STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Kauno technologijos universiteto

STUDIJŲ PROGRAMOS *MEDICINOS FIZIKA* (*621B92002*)

VERTINIMO IŠVADOS

EVALUATION REPORT

OF *MEDICAL PHYSICS* (*621B92002*)

STUDY PROGRAMME

at Kaunas University of Technology

Grupės vadovas: Team leader:	Prof. dr. Aleksandar Jovanovic
Grupės nariai: Team members:	Prof. dr. Lajos Borbas
	Prof. dr. Dalia Giedrimienė
	Dr. Graham Gavin
	Doc. dr. Julius Griškevičius
	Birutė Lašaitė

Išvados parengtos anglų kalba
Report language - English

Vilnius
2014

DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	***Medicinos fizika***
Valstybinis kodas	621B92002
Studijų sritis	Biomedicinos mokslai
Studijų kryptis	Medicina ir sveikata
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	Medicinos fizikos magistras
Studijų programos įregistravimo data	2003-05-29

INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	***Medical physics***
State code	621B92002
Study area	Biomedical Sciences
Study field	Medicine and Health
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 Medical Physics
Date of registration of the study programme	29-05-2003

CONTENTS

I. INTRODUCTION

Programme evaluated

The programme evaluated is a second-cycle study programme in Medical Physics (hereinafter – MP) from Kaunas University of Technology (hereinafter – KTU), Lithuania. KTU is one of the largest universities in the Baltic States, providing studies at Bachelor, Master and Doctoral level. KTU consists of 13 faculties offering fields of study in engineering and technology, arts and humanities, economics and management. The faculties are further divided into 74 departments with specialist institutes and centres in Mechatronics, Information Microsystems and Nanotechnology and Biomedical Engineering for example.

The Medical Physics programme is carried out at Physics Department of the Faculty of Fundamental Sciences (hereinafter – FFS) in close collaboration with the Lithuanian University of Health Sciences (hereinafter – LUHS), University Hospital "Kauno Klinikos" and Kaunas Oncology Hospital, where several courses are delivered in clinical environment due to the specificity of the study programme.

The evaluated programme was registered in 2003 with the provided qualification "Master of Biophysics", however in year 2010 study programme was assigned new ISCED code and qualification of study programme graduates was changed to "Master of Medical Physics".

During this evaluation the Faculty of Fundamental Sciences was reorganized and became Faculty of Mathematics and Nature Sciences (from 1st of January 2014). However, this change is written in Lithuanian version of a KTU website (http://ktu.edu/mgmf/naujienos/matematikos-ir-gamtos-mokslu-fakultetas-pradeda-savo-veikla) and in the English version of the website there was still old title of the faculty (http://en.ktu.lt/content/faculty/faculty-fundamental-sciences).

Evaluation Team

The evaluation team was assembled in February-March 2014. The team leader is Prof. dr. Aleksandar Jovanovic, Vice-rector, University of Pristina Serbia. The other members of the evaluation team are: Prof. dr. Dalia Giedrimienė, University of Saint Joseph, CT, USA; Prof. Lajos Borbás, Budapest University Technology and Economics (BME), Hungary; Dr. Graham Gavin, Dublin Institute of Technology, Ireland; Dr. Julius Griškevičius, Associated Professor and Head of Department of Biomechanics, Vilnius Gediminas Technical University, Lithuania. The student team member was Birutė Lašaitė from Lithuanian Sports University.

The procedure of evaluation

After the establishment of the evaluation team the process of evaluation began with the Self-Evaluation Report and supporting documentation being made available to the expert team in March 2014. The members of team examined the Self-evaluation report and prepared a preliminary report, highlighting positive areas and indicating areas for clarification, problem questions or discussion points.

The experts were able to further evaluate the programme during a site-visit at Kaunas University of Technology on April 24th 2014. This on-site evaluation included meetings with programme leaders, management, teaching staff, current students, graduates and employers.

Following this the expert team held a group meeting to discuss the documented evidence and outcomes of site-visit and a draft evaluation report was prepared.

II. PROGRAMME ANALYSIS

1. Programme aims and learning outcomes

Human health is one of the main factors having impact on wellbeing of the society. Cancer, chronic and degenerative diseases are appointed as the most important challenges in the European framework programme for research and innovation. The field of medical physics is very important part of cancer treatment, developing new technologies, devices and methods for radiotherapy and nuclear medicine; therefore demand on medical physicists it is expected to grow in the nearest future.

The content of MP study programme at KTU, its objectives and learning outcomes are in line with the requirements for recognition of MP specialists in Lithuania. Radiation Protection Center of Lithuania has estimated required number of medical physicist to cover the needs of Lithuania is 119 (Annex 4.9 in Self-evaluation report provides copies of writing "Concerning the demand of medical physicists in Lithuania").

From the economical point of view having small groups (6-8 per group) of students it is risky and expensive, but on the other hand small groups allow achieving transfer of the highest quality of knowledge.

In Lithuania there are two universities – Kaunas University of Technology and Vilnius University (hereinafter – VU), which are carrying out Master of Science studies in Medical Physics. The main difference between these two study programmes is that study programme at KTU is more focused on ionizing radiation and its use in clinical and radiation protection practice, while study programme at VU has broader scope including nonionizing radiation, biological imaging and nanomedicine (SER, p. 6, §17). However, it must be pointed out, that MP programme at KTU is carried out successfully without breaks in students' enrolment through the years 2003 until now, while there was no enrolment in 2013 in MP programme at VU.

The aims of the MP study programme are to deepen student's competences gained during first cycle studies, to provide new knowledge and to develop additional skills (SER, p. 5, §10). Also, programme aims to prepare masters in medical physics who conform to the needs of labour market at national and international levels (SER, p. 10, §36). However, programme description does not clearly reflects for what kind of activity – scientific or practical, this MP study programme is oriented according to General Requirements for Master Study programmes defined by the Ministry of Education and Science of Lithuanian Republic (§5, §7 and §19 of the general requirements are referring, that the character or orientation of the programme must be clearly described in the description of the programme, and according to the aimed activity orientation specific requirements for teaching staff are described also, http://www3.lrs.lt/pls/inter2/dokpaieska.showdoc_l?p_id=374821). The programme aims and learning outcomes are publicly accessible via website (http://uais.cr.ktu.lt/plsql/mod_dest/stp_report_ects.card_ml?p_valkod=621B92002&p_year=2014&p_lang=LT). The information on the Internet is available in Lithuanian and in English, but it must be pointed out that English version of the information provided in some cases is not the most recent comparing to Lithuanian.

The learning outcomes of the programme are defined in line with the principles of international recommendations (SER, p. 9, §31) and in compliance with national regulations (http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=412604&p_query=&p_tr2=).Learning outcomes are divided into five categories: (1) knowledge and its application; (2) research skills; (3) subject-specific skills; (4) social skills; (5) personal skills. Each category is subdivided into outcome groups, numbering 7 (knowledge and its application), 5 (subject specific skills) and 4 (research, social and personal skills).

The SER does not reflect precisely the latest changes in the description of programme's learning outcomes, because experts found a mismatch between Learning Outcomes defined in SER and in publicly accessible description of the programme (http://ktu.edu/studijos), where one can find 6 categories of learning outcomes for the enrolment years 2011-2012 (http://uais.cr.ktu.lt/plsql/mod_dest/stp_report_ects.card_ml?p_valkod=621B92002&p_year=2012&p_lang=LT), but 5 categories in year 2013 and 2014 (http://uais.cr.ktu.lt/plsql/mod_dest/stp_report_ects.card_ml?p_valkod=621B92002&p_year=2014&p_lang=LT). However, for scientific oriented master programmes a classification with regard to Blooms taxonomy is established, which requires the classification of learning outcomes into six categories. Experts would recommend adding 6th category of learning outcomes, for example transferrable skills.

The second cycle study programme Medical Physics leads to the qualification Master of Medical Physics on the basis of the learning outcomes that are compatible with the qualification offered. In summary, the name of the programme, its learning outcomes, contents and the qualifications offered are compatible with each other. Obtained degree in Medical Physics allows for graduates to continue their studies at doctoral level.

2. Curriculum design

The curriculum design with respect to the ECTS volume and duration of the programme meets the legal requirements for Master's Degree Study as outlined in the General Requirements for Master Degree Study Programmes. Both the ECTS volume and duration of the programme are appropriate: volume of the study programme is 120 ECTS and duration is 2 years.

The programme has an even distribution of subjects over all semesters with respect to credits (30 ECTS per semester), with a good balance of theoretical (60 % taught modules) and scientific research subjects (40%). Total amount of hours devoted to students' individual work is 77% (SER, p. 14, §46).The volume of the Final Degree Project is 30 ECTS (requirement: not less than 30 credits) and Degree Project are based on independent applied research. The volume of independent work in the majority of the modules is more than 30% of the volume of each module (requirement: not less than 30% of the volume of every study subject), except in one module "Radiation Dosimetry" there is only 20% (16 hours of total 80, SER, Annex 4.1, p. 29-32).

The module structure is clear and gives clear overall description of the programme; link of each module with the learning outcomes has been considered and reflected in the module description. All learning outcomes are well-covered.

The overall curriculum is very focussed in the theoretical area of ionizing radiation equipment, imaging, signal processing. Experts would recommend further expanding theoretical area by increasing the content of non-ionizing radiation and awareness of broader medical

technologies. The overall content facilitates learning at a master's level with significant theoretical and analytical knowledge. Study programme committee follows the requirements for Master degree in medical physics approved by European Federation of Organisations for Medical Physics (IOMP) and harmonizes MP study programme structure with the IOMP curriculum (SER, p. 16, Table 2.6). This ensures that the MP study programme is aimed to be delivered at European level.

The programme, in addition to strong theoretical and analytical, content includes a number of more applied practical subjects. The major part of lectures in "Diagnostic Radiation Physics", "Radiation Therapy Physics", "Radiation dosimetry", "Applied Radionuclide Physics" and practical work is conducted in clinical environment.

Teaching methods include lectures, class exercises, laboratory classes and seminars. The ratio of lectures, practicals and laboratory work and independent study is good.

The overall scope of the programme is appropriate to ensure that the learning outcomes are of a suitable level and achievable within the 2 year time frame.

However, the programme has an uneven distribution of subjects over all semesters based on number of subjects per semester, i.e. 6 subjects in 1st semester, 5 subjects in 2nd semester, and 6 subjects in 3rd semester. According to the requirements of the Master studies programme approved by the Ministry of Education and Science of Lithuanian Republic, there must be taught max 5 subjects per semester (http://www3.lrs.lt/pls/inter2/dokpaieska.showdoc_l?p_id=374821, section III, paragraph 18). The structure of the programme must be adjusted so not to contradict the laws of Lithuanian Republic.

Small number of elective subjects (only 6 ECTS credits) should be increased to engage students in learning not directly related to their programme, for example promoting student's business and entrepreneurial activities.

3. Staff

The Medical Physics programme is carried out at Physics Department of the Faculty of Fundamental Sciences in close collaboration with the LUHS, University Hospital "Kauno Klinikos" and Kaunas Oncology Hospital. The programme meets the legal requirements that at least 20 % of the subjects shall be taught by full professors. 84% of the study programme is delivered by professors or associate professors. Total number of teachers involved in MP study programme is 13: five professors, five associated professors, and the rest are lectors (SER, p. 17, §61). The academic experience of professors and assoc. professors exceeds 10 years.

All academic staff on the programme is research active with a good record of publications in scientific journals and international conferences. Lecturers are publishing scientific papers in top international peer-reviewed journals, for example Radiation Protection Dosimetry, Radiation physics and Chemistry, Applied radiation and Isotopes and others; regularly attend a broad range conferences (SER, Annex 4.3). Throughout the 5 years period MP programme teaching staff published 36 papers in ISI Web of Science journals. University and national policy should continue to support teaching staff to continuously engage in research. This is of great benefit to students, in general, as they get to engage with high level research.

Through the years 2008-2013, lecturers of MP programme participated in various project works (total number of research projects 10, SER p. 17, §66), for example: Analysis of carbon nanostructures synthesized from unsaturated hydrocarbon plasma; Dose modelling in radiation

therapy for patient treatment using linear accelerator; Creation and Verification of Innovative Optical Components in Bio Adaptive Modified Polymers (BIONA) supported by Research Council of Lithuania; Development of the "Methodology for the optimization of patients exposure in digital X-ray diagnostic" and others.

Professional development of the lecturers is regulated by the KTU rules of qualification development and lecturers must at least once in five years undertake qualification development in various areas – teaching, research and practical activities. Only 1/3 of the MP programme staff (SER, p. 20, §79) has attended special courses focused on improvements of study module design and course delivering methods. Therefore experts would recommend that all teaching staff of MP programme would be encouraged to attend courses on modern pedagogical approaches, programme aims and curriculum design, including teaching and assessment methodologies, team and multidisciplinary work. This would be beneficial in delivering study programme in more student-oriented approach.

Three teachers are aged over 65 and 6 are aged 50-65. To smooth the problems related to exchange of retired highly qualified programme lecturers, Physics Department initiates well in advance the on-site trainings and follow up lectures for the new beginners of the MP programme, who must be prepared to overtake the responsibilities for the assigned study courses (SER, p. 20, §76).

In summary, the number and qualification of the teaching staff is adequate to provide the expected learning outcomes, also to secure research-based studies in various aspects of medical physics application in clinical and non-clinical environment.

4. Facilities and learning resources

Programme has an appropriate number of classrooms and laboratories (3 auditorium classes and 7 laboratories) for the delivery of the programme. The majority of the laboratories have at least 8 individual workplaces, this is good for small groups (from 6 to 8 students) like in MP programme. All classrooms were renovated during the last 8 years The classes and library are sufficiently equipped with the cable and wireless internet access, computers, video and audio equipment. Students can access to various ionizing and imaging equipment available at the site of clinical partner of the MP programme, for example: linear accelerators, X-ray imaging and therapy units, CT, MRI, SPECT and other specialized medical equipment.

Student may work independently at the Faculty library's reading room, with 27 workplaces and at least 10 are computerized. Central university library has more than 170 workplaces for students' work.

The library has a well-structured web page where a database of physical hard copies of books and journals can be searched. Also, the university is subscribed to over 50 online databases for electronic content such as e-journals and e-books. Students also can avail of access to other libraries via the Central Library where material can be requested. Locally departments maintain textbooks in specialised disciplines and these can be borrowed by students.

In summary, the infrastructure and teaching facilities are excellent, close collaboration with hospitals ensures delivery of practical skills at the highest level and this is one of the strongest points of the programme. It is important that continuous upgrading of facilities and literature and improvement is facilitated through funding and policy making.

The teaching and learning equipment (laboratory and computer equipment, consumables) are adequate both in size and quality to provide Master's study programme in Medical Physics. Overall impression of the facilities and learning resources is very pleasant and this can be used as an exceptional example of combining theoretical teaching with strong emphasis on practical skills.

5. Study process and student assessment

Admission to the programme is carried out in accordance with the requirements of second cycle studies at KTU. Admission is based on first cycle studies (weighting of 0.8) and also on an evaluation of scientific and other activities (weighting of 0.2); these include publications, conference programmes, documents of awards etc.. The basic requirements are a bachelor's qualification or equivalent in Physics, Biophysics and Engineering sciences. All admission policies are publicly available on the University website and admission publications. The number of MP programme applicants is slightly increasing (from 11 in 2009, to 22 in 2012 and 18 in 2013) and reaches 3 applicants per study place in 2013, and this is a good sign of popularity and necessity of this programme. Active participation of MP students in various conferences provides information about the research activities and so attracts more students from other universities. 5 students from MP took a part at the exhibition of young researchers „Technorama" organized at KTU every year.

Students enter the programme on state-funded and private (fee-paying) strands and the entry requirements to both are the same.

All students have access to academic support structures such as library services, a counsellor for studies and the Academic Advisory Centre. These can assist students with academic guidance or assist with issues arising out of their studies. There are also additional non-academic support services such as financial assistance, psychological or mental health counselling services, students union and wide range of sporting clubs and arts & cultural groups and a careers centre. Additional financial support is available through scholarships based on social, motivation or academic achievement. These scholarships are awarded at national and university level.

Students are integrated into the local scientific community, for example the presentation of the research results at an International Conference "Medical Physics in the Baltic States" is mandatory for second year MP students.

Opportunities for students' abroad studies (ERASMUS programme) are provided and well documented. KTU and the FFS are involved in the Erasmus programme and currently have bilateral agreements with 18 European Universities. Students have opportunities to travel and study as part of this programme or through other relationships with universities in Austria, where they can engage in short intensive courses. However, there were no outgoing students from MP programme in ERASMUS mobility until 2012, only 1 incoming student from Germany and this student was attending one of the meetings of current students with experts during the site visit. These are great relationships and should be encouraged further with funding and other resources.

The Final Degree Project is worth 30 ECTS, assigned to writing a master thesis, but also has three lead in Research Projects (Research Project 1 + Research Project 2 + Research Project 3; 18 ECTS) and students are choosing the direction of their possible research work in the first semester and work on their Research skills needed to successfully complete their Master thesis through all two years of studies.

The majority of modules on the programme involve a mix of theoretical and practical activities and as such assessment methodologies often include continuous assessment and end of semester exams. Students are only allowed to take an exam after they have successfully completed all the tasks of the semester. Module descriptors are also available on-line.

The process of study result assessment is transparent and well defined. The criteria of assessment are available at the study module descriptions and they are publicized at the start of the semester. The assessment of students' knowledge, abilities and skills is carried out by means of the ten-point system and the cumulative marking scheme, which includes colloquiums, seminars, group works, individual tasks and aims at stimulating good academic performance throughout the semester, not only during the sessions. If the student fails, he/she has an opportunity to retake exam twice until the end of the first week of the following semester and appeal results based on certain criteria.

Graduates of the MP programme have had good success in gaining employment in areas such as medical equipment development, clinical engineering, and service and support roles. 40% of graduates are employed in hospitals and clinics as medical physicists, 35% worked in health care system or as radiation protection officers. 4% of graduates continue their studies to third-cycle (SER, p. 29, §148, Annex 4.10).

On the other side, students are engaging with learning that is not explicitly recognised within the programme, in particular, writing research articles for scientific conferences etc. Although these are often based on required activities within the programme such as Research Projects, the panel recommends that these activities be formally recognised. Experts would recommend expand individual work tasks in each module of Research Project 1, 2 and 3 to more detailed formalization explicitly allocating certain amount of individual work hours addressing various scientific activities. At the moment the individual task in mentioned modules is very broad, i.e. "Course work". Dividing it into several certain tasks (like "Article" or similar) would benefit students' assessment procedure, a precise measure of learning outcomes achievement and better motivate students.

The structure of the Master thesis as described in SER (p. 15, §52) is not precisely followed by the graduates (experts were able to analyse examples of finished Master Theses during the site visit). The final work is focused more on practical task (SER, p. 25, §110) than on scientific research driven master thesis. The provided examples lack clearly distinguished Discussion section and for a thoroughly prepared scientific work the number of literature sources referenced in the thesis should be increased at least twice. Experts would recommend providing topics for possible master thesis during the first year of the study cycle, not at the end of third semester. This would allow students to prepare their research works more thoroughly.

6. Programme management

The programme has clear internal and external procedures for the evaluation and monitoring of the programme, continued improvement and compliance with best international practice. The implemented quality assurance system is based on the Standards and Guidelines for Quality Assurance in the European Higher Education Area. The programme is managed in accordance with KTU guidelines.

The MP programme is supervised by the Study Programme Committee whose members include the heads of the 3 departments of the Faculty, study programs coordinators, and students'

representatives. The MP programme has a co-ordinator who is tasked with overseeing the study programme and improvements together with the head of Physics Department.

There is a System of Internal Quality Assurance of Studies which includes self-monitoring of the programme, programme development, feedback from students and staff and subjects are reviewed annually.

Two level (University and Faculty) Qualification Commissions for Certification of Lecturers and Researchers and Contest Commission are appointed by the Rector's order and accomplish management of human recourses. Certification of lecturers is performed once per 5 years and is followed by the contest to occupy distinguished positions at the Department.

The students, lecturers and external social partners are also taking part in programme quality assessment and improvement. Students have their representatives in University Senate, Faculty Council and the Study Programme Committee, students can participate in questionnaire which is aimed to evaluate study module. They can express their ideas, objections or criticism at the round-table discussions organized by the faculty, whereby the students together with the teachers discuss study quality. Social partners (graduates of the KTU and employers) also take part in the programme quality assessment by participating in surveys, or providing personal offers to programme coordinators.

Despite the fact, that the process of study programme administration and its quality assessment is possible to monitor using internal KTU information system, i.e. there is a source to follow all latest normative documents concerning the organization of study programmes, the programme committee of MP failed to follow legal requirements for master studies as defined by the Ministry of Education and Science of Lithuanian Republic. These changes must have been incorporated immediately after the order was released and experts aim to provide strong signal of change and constant awareness, which is required in rapidly changing environment.

The quality assurance measures should be used to assist the strategic development of the curriculum according to the needs of changing world, like introduction of new approaches in the teaching process and changes in curriculum structure. Programme management should organize, support and encourage all teaching staff of MP study programme to take part in development and improvement of study programme curriculum and delivery methods, in order to ensure providing and achieving learning outcomes on quality-wise equally high level through all the modules of the programme. This is especially crucial, because only third of the MP programme teaching staff were participating in the pedagogical courses of teaching methods improvement; the remaining two thirds of the staff, the most of whom are involved in MP study programme only by delivering only one or two courses and with the least amount of contact hours in MP programme (32, SER, Annex 4.2, visit) did not attend the pedagogical trainings.

The outcomes of the former external evaluation of the MP study programme were used for the improvement of the programme, i.e. joint course "Fundamentals of Human Anatomy and Physiology" was prepared and included in to the programme, and laboratories were renewed and newly equipped with the modern teaching and research equipment.

III. RECOMMENDATIONS

1. The programme has an uneven distribution of subjects over all semesters based on number of subjects per semester. The structure of the programme modules must be reviewed and adjusted according to the requirements of the master studies programmes approved by the Ministry of Education and Science of Lithuanian Republic.

2. The character or orientation of the intended activity of the study programme (scientific or practical) must be clearly defined in programme description and corresponding requirements must be accounted while developing curriculum.
3. For scientific oriented master programmes, a classification with regard to Blooms taxonomy is established, which requires the classification of learning outcomes into six categories. Transferable Skills need to be included.
4. Small number of elective subjects (only 6 ECTS credits) should be increased to engage students in learning not directly related to their programme, for example, by promoting and supporting students' business and entrepreneurial activities. The content of non-ionising radiation and awareness of broader medical technologies should be increased.
5. Students are engaging with learning that is not explicitly recognised within the programme, in particular, writing research articles for scientific conferences etc. Although these are often based on required activities within the programme such as Research Projects, the panel recommends that these activities would be formally recognised and expanded more thoroughly in the module's individual work tasks.
6. Programme management should organize, support and encourage all teaching staff of MP study programme to take part in the development and improvement of study programme curriculum and delivery methods by applying modern pedagogical approaches, like teaching and assessment methodologies, team and multidisciplinary work, in order to ensure providing and achieving learning outcomes on quality-wise equally high level through all the modules of the programme.
7. No student from MP study programme has undertaken ERASMUS mobility programme. These are great relationships and should be encouraged further with funding and other resources. Continue to support knowledge in new technologies, quality assurance techniques and procedures. Support and increase European transfer and exchange of students.

IV. SUMMARY

The field of medical physics is very important part of cancer treatment, developing new technologies, devices and methods for radiotherapy and nuclear medicine. High popularity among the potential students, i.e. high enrolment competition on average 3 students per 1 state funded place requires more support from Lithuanian government to ensure answering the high demand of highly skilled medical physicists form the labour market.

Medical Physics (MP) studies at the Master Level in Lithuania are offered by KTU and VU. MP Study Programme at KTU aims to prepare masters in medical physics who conform to the needs of labour market at national and international levels and deepen student's competences gained during first cycle studies, to provide new knowledge on modern radiation physics, radiation measurements, imaging, dosimetry, radiation protection, development of practical skills to maintain medical equipment and technologies and to apply new scientific methods in the interdisciplinary research field.

The content of MP study programme, its objectives and study results are in line with the requirements for recognition of MP specialists in Lithuania. However, programme description does not clearly reflects for what kind of activity – scientific or practical, this MP study

programme is oriented according to General Requirements for Master Study programmes defined by the Ministry of Education and Science of Lithuanian Republic.

The learning outcomes of the programme are defined in line with the principles of international recommendations and in compliance with national regulations. However, for scientific oriented master programmes a classification with regard to Blooms taxonomy is established, which requires the classification of learning outcomes into six categories. Experts would recommend adding 6th category of learning outcomes, for example transferrable skills.

In summary, the name of the programme, its learning outcomes, contents and the qualifications offered are compatible with each other. Obtained degree in Medical Physics allows for graduates to continue their studies at doctoral level.

The curriculum design with respect to the ECTS volume (120 ECTS) and duration (2 years) of the programme meets the legal requirements for Master's Degree Study. The programme has an even distribution of subjects over all semesters with respect to credits (30 ECTS per semester). The programme is composed of modules (3-6 ECTS). The link of each module with the learning outcomes has been considered and clearly reflected in the module description. All learning outcomes are well-covered. The volume of the Final Degree Project is 30 ECTS. The volume of independent work in the majority of the modules is more than 30% of the volume of each module, except in one module "Radiation Dosimetry" where volume of independent work is only 20%. However, the programme has an uneven distribution of subjects over all semesters based on number of subjects per semester, i.e. 6 subjects in 1st semester, 5 subjects in 2nd semester, and 6 subjects in 3rd semester. Small number of elective subjects (only 6 ECTS credits) should be increased to engage students in learning not directly related to their programme, for example promoting student's business and entrepreneurial activities. Students are engaging with learning that is not explicitly recognised within the programme, in particular, writing research articles for scientific conferences. Experts would recommend expand individual work tasks in each module of Research Project 1, 2 and 3 to more detailed formalization explicitly allocating certain amount of individual work hours addressing various scientific activities. At the moment the individual task in mentioned modules is very broad, i.e. "Course work". Dividing it into several certain tasks (like "Article") would benefit students' assessment procedure, a precise measure of learning outcomes achievement and better motivate students. The final work is focused more on practical task than on scientific research driven master thesis. Experts would recommend providing topics for possible master thesis during the first year of the study cycle, not at the end of third semester. This would allow students to prepare their research works more thoroughly.

The overall scope of the programme is appropriate to ensure that the learning outcomes are of a suitable level and achievable within the 2 year time frame.

The Medical Physics programme is carried out at Physics Department of the Faculty of Fundamental Sciences (FFS) in close collaboration with the LUHS, University Hospital "Kauno Klinikos" and Kaunas Oncology Hospital. The programme meets the legal requirements that at least 20% of the subjects be taught by full professors. Total number of teachers involved in MP study programme is 13: five professors, five associated professors, and the rest are lectors. The academic experience of professors and assoc. professors exceeds 10 years. All academic staff on the programme is research active with a good record of publications in scientific journals and international conferences. Throughout the 5 years period MP programme teaching staff published 36 papers in ISI Web of Science journals. The number and qualification of the

teaching staff is adequate to provide the expected learning outcomes, also to secure research-based studies in various aspects of medical physics application in clinical and non-clinical environment.

Programme has an appropriate number of classrooms and laboratories (3 auditorium classes and 7 laboratories) for the delivery of the programme. The majority of the laboratories have at least 8 individual workplaces, this is sufficient for small groups (from 6 to 8 students) like in MP programme. The classes and library are sufficiently equipped with the cable and wireless internet access, computers, video and audio equipment. Students can access to various modern ionizing and imaging equipment available at the site of clinical partner of the MP programme.

The infrastructure and teaching facilities are excellent, close collaboration with hospitals ensures delivery of practical skills at the highest level and the programme and its staff are to be commended on a very good applicable programme providing a great learning experience for students. The teaching and learning equipment are adequate both in size and quality to provide Master's study programme in Medical Physics.

Admission to the programme is carried out in accordance with the requirements (bachelor's qualification or equivalent in Physics, Biophysics and Engineering sciences) of second cycle studies at KTU. All admission policies are publicly available on the University website and admission publications. The number of MP programme applicants is slightly increasing (from 11 in 2009, to 22 in 2012 and 18 in 2013) and reaches 3 applicants per study place in 2013. Active participation of MP students in various conferences provides information about the research activities and so attracts more students from other universities. Students are integrated into the local scientific community, for example the presentation of the research results at an International Conference "Medical Physics in the Baltic States" is mandatory for second year MP students.

No student from MP study programme has undertaken ERASMUS mobility programme, only one incoming student. These are great relationships and should be encouraged further with funding and other resources.

The KTU student and administration institutions take care for the students' sport, culture activities and social life. The assessment of students' knowledge, abilities and skills is carried out by means of the ten-point system and the cumulative marking scheme, which includes colloquiums, seminars, group works, individual tasks and aims at stimulating good academic performance throughout the semester, not only during the sessions. Graduates of the MP programme have had good success in gaining employment in areas such as medical equipment development, clinical engineering, and service and support roles. 40% of graduates are employed in hospitals and clinics as medical physicists, 35% worked in health care system or as radiation protection officers. 4% of graduates continue their studies to third-cycle

The quality assurance measures should be used to assist the strategic development of the curriculum according to the needs of changing world, like introduction of new approaches in the teaching process and changes in curriculum structure. In order to ensure providing and achieving programme's learning outcomes on quality-wise equally high level through all the modules of the programme, programme management should be more active in promoting, supporting and encouraging all teaching staff of MP study programme to be involved in development and improvement of study programme curriculum and delivery methods.

The learning outcomes and curriculum design with respect of the structure of the programme modules must be reviewed and adjusted according to the requirements of the master studies programs approved by the Ministry of Education and Science of Lithuanian Republic.

V. GENERAL ASSESSMENT

The study programme Medical physics (state code – 621B92002) 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	2
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)	2
	Total:	**17**

*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. Aleksandar Jovanovic
Grupės nariai: Team members:	Prof. dr. Lajos Borbas
	Prof. dr. Dalia Giedrimienė
	Dr. Graham Gavin
	Doc. dr. Julius Griškevičius
	Birutė Lašaitė

<...>

V. APIBENDRINAMASIS ĮVERTINIMAS

Kauno technologijos universiteto studijų programa *Medicinos fizika* (valstybinis kodas – 621B92002) vertinama teigiamai.

Eil. Nr.	Vertinimo sritis	Srities įvertinimas, balais*
1.	Programos tikslai ir numatomi studijų rezultatai	3
2.	Programos sandara	2
3.	Personalas	3
4.	Materialieji ištekliai	4
5.	Studijų eiga ir jos vertinimas	3
6.	Programos vadyba	2
	Iš viso:	**17**

* 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

Medicinos fizikos sritis – labai svarbi gydant vėžį, kuriant naująsias radioterapijos ir branduolinės medicinos technologijas, prietaisus ir metodus. Didelis studijų programos populiarumas tarp potencialių studentų, t. y. didelė konkurencija tarp stojančiųjų (vidutiniškai trys studentai į vieną valstybės finansuojamą vietą) reiškia, kad Lietuvos vyriausybė turėtų teikti didesnę paramą, jog būtų patenkinta didžiulė aukštos kvalifikacijos medicinos fizikų darbo rinkos paklausa.

Medicinos fizikos (toliau – MF) magistratūros studijas Lietuvoje siūlo KTU ir VU. KTU MF studijų programoje rengiami medicinos fizikos magistrai, atitinka darbo rinkos poreikius nacionaliniu ir tarptautiniu lygmeniu. Šioje studijų programoje taip pat sustiprinamos studentų kompetencijos, įgytos per pirmąją studijų pakopą. Be to, studentai gauna naujų žinių apie šiuolaikinę radiacinę fiziką, radiacijos matavimus, vaizdavimą, dozimetriją, radiacinę saugą, praktinių gebėjimų ugdymą medicininei įrangai ir technologijoms prižiūrėti, taip pat mokomi, kaip pritaikyti naujus mokslinius metodus tarpdisciplininėje mokslinių tyrimų srityje.

MF studijų programos turinys, jos tikslai ir studijų rezultatai atitinka medicinos fizikos specialistų pripažinimo Lietuvoje reikalavimus. Vis dėlto programos aprašyme nėra aiškiai nurodyta, kokios pakraipos (mokslinės ar praktinės) yra ši MF studijų programa, atsižvelgiant į

Lietuvos Respublikos švietimo ir mokslo ministerijos patvirtintus magistratūros studijų programai taikomus bendruosius reikalavimus.

Programos studijų rezultatai apibrėžti pagal tarptautinių rekomendacijų principus ir vadovaujantis nacionaliniais teisės aktais. Vis dėlto mokslinės pakraipos magistratūros programoms taikoma Bloomo taksonomija, pagal kurią studijų rezultatai skirstomi į šešias kategorijas. Ekspertai rekomenduotų pridėti šeštą mokymosi rezultatų kategoriją – pavyzdžiui, perkeliamuosius gebėjimus.

Apibendrinant, programos pavadinimas, jos studijų rezultatai, turinys ir siūloma kvalifikacija dera tarpusavyje. Įgytas mokslinis laipsnis medicinos fizikos srityje suteikia galimybę studentams siekti trečiosios pakopos studijų.

Studijų programos apimtis (120 ECTS) ir trukmė (2 metai) atitinka magistratūros studijų programai taikomus teisinius reikalavimus. Kreditų skaičius visuose semestruose išdėstytas nuosekliai (vienam semestrui tenka 30 ECTS). Programą sudaro moduliai (3–6 ECTS). Kiekvieno modulio sąsaja su studijų rezultatais gerai apgalvota ir atspindėta modulio aprašyme. Visų studijų rezultatų siekiama tinkamai. Baigiamojo darbo projektui skiriama 30 ECTS. Daugelyje modulių savarankiškas darbas siekia daugiau kaip 30 proc., išskyrus vieną modulį – „Radiacijos dozimetrija“, per kurį savarankiškas darbas sudaro tik 20 proc. visų studijų. Vis dėlto dalykai nėra tolygiai paskirstyti pagal semestrus: pavyzdžiui, pirmame semestre – 6 dalykai, antrame semestre – 5 dalykai, trečiame semestre – 6 dalykai. Reikėtų padidinti pasirenkamųjų dalykų skaičių (tik 6 ECTS kreditai), kad studentai mokytųsi ir netiesiogiai su jų programa susijusių dalykų, pavyzdžiui, verslo ir verslumo. Studentai mokosi dalykų, kurie nėra aiškiai pripažįstami pagal programą: pavyzdžiui, jie rašo mokslinių tyrimų straipsnius mokslinėms konferencijoms ir pan. Ekspertai rekomenduotų išplėsti savarankiško darbo užduotis pagal kiekvieno modulio 1, 2 ir 3 mokslinio tyrimo projektą ir aiškiai formalizuoti tam tikrą mokslinei veiklai skirtą savarankiško darbo kiekį. Šiuo metu moduliuose savarankiškos užduotys minimos labai plačiai, pvz., „Studijų darbas“. Paskirsčius jį į keletą atskirų užduočių (pavyzdžiui, „straipsnius“), būtų lengviau vertinti studentus, tiksliau išmatuoti studijų rezultatus ir geriau motyvuoti studentus. Baigiamasis darbas labiau sutelkiamas į praktines užduotis, o ne į moksliniais tyrimais pagrįstą magistro darbą. Ekspertai rekomenduotų magistro darbo temas siūlyti per pirmus studijų programos metus, o ne trečio semestro pabaigoje. Tada studentai galėtų išsamiau pasiruošti savo moksliniam darbui.

Studijų programos apimtis tinkama, siekiant užtikrinti, kad būtų pasiekti tinkamo lygio studijų rezultatai per dvejų metų laikotarpį.

Studijų programa MF vykdoma KTU Fundamentaliųjų mokslų fakulteto Fizikos katedroje, glaudžiai bendradarbiaujant su Lietuvos sveikatos mokslų universitetu, universitetine ligonine „Kauno klinikos“ ir Kauno onkologine ligonine. Programa atitinka teisinius reikalavimus, kad ne mažiau kaip 20 proc. dalykų dėstytų profesoriai, o kitus – lektoriai. Iš viso MF studijų programoje dirba 13 dėstytojų: penki profesoriai, penki docentai ir trys lektoriai. Akademinė profesorių ir docentų patirtis – daugiau nei 10 metų. Visas akademinis personalas aktyviai atlieka mokslinius tyrimus ir daug spausdina savo darbų moksliniuose žurnaluose bei pristato tarptautinių konferencijų metu. Per penkerių metų laikotarpį MF programos dėstytojai publikavo 36 savo darbus ISI *Web of Science* moksliniuose žurnaluose. Dėstytojų skaičius ir kvalifikacija tinkama, siekiant užsibrėžtų studijų rezultatų, taip pat norint užtikrinti, kad studijos būtų paremtos moksliniais tyrimais, atsižvelgiant į įvairiausius medicinos fizikos pritaikymo klinikinėje ir neklinikinėje aplinkoje aspektus.

Studijų programoje numatytas pakankamas auditorijų ir laboratorijų skaičius (3 auditorijos ir 7 laboratorijos). Daugumoje laboratorijų yra ne mažiau kaip 8 atskiros darbo vietos, kurių užtenka, kai pagal tokią kaip MF programą dirbama mažose grupėse (nuo 6 iki 8 studentų). Auditorijos ir biblioteka yra pakankamai aprūpinta kabeliniu ir bevieliu internetiniu ryšiu, kompiuteriais, vaizdo ir garso įranga. Studentai gali naudotis įvairia šiuolaikine jonizacijos ir vaizdavimo įranga, kurią turi ligoninė – MF programos partnerė.

Infrastruktūra ir mokymo patalpos bei įranga puikios. Glaudžiai bendradarbiaujant su ligoninėmis užtikrinama, kad būtų įgyjami aukščiausio lygio praktiniai gebėjimai. Reikėtų pagirti personalą dėl labai gerai taikomos programos, kuri padeda studentams mokytis praktiškai. Mokymo ir mokymosi įrangos dydis bei kokybė atitinka Medicinos fizikos magistratūros studijų programos reikalavimus.

Studijuoti programoje priimama, atsižvelgiant į antrosios pakopos studijų (bakalauro ar jam prilyginto kvalifikacinio laipsnio fizikos, biofizikos ar inžinerijos mokslų srityje) KTU reikalavimus.

Visos priėmimo taisyklės skelbiamos viešai universiteto tinklalapyje ir stojimo leidiniuose. Norinčiųjų studijuoti pagal MF programą po truputį daugėja (2009 m. – 11, 2012 m. – 22, 2013 m. – 18). 2013 m. į vieną vietą buvo 3 norintieji. Aktyviai įvairiose konferencijose dalyvaujantys MF studentai teikia informaciją apie mokslinių tyrimų veiklą ir pritraukia daugiau studentų iš kitų universitetų. Studentai integruojami į vietos mokslininkų bendruomenę. Pavyzdžiui, antrų metų MF studentams privaloma pristatyti mokslinių tyrimų rezultatus per tarptautinę konferenciją „Medicinos fizika Baltijos valstybėse“.

Nė vienas MF studijų programos studentas nėra išvykęs pagal *Erasmus* judumo programą. Joje dalyvavo tik vienas atvykęs studentas. Pagal šią programą užmezgami puikūs santykiai ir juos reikėtų puoselėti, pasitelkiant finansavimą ir kitus išteklius.

KTU studentų atstovybė ir administracija rūpinasi sporto, kultūrine ir socialinio gyvenimo veikla. Studentų žinios, gebėjimai ir mokėjimai vertinami naudojant dešimties balų sistemą ir kaupiamąją vertinimo sistemą, apimančią kolokviumus, seminarus, grupinį darbą, savarankiškas užduotis. Naudojant kaupiamąją vertinimo sistemą siekiama, kad studentai gerai mokytųsi viso semestro, o ne tik sesijų metu. MF studijų programos absolventai sėkmingai įsidarbina tokiose srityse kaip medicinos įrangos kūrimas, klinikinė inžinerija, ten dirba asistentais ir pagalbininkais. 40 proc. absolventų dirba ligoninėse ir klinikose medicinos fizikais, 35 proc. sveikatos priežiūros sistemoje arba radiacijos saugos pareigūnais. 4 proc. absolventų toliau tęsia trečiosios pakopos studijas.

Reikėtų panaudoti kokybės užtikrinimo priemones, kad mokymo programa būtų strategiškai vystoma pagal besikeičiančio pasaulio poreikius ir kad mokymo procesas apimtų naujus metodus. Siekiant užtikrinti aukštą puikią visų modulių kokybę atsižvelgiant į studijų programos tikslus, programos rengėjai turėtų aktyviau skatinti, remti ir drąsinti MF studijų programos dėstytojus dalyvauti rengiant ir tobulinant studijų programos sandarą ir jos įgyvendinimo metodus.

Studijų rezultatai ir programos sandara turėtų būti peržiūrėta, atsižvelgiant į programos modulius ir Lietuvos Respublikos švietimo ir mokslo ministerijos patvirtintus magistratūros studijų programos reikalavimus.

III. REKOMENDACIJOS

1. Studijų programoje dalykai yra paskirstyti nevienodai pagal vienam semestrui tenkantį dalykų skaičių. Reikia peržiūrėti programos modulių struktūrą ir ją pritaikyti prie Lietuvos Respublikos švietimo ir mokslo ministerijos patvirtintų magistratūros studijų programų reikalavimų.
2. Programos aprašyme būtina aiškiai apibrėžti planuojamos studijų programos veiklos pobūdį ar pakraipą (mokslinė ar praktinė), o rengiant mokymo programą būtina numatyti atitinkamus reikalavimus.
3. Mokslinės pakraipos magistratūros programoms numatomas klasifikavimas pagal Bloomo taksonomiją, o tai reiškia studijų rezultatų paskirstymą pagal šešias kategorijas. Reikėtų įtraukti perkeliamuosius gebėjimus.
4. Reikėtų padidinti mažą pasirenkamųjų dalykų skaičių (dabar tik 6 ECTS kreditai), kad studentai mokytųsi dalykų, tiesiogiai nesusijusių su jų programa, pavyzdžiui, skatinančių ir remiančių studentų verslą ir verslumą. Reikėtų papildyti programos turinį nejonizuojančiosios spinduliuotės tema ir žiniomis apie platesnio pobūdžio medicinos technologijas.
5. Studentai mokosi dalykų, kurie nėra aiškiai užskaitomi programoje: pavyzdžiui, jie rašo mokslinių tyrimų straipsnius mokslinėms konferencijoms ir pan. Nors tokia veikla dažnai būtina pagal programą, kaip antai vykdant mokslinių tyrimų projektus, vis dėlto ekspertai rekomenduoja šią veiklą formalizuoti ir įtraukti kaip savarankiškas modulių užduotis.
6. Programos rengėjai turėtų pakviesti, paremti ir paskatinti studijų programos dėstytojus dalyvauti rengiant ir tobulinant studijų programą ir jos įgyvendinimą, taikant šiuolaikinius pedagogikos metodus, kaip antai mokymo ir vertinimo metodologiją, komandinį ir daugiadisciplininį darbą. Taip užtikrinama, kad studijų rezultatai būtų numatyti ir jų būtų siekiama aukščiausiu lygmeniu įgyvendinant visus programos modulius.
7. Nė vienas iš studijų programos Medicinos fizika studentų nėra dalyvavęs *Erasmus* judumo programoje. Pagal ją užmezgami puikūs santykiai ir juos reikėtų puoselėti, pasitelkiant finansavimą ir kitus išteklius. Reikėtų ir toliau skatinti siekti žinių naujų technologijų, kokybės užtikrinimo metodų ir procedūrų srityje. Reikėtų remti ir didinti Europos studentų perkėlimą ir mainus.

<…>
