the doctoral studies (29% in Vilnius University, 17% in the Center for Physical Sciences and Technology and the other 17% in foreign universities). It should be noted that all the graduates whose period of doctoral studies is over, have successfully defended the PhD thesis or have submitted them for defense. About 25% of the graduates find employment in Lithuanian business companies.

## **6. Programme management**

Responsibilities for decisions and monitoring of the implementation of the programme are clearly allocated. The programme committee of the *Materials Science and Semiconductor Physics* is made of the teachers from the Faculty of Physics, the students recommended by Students' Representation Office and the representatives of the social partners. The Study Programme Committee offers changes of the programme, submits them for approval to the Council of the Faculty, discusses and confirms the course units' descriptions approved at the meetings of the departments. The heads of the departments are in charge of the course units' quality and the study process of these course units. The course of the study programme is administered by the Dean and the Vice-dean for academic issues.

Though it seems to be clear, the internal organization of the staff for this master degree programme is, from the social point of view, only moderately developed. During the site visit it turned out that more than the half of the staff are familiar with the programme aims and learning outcomes. The Expert Team has an impression that the management of the programme did not spend enough efforts for a stronger engagement of the staff with this master degree programme.

Information and data on the implementation of the programme are regularly collected and analysed. The Dean's office receives information about the problems of the programme from the students' self-governance representatives. The survey results related to the courses taught within the programme are accessible for the Study Programme Committee, the feedback on the course units taught by the department teachers are available to the head of the corresponding department. The outcomes of internal and external evaluations of the programme are used for the improvement of the programme. The evaluation and improvement processes involve stakeholders.

The internal quality assurance of the programme has many right elements. However, the Expert Team suggests further improvements of the quality assurance system in the future.

### III. RECOMMENDATIONS

1. The programme should make efforts to enhance the mobility and staff exchange, in particular for students. Various available instruments can be used for this purpose, for example, ERASMUS grants, project research grants, bilateral agreements between institutions, etc.
2. The programme should continue and strengthen their efforts in providing courses in English. This should be the case if the students' group involves some foreign students. In this regard, the programme might be promoted as capable to offer lectures and practical courses in English. Equally, invitation of more guest lecturers and scientists is strongly encouraged. Finally, students should have a chance to give a seminar or conference presentation in English.
3. The internal quality assurance of the programme is one of the most important prerequisite to maintain its sustainability. Therefore it is recommended that the programme management builds up a closed and detailed system of quality assurance and quality control. It should include all aspects of curriculum development, staff renewal and further training of the members, the review of material resources and all other aspects of the study process. This quality assurance system should interlock in those of the Faculty of Physics and of the Vilnius University.
4. The final thesis composing needs additional attention. The knowledge of presenting results should be strengthened by additional course/seminar dedicated to this topic, in particular explaining the format and structure of the diploma thesis work.

#### IV. SUMMARY

The *Materials Science and Semiconductor Physics* study programme is an important and successful member of the second cycle programme family at the Faculty of Physics of Vilnius University.

The study programme gives a good knowledge in master level Physics, excellent to found the Master of Physics degree. The structure of the study is well thought through and it is on up-to-date international scientific level.

The laboratories for the material science and semiconductor physics had a substantial and positive development in the last years. They are significant even when compared to international practice. The teaching staff is competent and motivated. The curriculum design can be appreciated; there is no obvious overlapping or mistakes. The students are motivated and committed persons, they seem to be knowledgeable and able to work in research groups.

The Expert Team, besides the appreciation has several recommendations to the management of the *Materials Science and Semiconductor Physics* second cycle program.

The thesis works are in most cases of appropriate scientific level, sometimes they are very good. However, the structure of the thesis works show in many cases a structure, which does not correspond to the best international edition standards. In many cases the motivations/objectives of the work are not stated or there are no real conclusions drawn from the work.

The group identity of the members of the staff with the study programme seems not to be the strong. They should be more conscious and this consciousness should be strengthened by the programme management. The involved staffs need to be motivated and they should strengthen their engagement in the programme preparation and implementation, identify their direct contribution to the programme aims and learning outcomes.

The programme should make efforts to facilitate and increase the mobility of students and staff exchange. This mobility is in fact low. Various available instruments can be used for the purpose to change this unfortunate fact, like ERASMUS scholarships, project research grants, or bilateral agreements between institutions. The programme management should study additional reasons and take innovative measures in order to enhance the mobility.

The programme management should continue and strengthen their efforts in providing courses in English. This should be the case if the students' group involves some foreign students. In this regard, the programme might be promoted as capable to offer lectures and practical courses in English. Equally, invitation of more guest lecturers and scientists should be strongly encouraged. Finally, students should have a chance to give a seminar or conference presentation in English.

The internal quality assurance of the programme is one of the most important prerequisite to maintain sustainability. Therefore it is recommended that the programme management of *Materials Science and Semiconductor Physics* should build up a closed and detailed system of quality assurance. It should include all aspects of curriculum development, staff renewal and further training of the members, the material resources and all aspects of the study process. This quality assurance system should interlock in those of the Faculty of Physics and of the Vilnius University.

## V. GENERAL ASSESSMENT

The study programme *Materials Science and Semiconductor Physics* (state code – 621F30003) at Vilnius University 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	4
2.	Curriculum design	4
3.	Staff	4
4.	Material resources	4
5.	Study process and assessment (student admission, study process student support, achievement assessment)	4
6.	Programme management (programme administration, internal quality assurance)	3
	<b>Total:</b>	<b>23</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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Prof. habil. dr. Arvidas Galdikas  
Darius Eidukynas

## V. APIBENDRINAMASIS ĮVERTINIMAS

Vilniaus universiteto studijų programa *Medžiagotyra ir puslaidininkų fizika* (valstybinis kodas – 621F30003) vertinama **teigiamai**.

Eil. Nr.	Vertinimo sritis	Srities įvertinimas, balais*
1.	Programos tikslai ir numatomi studijų rezultatai	4
2.	Programos sandara	4
3.	Personalas	4
4.	Materialieji ištekliai	4
5.	Studijų eiga ir jos vertinimas	4
6.	Programos vadyba	3
	<b>Iš viso:</b>	<b>23</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

*Medžiagotyros ir puslaidininkų fizikos* studijų programa yra viena iš Vilniaus universiteto Fizikos fakulteto antrosios pakopos programų, svarbi ir turinti pasisekimą.

Ši studijų programa suteikia išsamių magistrinio lygio fizikos žinių, kurios puikiai pagrindžia fizikos magistro laipsnio suteikimą. Studijų programos sandara gerai apgalvota, programa atitinka tarptautinį mokslo lygį.

Medžiagotyrai ir puslaidininkų fizikai skirtos laboratorijos pastaraisiais metais buvo iš esmės patobulintos. Jos yra aukšto lygio netgi palyginus su tarptautine praktika. Dėstytojai kompetentingi ir motyvuoti. Programos sandara vertinama gerai, dalykai iš esmės nesikartoja, nėra pastebimų klaidų. Studentai motyvuoti ir stropūs, panašu, kad gerai nusimanantys ir gebantys dirbti mokslinių tyrimų grupėse.

Ekspertų grupė, nepaisant palankaus *Medžiagotyros ir puslaidininkų fizikos* antrosios pakopos programos vertinimo, jos vadovams pateikia keletą rekomendacijų.

Baigiamieji darbai dažniausiai yra tinkamo mokslinio lygio, kartais labai geri. Tačiau šių darbų struktūra neatitinka aukščiausių tarptautinių leidybos standartų. Dažnai nenurodyta šių darbų motyvacija / tikslai arba nepateiktos tikrosios išvados.

Atrodo, kad šią studijų programą įgyvendinančio personalo grupinė identifikacija silpna. Darbuotojai turėtų būti labiau sąmoningi, o ši sąmoningumą turėtų stiprinti programos vadovai. Darbuotojai turi būti motyvuoti, aktyviau dalyvauti rengiant šią programą ir ją įgyvendinant programą, žinoti, kuo jie tiesiogiai prisideda prie programos tikslų ir numatomų studijų rezultatų.

Įgyvendinant šią programą, reikėtų pasistengti padidinti studentų judumą ir keitimąsi darbuotojais. Judumas iš tikrųjų mažas. Yra įvairių priemonių šiai problemai išspręsti, pavyzdžiui, ERASMUS stipendijos, mokslinių tyrimų projektams skirtos lėšos ir institucijų dvišaliai susitarimai. Programos vadovai turėtų ištirti kitas galimas mažo judumo priežastis ir imtis priemonių judumui padidinti.

Programos vadovai turėtų dar labiau stengtis, kad dalykai būtų dėstomi anglų kalba. Tai turėtų būti daroma, kai studentų grupėje yra keletas užsieniečių. Šiuo atžvilgiu programa galėtų būti reklamuojama kaip galinti pasiūlyti paskaitas ir praktinį kursą anglų kalba. Be to, primygtinai raginama pasikviesti daugiau atvykstančiųjų dėstytojų ir mokslininkų. Pagaliau ir studentams turėtų būti suteikta galimybė pristatyti seminarą ar konferenciją anglų kalba.

Viena iš svarbiausių programos tvarumo išsaugojimo prielaidų yra jos vidinis kokybės užtikrinimas. Todėl rekomenduojama, kad *Medžiagotyros ir puslaidininkių fizikos* studijų programos vadovai sukurtų uždara ir išsamią kokybės užtikrinimo bei kokybės kontrolės sistemą. Ji turėtų apimti visus programos tobulinimo, personalo atnaujinimo ir tolesnio jų mokymo klausimus, materialiuosius išteklius ir visus kitus studijų proceso aspektus. Ši kokybės užtikrinimo sistema turėtų būti sujungta su Fizikos fakulteto ir Vilniaus universiteto sistemomis.

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### III. REKOMENDACIJOS

1. Įgyvendinant šią programą, reikėtų pasistengti padidinti judumą ir keitimąsi darbuotojais ir ypač studentais. Šiam tikslui galima pasinaudoti įvairiomis priemonėmis, pavyzdžiui, ERASMUS stipendijomis, mokslinių tyrimų projektams skiriamomis dotacijomis, dvišaliais institucijų susitarimais ir t. t.
2. Įgyvendinant šią programą turėtų būti ir toliau didinamos pastangos dėstyti dalykus anglų kalba. Tai turėtų būti daroma, kai studentų grupėje yra užsieniečių. Šiuo atžvilgiu programa galėtų būti reklamuojama kaip galinti pasiūlyti paskaitas ir praktinį kursą anglų kalba. Be to, primygtinai raginama pasikviesti daugiau atvykstančiųjų dėstytojų ir mokslininkų. Pagaliau ir studentams turėtų būti suteikta galimybė pristatyti seminarą ar konferenciją anglų kalba.
3. Viena iš svarbiausių programos tvarumo išsaugojimo prielaidų yra jos vidinis kokybės užtikrinimas. Todėl rekomenduojama, kad programos vadovai sukurtų uždara ir išsamią kokybės užtikrinimo ir kokybės kontrolės sistemą. Ji turėtų apimti visus programos tobulinimo, personalo atnaujinimo ir tolesnio jų mokymo klausimus, materialiuųjų išteklių peržiūrą ir visus kitus studijų proceso aspektus. Ši kokybės užtikrinimo sistema turėtų būti sujungta su Fizikos fakulteto ir Vilniaus universiteto sistemomis.
4. Daugiau dėmesio reikia skirti baigiamųjų darbų rašymui. Reikėtų geriau susipažinti, kaip pateikti rezultatus, tam tikslui rengiant papildomą kursą ir (arba) seminarą, skirtą šiai temai, ypač diplominio darbo formatui ir sandarai išaiškinti.