



STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Kauno technologijos universiteto  
**STUDIJŲ PROGRAMOS TAIKOMOJI MATEMATIKA**  
*(valstybinis kodas - 621G10003)*  
**VERTINIMO IŠVADOS**

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**EVALUATION REPORT**  
**OF APPLIED MATHEMATICS** *(state code -621G10003)*  
**STUDY PROGRAMME**  
at Kaunas University of Technology

**Experts' team:**

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2. **Prof. Neda Bokan,** *academic,*
3. **Assoc. Prof. Ants Aasma,** *academic,*
4. **Mr. Marijus Mikalauskas,** *representative of social partners,*
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**Evaluation coordinator -**

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Išvados parengtos anglų kalba  
Report language – English

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## DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	<i>Taikomoji matematika</i>
Valstybinis kodas	621G10003
Studijų sritis	Fiziniai mokslai
Studijų kryptis	Matematika
Studijų programos rūšis	Universitetinė studijos
Studijų pakopa	Antroji
Studijų forma (trukmė metais)	Nuolatinė (2)
Studijų programos apimtis kreditais	120
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Matematikos magistras
Studijų programos įregistravimo data	2011-11-23

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## INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	<i>Applied mathematics</i>
State code	621G10003
Study area	Physical sciences
Study field	Mathematics
Type of the study programme	University Studies
Study cycle	Second
Study mode (length in years)	Full-time (2)
Volume of the study programme in credits	120
Degree and (or) professional qualifications awarded	Master of Mathematics
Date of registration of the study programme	2011-11-23

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The Centre for Quality Assessment in Higher Education

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## **I. INTRODUCTION**

### ***1.1. Background of the evaluation process***

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

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

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

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

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

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

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

### ***1.2. General***

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

No.	Name of the document
1.	Guidelines for study programme improvement
2.	Marketing material

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

The Applied Mathematics Master Programme in the field of Mathematics is carried out by the Faculty of Mathematics and Natural Sciences, Kaunas University of Technology. The Expert Team visited the Faculty on May 9-10th. First, the Expert Team met the administrative staff of

the Faculty. Next, at the meeting with staff members responsible for preparation of the Self-assessment report the Expert Team was given answers to the questions concerning less covered in the Self-assessment report issues. After that, a meeting with members of teaching staff took place. The Expert Team had possibility to observe various study support services (class rooms, computer services, library), as well as to familiarize with students' final thesis work. The Expert Team conducted also interviews with students. The Expert Team was familiarized with students' attitude towards the study programme. The meeting was carried out in an active and constructive atmosphere. The students expressed positive as well as critical opinions about the programme. In the following, the findings of the Expert Team are outlined. The Self-assessment report submitted by the Faculty, the observations made at the time of the visit, and the supplementary material received during the visit form the basis of these assessments.

#### **1.4. The Review Team**

The review team was completed according *Description of experts' recruitment*, approved by order No. V-41 of Acting Director of the Centre for Quality Assessment in Higher Education. The Review Visit to HEI was conducted by the team on 09 May, 2017.

1. **Prof. Miklós Hoffmann (team leader)**, *Full Professor, Head of institute of mathematics and Computer Science, Eszterhazy Karoly University, Hungary;*
2. **Prof. Neda Bokan**, *Former Professor of the University of Belgrade, Serbia;*
3. **Assoc. Prof. Ants Aasma**, *Associate Professor, Department of Mathematics and Finance , Tallinn University, Estonia;*
4. **Mr. Marijus Mikalauskas**, *CEO of insurance company "Būsto paskolų draudimas";*
5. **Mr. Henrikas Vaickus**, *student of Vilnius University study programme Physics of Energy.*

**Evaluation coordinator – Mr. Pranas Stankus.**

## **II. PROGRAMME ANALYSIS**

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

The Applied Mathematics Master Programme in the field of Mathematics is carried out by the Faculty of Mathematics and Natural Sciences, Kaunas University of Technology. The declared programme objectives and implementation are clearly defined and fully in line with European and Lithuanian higher education recommendations, standards and legal requirements. The objectives perfectly fit the mission, operational objectives and strategy of the Kaunas University of Technology. The title of the programme Applied Mathematics well reflects the

goals of the programme. The review team acknowledges the fact that the title of the degree awarded is still „Master of Mathematics” instead of Master of Applied Mathematics, due to national legislations, which are currently under revision.

The Master is aiming at improving student’s competences gained during the first cycle study programme Applied Mathematics BSc, including modelling principles and their application possibilities in technological, physical, economical, medical and sociological sciences; financial and actuarial mathematics theory and its application for modelling financial markets; reliability theory and its application; statistical analysis methods of multidimensional data.

The intended learning outcomes of the Programme are well presented in the SER, and are publicly announced (website, marketing material etc.), which is an asset. These objectives correspond with Dublin descriptors and cover scientific and soft skills as well. According to the formulated learning outcomes of the Programme students are supposed to obtain knowledge and understanding of the basic concepts, definitions and proofs from major areas of mathematics and the ability to apply them to the solution of theoretical and real-life problems; have knowledge and understanding of a range of mathematical methods used to develop and analyse mathematical models; have knowledge of the main numerical methods; have knowledge and understanding of the theory of algorithms and programming and further ICT tools. In addition, soft skills such as research social abilities and personal abilities are included in the list.

Although it is declared that contacts with representatives of some companies are in place, it could be even better structured beside occasional meetings how and when industrial and further non-educational partners can provide regular feedback and support to continuously improve the content of the Programme. It is of central importance in case of applied sciences. Since the Programme possesses several industrial partners, the introduction of internships could be an asset to further improve the applied knowledge of students. This is important from the perspective of future programme development and programme management

The learning outcomes are well assigned with modules and courses, which is credible. There are two specializations in this Programme: after finishing the core subjects one can either choose Module of Data Mining or Module of Financial Mathematics. It is not clearly stated in the description of the programme if these modules have some entrance requirements (notably from BSc level). The description of the Programme should pay more attention to the distinction between these two paths, also at the level of learning outcomes gained by core subjects and by elective modules. It is not fully clearly explained in the programme description, if all the planned outcomes are gained even independently of the selected module. However the review team believes this is a minor issue which should be resolved but does not affect the quality of learning

outcomes of the programme. This is considered rather as a mean of structuring and presenting two specialisations. Beside the degree awarded, a diploma supplement with the description of the elective module part is attached to the diploma, which is a plus in this regard.

## ***2.2. Curriculum design***

The structure and volume of this study programme corresponds to the General Requirements for Master's Degree Study Programmes, the order of the Minister of Education and Science of the Republic of Lithuania, No. V-826, 03 June 2010. It has full time 2 years form. The study programme scope is 120 ECTS. The core and compulsory subjects of study field make 60 ECTS. In order to provide students with the possibilities of deepening their knowledge in application of mathematics in computer science and business, the elective study subjects are envisaged. 30 ECTS are given for the optional courses. Three research projects (18 ECTS) are foreseen in the programme for research working abilities training. 30 ECTS are allocated for Final Degree project preparation and its defence. Such programme structure and indicated number of credits is appropriate for students to achieve successfully the objectives of the studies.

Student's workload is determined in accordance with KTU temporary academic regulation. By this regulation 586 or 618 hours depending on elective chosen (36.6% or 38.6%) are appointed for contact hours at the study programme, 1014 or 982 hours (63.4% or 61.4%) for students' individual work. Individual work during Research Projects 1, 2, 3 and Final Degree Project consists of 480 and 800 hours respectively. Therefore the review team concludes the ratio of compulsory, alternative and optional subjects are well chosen to allow successful achievement of learning outcomes.

According to SER (pg. 53.) starting with 2016 at Kaunas University of Technology, certain master's level study programme provide the students with the possibility to apply competence based study model (MA+). Students individually select desired competence comprised of 18 ECTS instead of elective courses. Thus, a student centred learning approach is applied. During the meeting with self-assessment group the review team learned that the idea of M+ study model is 10 years old and competences block involves: leadership, entrepreneurship, and project management with their corresponding courses. This model has started this academic year and 6 out of 10 students have chosen this model. However, the teaching staff emphasized there exist some difficulties in the conducting of this master study model from the teaching staff perspective which is covered partially by inviting people from industry to teach part of courses. Students' representatives informed the review team that they are not well informed about this model M+. Therefore the review team supports this idea and recommends the continual analysis

to achieve an appropriate quality with benefit for graduates and society as well as a proper promotion of this model among students.

Subjects of the master study programme Applied Mathematics are taught in a consistent manner. Description of study subjects is really well organized. It involves all details (prerequisites, course learning outcomes, programme learning outcomes, teaching/learning methods, assessment methods, etc.) important for acquiring of the aim of subjects separately as well as of the study programme at all. However, analysing the description of some study subjects one can survey some areas of improvement. The syllabus of Nonlinear Dynamical Models is of very high level, good introduction for a research, but involves sections and themes: Invariant manifolds, Central manifolds and their existence conditions which are difficult to understand as the notion of manifold is not known to students taking into consideration the study plan of the bachelor study programme Applied Mathematics and other courses in this master study programme. Prerequisites for some courses might be better to formulate (instead Informatics for Data Mining Methods and Software, it would be better to write more precisely which subjects from the field of informatics is requisite, etc.).

The content of subjects (modules) corresponds to the type and cycle of studies according the Mathematics Study Field Description of the Requirements on the Degree Granting for the Second Cycle and Full Time Study Programs. The basis of Programme consists of compulsory courses: Algebraic Systems, Nonlinear Dynamical Models, Multivariate Statistical Analysis, Theory of Reliability, Stochastic Programming, Combinatorial Optimization, and Cryptographic Systems. There exist two elective modules groups: Data Mining and Financial Mathematics. Both modules enable students to acquire deeper knowledge of mathematics allowing understanding and mastering subjects.

The content of subjects (modules) and study methods enable to achieve the intended learning outcomes. We learned that students of this programme are capable to conduct the research in some fields, e.g. cryptography, using the number theory and to prepare papers, presented in the students conferences and published in the scientific journals. Students' representatives emphasized a good communication with research groups in cryptography, non-linear dynamics and other to introduce themselves in the research. Master theses are connected with real problems considering in companies and one representative of company is the committee member for the master thesis defence. Hence the review team concludes the programme Applied Mathematics is structured in such a way that all the study modules match the aim of the Programme and helps to achieve the research abilities as well as other learning outcomes on the level of the Programme. Various teaching/learning methods, including course materials access through Moodle for majority of courses are used.



The study programme scope is sufficient to achieve the learning outcomes. In this spirit the well-chosen subjects, their content, teaching/learning methods, assessment methods, etc. play an important role as well as the proper distribution of credits.

The content of the programme corresponds to the latest academic and technological achievements. To achieve this aim study subjects and their content are regularly changed according to progress in the development of mathematics and proper applications in informatics and economics. This was also proved during the visit.

### ***2.3. Teaching staff***

In total there are 12 lecturers affiliated with the Programme, besides 11 lecturers as full time employees at KTU. The academic staff, working in the Programme, consists of 6 professors, 5 associate professors and 1 lecturer (with PhD). Half of teaching team members are older than 62 years old. So the age distribution of the academic staff of the program will see the replacement of several high qualified professors and associated professors within a few years. This will provide an opportunity to attract younger academics with new research competences and new ideas for teaching and learning to the Programme.

30.2 % of study subjects are given by full time professors (no less than 20% required), all study subjects are given by scientists. The study programme to a great extent corresponds to the research interests of the teaching staff (mathematical modelling, financial modelling, operations research, mathematical analysis, differential equations, numerical analysis, probability theory and statistics, time series analysis, complex systems, computer science and information systems, software engineering, industrial mathematics). The requirement not less than 80% of the study subjects to be given by teachers, who perform research in the field of taught subject, is fulfilled, since 85 % of study subjects are delivered by the professors and associated professors that do the research work, projects and write scientific articles in the fields of delivered study modules.

The academic staff is highly qualified and competent. During the assessment period, lecturers have published many scientific publications and participate 25 international conferences, and research traineeships and international exchange programs. 6 lecturers working at the study programme took part at the scientific internships and international exchange programs. All members of teaching staff participated in various activities to raise their teaching skills and professional qualification. Lecturers use traineeship possibilities at foreign studies and research institution, possibility to work of associated researcher at foreign studies and research

institution. So the qualification of the current academic staff serves well for achievement all the aims and learning outcomes set for the Programme, and surely meet the legal requirements.

#### ***2.4. Facilities and learning resources***

The Faculty of Mathematics and Natural Sciences has a sufficient number of classrooms and laboratories for the study Programme. The same material resources are used by bachelor programme in Mathematics. The premises used by the studies are adequate both as to the size and as to the quality. The academic premises generally conform to the requirements of occupational safety and hygiene. Regarding smaller sizes of students in master programme the classrooms are more suitable for group work.

All teaching workplaces are equipped in appropriate level: auditoriums repaired during the last 6 years, computer classrooms renewed every 5-6 years (part of them renewed in year 2016), equipped by video and audio equipment, wireless internet access. The various software and programming tools used in the learning process are adequate and sufficient. During the visit students did not express any complaints regarding the material resources.

As the master students have considerably higher amount of independent work, the library and other premises serves well for such work. During our visit to the library, the reading room was rather fully occupied by the students working with their laptops rather than using the literature. The library has the contemporary electronic catalogue with many necessary scientific databases present. The students informed review panel that all necessary information for their independent work is well presented; the Moodle platform is well established and intensively used by the students.

The teaching materials and accessibility to the students are suitable. Moodle learning environment is used for this purpose. The review team had a chance to visit distance learning laboratory which is beneficial.

There is no obligatory internship in the program. Student's voluntary can use the Erasmus+ program for summer practice or they can participate individually in Lithuanian Science Council organized competitions for students' scientific practice.

#### ***2.5. Study process and students' performance assessment***

Entrance requirements are well-founded (internet page of University and annual information publications) and consistent, there is detailed curriculum available for applicants. Admission procedure to the second cycle study programme is organised by the faculty level

admission commission, which ranks applicants according to the competitive points system. The competitive marks are composed based on grades from the first cycle study programme (weight factor 0,7), grades based on research activities (weight factor 0,2) and motivation (weight factor 0,1). The possibility of appellations and the supplementary admission are foreseen. Consequently, the admission process and requirements are clear, consistent and transparent. The average competitive scores are stable (around 5,7 annually), the lowest points of admitted students are relatively high (approximately 4,9 in last five years). However, the highest point are decreasing (6,67 in 2012, 9,8 in 2013, 9,91 in 2014, 8,55 in 2015 and only 6,6 in 2016).

Organisation of the study process ensures proper implementation of the programme and achievement of the intended learning outcomes. The proportions between independent and contact work are adequate. The exam schedules preparation in agreement with the lecturer and students as well as ability to do missed semester tasks during the time of session allows achieving the intended learning outcomes in less stressful manner. With no doubts, the virtual means (i.e. Moodle) for study process implementation are used consistently; the majority of teaching materials are available online. There is a working system of feedback from lecturers to students as well as the opposite feedback from students to lecturers. It is highly advisable, to continue the encouragement of students to fill the surveys about studies quality. The students during the visit did not have any comments about improvement of study process area.

Students are provided conditions to take part in scientific of applied science activities: they are coordinated by two departments (Mathematical Modelling and Applied Mathematics), there is an ability to participate in faculty, university, state or international level conferences and present the results of the research, and students have the possibility to publish their papers in scientific journals. The actual result of participation in conferences indicates a high percent of students involved into scientific research in recent years. Students are encouraged to do research and this should be continued.

KTU makes effort to provide conditions for students to take part in mobility programmes. The University intensely extends the range of bilateral agreements in recent years, informational events are organised, it is foreseen to have obligatory 18 credits in English in the future for language improvement. In addition, the development of students' mobility is intended in the strategy. Students, who took part in mobility programs are satisfied with the support of University. In addition, the incompatibility of students' jobs and studies abroad is a determinant factor, because almost all of postgraduates are employed. Consequently, the average number of outgoing students still should be improved.

The higher education institution ensures proper academic and social support. University provides actual studies' information in a few sources, which guarantees an efficient information

spread between academic community. University pays extra attention for the freshmen introduction to the studies through additional courses and events, students are satisfied with the introduction to the studies. The University provides additional support and attention for especially gifted students and those, who have learning difficulties, this support was positively evaluated by students. There is a high level of students' career consultations and support, which is proved by very successful Career Days. The opinion of students in support processes is represented by Students' Broad. The need of dormitories is fully satisfied. It is clear, that students' support is clearly of a high level.

The system of assessing student achievements is clear, public and appropriate. This is achieved through appropriate dissemination of information and introductory lectures. The system of assessing is clearly defined by internal regulations of University. Examination schedules are flexible and made in agreement with students. It is good that virtual information system is widely used for assessing implementation. Another strength of assessing is operative feedback from lecturers about evaluations and individual works. However, some of the exams and assignments are not updated/renewed annually, which could cause an inappropriate assessment, therefore this problem requires an attention. Final degree projects are made and defended in common process, which is usual for most universities in Lithuania. The wide variety of research spheres in final projects and high average grades indicates a good quality of final assessment. The students did know the criteria and reasons for particular marks they have got from evaluations.

The Faculty gathers information about the employability of graduates: in this way, the relation between graduates' skills/erudition and expectations of programme operators and employers is maintained. A very high percent of graduates' and even students employment reveals that graduates (or even students) of the programme are very popular in the current labour market. Graduates are highly assessed by employers. In conclusion, professional activities of the majority of programme graduates fully correspond to the expectations of programme operators and employers and only sphere for improvement mentioned by social partners – more attention for applied subjects.

The programme corresponds to the state and international economic, social and cultural and future development needs. A wide range analysis in SER proves that the need of mathematicians will be constant or increasing and there is no facts mentioned suggesting otherwise. Moreover, the collaboration with employers allows developing the programme in a correct way.

Fair learning environment is ensured, there is a legal basis, preventative measures. The exams are supervised, laboratory assignments are defended orally, all final projects are checked

by anti-plagiarism software. The academic community emphasizes, that there are no examples of cheating cases.

Processes of complaints and appeals submission are clearly defined by internal regulations in all spheres of studies. They are considered by a competent group of commissioners. Students' representatives take part in these commissions (i.e. round table discussions) in order to express students' opinion and improve studies quality. Students' opinion about their side representation is good, their noticed problems are usually fluently solved.

## ***2.6. Programme management***

The programme management, decision-making and control are implemented on the basis of the KTU Statute and other legal acts of the University and Lithuania which regulate the area of higher education. Study programme administration and internal study programme quality assurance activities are managed and coordinated by the Vice-Rector for Studies who is assisted by Study Department of the University, Study Quality Assurance and Development, Student Affairs Department and other administrative units. The role of Senate, Faculty Council, Field Study Programmes Committee and other units in these procedures are clearly described. Students, stakeholders have their own representatives in all management units in compliance with their interest.

In 2015, with the purpose for more effective management of the study programmes and for ensuring their quality, the University enhanced study programme management model. The Field's Study Programme Committees were established instead of the Faculty Programme Committee. It consists of lecturers (scientists), social stakeholders and students. Their work is regulated by Guidelines for improvement of KTU study. This is one of steps of improvement in responsibilities for decisions and monitoring of the implementation of the programme. During the meeting with teaching staff, students, and social partners the review team concluded that this new programme management is more efficient with quality assurance benefit as well.

For the purpose of improvement of study quality the University has own feedback system. The procedures for feedback organizing are regulated by the Description of Feedback Organizing Procedures of KTU. Each year, University Survey Plan is prepared and approved. A systematic collection of opinions and feedback is organized from all study process participants: students, lecturers, graduates, employers. The general feedback results are discussed at the meetings of the Rector and Senate, Deans and Department; they are published on University Intranet. During the meeting with students the review team learned that this level of system

seems quite complicated as they do not recognize their feedback as they expect. They prefer more direct communications with teaching staff, which are also organized, and the corresponding feedback. The review team supports these analyses at the various levels as well as publishing on University Intranet. To provide a proper analysis of the achievement indicators the review team recommends using more statistical data and concluding by proper statistical methods, although an improvement of the programme Applied Mathematics MSc is also recognized in this way.

Faculty Study Centre, headed by the Vice-Dean of Studies, coordinates the major processes of studies, ensures the establishment of procedures for the implementation of study programme. The Study Centre collects, accumulates and systematizes the data of the implemented study programme. A periodical analysis of programme implementation is organized on various levels: from Senate, through Faculty, Department and other corresponding institutions. It is determined who is responsible for proposals of the improvement and the decision-making for corresponding changes.

Outcomes of internal and external evaluations of the programme are used for the improvement of the programme. The major part of external team recommendations are used for the improvement of the programme. For example, the role of three research project works is more precisely determined in the master thesis, elective courses are placed later, etc.

Based on the results of the 2016 spring surveys it can be stated that the students of the programme positively evaluate (the average of evaluation is over 8) the schedule of the classes held in the evenings, the teachers team suitability for this programme. During the meeting with the review team students emphasized they would recommend to study this programme and the administrative staff appreciates their opinions, comments and proposals. Students would like to have more optional modules and most importantly – more practice adaptable to business. "Round tables" and other meetings are organized to learn students comments in order to improve the programme.

The internal quality assurance measures are effective and efficient in various aspects. It can be illustrated by students evaluation results, mentioned above, the influence of stakeholders and Study Field Programme Committee. The implementation of their recommendations, play an important role in the innovations in the study programme to achieve better quality.

The information on the programme evaluation and accreditation is published on the website of KTU. The Faculty staff receives information on evaluation conclusions and recommendations during the meetings of their Departments and open meetings of FSPC. The main documents related to study quality issues are provided on the website of the KTU, summarized survey is provided on DMS.

### **III. RECOMMENDATIONS\***

1. Students are not familiar with M+ master study programme. It is recommended to promote this subprogramme more intensively.
2. As it is recommended by the previous report, stronger orientation to practical work (more group-based and project-based approach) needs to be involved in lectures and practices.
3. Subject descriptions need to be more precisely defined in compliance with analysis of curriculum design presented above.
4. In order to have a proper analysis of QA system it is important to use statistical data and appropriate statistical methods.
5. The description of the Programme should pay more attention to the distinction between two specialisation paths, also at the level of learning outcomes gained by core subjects and by elective modules.

#### **IV. SUMMARY**

In terms of programme aims and learning outcomes, European and Lithuanian higher education recommendations, standards and legal requirements are all fulfilled. Learning outcomes are clearly presented in the SER and online as well, and are assigned with courses. The needs analysis is convincing. However, the Expert Team observed, that after finishing the core subjects one can either choose Module of Data Mining or Module of Financial Mathematics, The description of the Programme should pay more attention to the distinction between these two paths, also at the level of learning outcomes gained by core subjects and by elective modules. Since the Programme possesses several industrial partners, the introduction of internships for those students who have no full time job could be an asset to further improve the applied knowledge of students.

In terms of Curriculum design the Programme structure corresponds the needs of law, the scope of Programme is sufficient to ensure the learning outcomes; It seems this programme is the most attractive ones among other master degree programmes in Mathematics in Lithuania. The need of this programme comes from institutions and enterprises using mathematics or applications. Possibility to form individual study programme by choosing elective courses (elective subjects for deeper specialization in the field or other field module(s) or course(s), or general university study course(s). Description of study subjects is well designed.

As a weakness, the Expert Team experienced too low participation in the study process and study courses of the business representatives according to students interest to have more practice adaptable to business. Further on, prerequisites for study course are expressed in very general form: calculus (for Models of Financial Mathematics), informatics (for Data Mining methods and Software). It would be better to use titles of corresponding courses in curriculum of bachelor or master level.

Highly qualified and competent staff: the academic staff includes the high percentage of professors and associated professors; the lecturers are active in the research work and have published several scientific publications and performed some research projects. Academic staff members participate in international conferences, research traineeships and international exchange programs. Some lecturers do research together with the industrial and academic organizations in the regions. Teaching materials, including recorded lectures are available online.

However, the high percentage of the high qualified academic staff members (professors and associated professors) are approaching retirement nearest years, which is a potential risk. Teaching load is too high, there is not enough space and time for research. As it has been



recommended by the previous report, stronger orientation to practical work (more group-based and project-based approach) is missing in lectures and practices. Participation of professors from foreign universities in the study courses should be higher.

In terms of facilities and learning resources the Expert Team experienced overall well-equipped building and classrooms, and wide access of online scientific materials.

In terms of study process and students' performance assessment, Flexible and highly individualised studies are available as optional subjects, development of "M+ " and studies schedule harmonisation with students. Comprehensive academic, social and etc. support for students is present. A wide portfolio of virtual teaching materials is available, including recorded lectures online. The knowledge and abilities of students very well correspond to the expectations of employers, which causes a very high level of graduates' employment.

However, the level of mobility of students is low. There is a need for efficient internalisation strategy to increase a number of incoming/out coming students. As it has been recommended by the previous report, stronger orientation to practical work (more group-based and project-based approach) is missing in lectures and practices, more alternative ways of teaching.

In terms of programme management, implementation of various principles of KTU quality assurance of studies is a strength. Graduates, members of Field Study Programme Committee, social partners and companies discussions with potential employers are also involved in studies' quality assurance and improvement process. Implementation of the programme is strongly regulated by the University administration, which is a plus. Students take part at all level of Programme management and their opinion is appreciated. However, descriptive statistical methods are not used very much to evaluate achieved improvement of the study programme (employability, number of enrolled foreign and domestic students, etc.). Participation of the industry representatives in programme according to students opinion to have more practice adaptable to business.

## V. GENERAL ASSESSMENT

The study programme Applied mathematics (state code – 621G10003) at Kaunas University of Technology is given **positive** evaluation.

*Study programme assessment in points by evaluation areas.*

No.	Evaluation Area	Evaluation of an area in points*
1.	Programme aims and learning outcomes	4
2.	Curriculum design	3
3.	Teaching staff	3
4.	Facilities and learning resources	4
5.	Study process and students' performance assessment	3
6.	Programme management	3
	<b>Total:</b>	<b>20</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.

Grupės vadovas: Team leader:	Prof. Miklos Hoffmann
Grupės nariai: Team members:	Prof. Neda Bokan
	Assoc. Prof. Ants Aasma
	Mr. Marijus Mikalauskas
	Mr. Henrikas Vaickus

**KAUNO TECHNOLOGIJOS UNIVERSITETO ANTROSIOS PAKOPOS STUDIJŲ PROGRAMOS  
 TAIKOMOJI MATEMATIKA (VALSTYBINIS KODAS - 621G10003)  
 2017-09-14 EKSPERTINIO VERTINIMO IŠVADŲ NR. SV4-190 IŠRAŠAS**

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**V. APIBENDRINAMASIS ĮVERTINIMAS**

Kauno technologijos universiteto studijų programa *Taikomoji matematika* (valstybinis kodas – 621G10003) vertinama **teigiamai**.

<b>Eil. Nr.</b>	<b>Vertinimo sritis</b>	<b>Srities įvertinimas, balais*</b>
1.	Programos tikslai ir numatomi studijų rezultatai	4
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>20</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)

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**IV. SANTRAUKA**

Vertinant programos tikslus ir studijų rezultatus, Europos ir Lietuvos rekomendacijos, standartai ir teisiniai reikalavimai aukštajam mokslui įvykdyti. Studijų rezultatai aiškiai pateikiami SS ir internete, priskirti dalykams. Poreikių analizė įtikinanti. Tačiau ekspertų grupė pastebėjo, kad baigę privalomuosius dalykus studentai gali rinktis arba duomenų gavybos modulį, arba finansų matematikos modulį. Programos aprašyme turėtų būti geriau išskirtos šios dvi kryptys, taip pat privalomųjų dalykų ir pasirenkamųjų dalykų studijų rezultatai. Kadangi programoje dalyvauja keli pramonės dalininkai, tiems studentams, kurie nedirba visu etatu, galima būtų pasiūlyti praktiką, skirtą toliau tobulinti taikomas žinias.

Vertinant programos sandarą, programos struktūra atitinka įstatymų reikalavimus, jos apimtis pakankama studijų rezultatams pasiekti. Atrodo, kad ši programa yra patraukliausia iš visų Lietuvoje siūlomų matematikos magistrantūros studijų programų. Šios programos paklausą kuria institucijos ir įmonės, naudojančios matematiką ar jos taikymus. Siūloma galimybė sudaryti individualią studijų programą iš pasirenkamųjų modulių (t. y. pasirenkamųjų dalykų, skirtų gilinti specializaciją studijų kryptyje arba kitos studijų krypties modulyje (-iuose) ar dalyke (-uose)) arba bendrų universiteto siūlomų modulių. Geras studijų dalykų aprašymas.

Kaip trūkumą, ekspertų grupė išskyrė nepakankamą įmonių atstovų dalyvavimą studijų procese ir studijų dalykuose, turint omenyje studentų išreikštą prašymą turėti daugiau įmonėms aktualios praktikos. Be to, pasirengimo studijų dalykams reikalavimai nurodyti labai bendrai: tiesinė algebra (Finansų matematikos modelių dalykui), informatika (Duomenų gavimo metodų ir programinių priemonių dalykui). Geriau būtų vartoti atitinkamų bakalauro ar magistro dalykų pavadinimus.

Akademinis personalas turi aukšto lygio kvalifikacijas ir yra kompetentingas: didelę jo dalį sudaro profesoriai ir docentai, dėstytojai aktyviai dalyvauja mokslinių tyrimų veikloje, yra išleidę keletą mokslinių publikacijų ir atlikę keletą mokslinių tyrimų projektų. Akademinis personalas dalyvauja tarptautinėse konferencijose, mokslinių tyrimų stažuotėse ir tarptautinėse mainų programose. Kai kurie dėstytojai atlieka tyrimus kartu su pramonės ir akademinėmis organizacijomis regione. Metodiniai ištekliai, tai pat ir paskaitų įrašai, pateikiami internete.

Didelė dalis aukštą kvalifikaciją turinčių akademinių darbuotojų (profesorių ir docentų) artimiausiais metais išeis į pensiją, o tai yra potenciali rizika. Dėstytojų apkrova per didelė, tyrimams nepakanka vietos ir laiko. Kaip jau rekomenduota ankstesnėje ataskaitoje, paskaitose ir praktikoje daugiau dėmesio turėtų būti skiriama praktiniam (labiau grupiniam ir projektiniam) darbui. Galėtų būti padidintas iš užsienio universitetų atvykstančių profesorių skaičius studijų dalykams dėstyti.

Vertinant materialiuosius išteklius, ekspertų grupės nuomone, universiteto pastatas ir klasės gerai įrengti, suteikiama plati prieiga prie mokslinės medžiagos internete.

Vertinant studijų eigą ir studentų pasiekimų vertinimą, užtikrinamas studijų lankstumas ir galimybė didelę studijų dalį individualizuoti renkantis iš gilinamųjų dalykų, „M+“ programos, derinant studijų grafiką. Studentams teikiama visapusiška akademinė, socialinė ir kt. parama. Platus virtualių metodinių išteklių pasirinkimas, taip pat ir paskaitų įrašai internete. Studentų žinios ir gebėjimai labai gerai atitinka darbdavių lūkesčius, todėl labai aukštas absolventų įsidarbinimo rodiklis.

Tačiau žemas studentų judumas. Reikalinga veiksminga internalizacijos strategija, kad būtų galima padidinti atvykstančių ir išvykstančių studentų skaičių. Kaip jau rekomenduota ankstesnėje ataskaitoje, paskaitose ir praktikoje daugiau dėmesio turėtų būti skiriama praktiniam (labiau grupiniam ir projektiniam) darbui, alternatyviems dėstytojų būdams.

Programos vadybos stiprioji pusė ta, kad įgyvendinami įvairūs KTU studijų kokybės užtikrinimo principai. Į studijų kokybės užtikrinimo ir tobulinimo procesą taip pat įtrauktos diskusijos tarp absolventų, krypties studijų programos komiteto narių, socialinių dalininkų, įmonių ir potencialių darbdavių. Programos įgyvendinimą griežtai reglamentuoja universiteto administracija – tai yra teigiamas dalykas. Studentai dalyvauja visuose programos vadybos lygmenyse ir jų nuomonė vertinama. Nepaisant to, vertinant studijų programos pagerėjimą (įsidarbinimo galimybes, įstojusią užsienio ir šalies studentų skaičių, t. t.), trūksta apibūdinamųjų statistinių metodų. Reikėtų didinti įmonių atstovų dalyvavimą programoje, nes, studentų nuomone, reikėtų daugiau įmonėms aktualios praktikos.

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### **III. REKOMENDACIJOS**

1. Studentai nėra supažindinti su „M+“ magistrantūros studijų programa. Rekomenduojama intensyviau skatinti šią programos dalį.
2. Kaip jau rekomenduota ankstesnėje ataskaitoje, per paskaitas ir praktiką daugiau dėmesio turėtų būti skiriama praktiniam (labiau grupiniam ir projektiniam) darbui.
3. Dalykų apibūdinimai turi būti patikslinti pagal pirmiau pateiktą programos sandaros analizę.
4. Siekiant tinkamai atlikti kokybės užtikrinimo sistemos analizę, svarbu naudoti statistinius duomenis ir atitinkamus statistinius metodus.
5. Programos aprašyme turėtų būti geriau išskirtos dvi specializacijos kryptys, taip pat privalomųjų dalykų ir pasirinkamųjų dalykų studijų rezultatai.

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