



STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Vytauto Didžiojo universiteto
STUDIJŲ PROGRAMOS MATEMATIKA IR JOS TAIKYMAS
(valstybinis kodas - 612G10004)
VERTINIMO IŠVADOS

EVALUATION REPORT
OF MATHEMATICS AND ITS APPLICATION (*state code -*
612G10004) **STUDY PROGRAMME**
at Vytautas magnus University

Experts' team:

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Išvados parengtos anglų kalba
Report language – English

Vilnius
2017

DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	<i>Matematika ir jos taikymas</i>
Valstybinis kodas	612G10004
Studijų sritis	Fiziniai mokslai
Studijų kryptis	Matematika
Studijų programos rūšis	Universitetinė studijos
Studijų pakopa	Pirmoji
Studijų forma (trukmė metais)	Nuolatinė (4)
Studijų programos apimtis kreditais	240
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Matematikos bakalauras
Studijų programos įregistravimo data	1997-05-19

INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	<i>Mathematics and its application</i>
State code	612G10004
Study area	Physical sciences
Study field	Mathematics
Type of the study programme	University Studies
Study cycle	First
Study mode (length in years)	Full-time (4)
Volume of the study programme in credits	240
Degree and (or) professional qualifications awarded	Bachelor of Mathematics
Date of registration of the study programme	1997-05-19

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The Centre for Quality Assessment in Higher Education

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I. INTRODUCTION

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

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

The Mathematics and its Application Bachelor Programme in the field of Mathematics is carried out by Department of Mathematics and Statistics, and the Department of Applied Informatics in the Faculty of Informatics at Vytautas Magnus University. The Expert Team

visited the Faculty on May 11 th. 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 *11 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 Mathematics and its Application Bachelor Programme in the field of Mathematics is carried out by Department of Mathematics and Statistics, and the Department of Applied Studijų kokybės vertinimo centras

Informatics in the Faculty of Informatics at Vytautas Magnus University. 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 Vytautas Magnus University. The title of the programme well reflects the goals of the programme. The degree awarded is „Bachelor of Mathematics” instead of Bachelor of Applied Mathematics, which would better describe the gained knowledge, especially in the light of specializations.

The intended aims of the Programme are presented in detail, however the specializations are not well separated in this part of the SER, therefore the description is a bit confusing: e.g. “skills in energy, biomedicine systems analysis” are not necessarily acquired by those students who choose “Teaching Mathematics” specialization.

Learning outcomes of the Programme are well presented in the SER, and are publicly announced, which is an asset, although not available in the main website <http://www.vdu.lt/en/study/program/search/>. The objectives correspond with Dublin descriptors and cover scientific and soft skills as well. According to the formulated learning outcomes of the Programme the students are supposed to know, interpret and explain the main theoretical concepts of applicable mathematical methods, to have skills for the application of the main numerical methods and algorithms, mathematical methods in systems modelling and be able to apply them in interdisciplinary areas of studies and in practice, sophisticate types of statistical data, as well as consolidate and integrate the main principles of mathematical didactics in education, to understand and interpret new forms of IT-supported collaboration and management. Further soft skills are also included in the outcomes, which is a plus. Again, specializations and their specific objectives should already appear here, in the description of learning outcomes, therefore we suggest to separate those outcomes which belongs to the core part of the Programme, and those ones which are planned to be acquired during the specialization phase. Learning outcomes are subject to revision every three years, which is credible. The learning outcomes are well assigned with modules and courses, which is credible.

These outcomes and the curriculum itself are declared to be designed in response to societal and especially to labour market needs. There are four possible specializations to improve knowledge in applied mathematics in this Programme with elective courses in these fields. These specializations appear in the diploma supplement, which is a definite plus. The description of the Programme should make clear distinction between learning outcomes gained by core subjects and by elective courses. A presentation could be more clearly declared and summarized what learning outcomes can be gained through the core part and what further outcomes can be obtained by the elective courses (specialisations).

2.2. Curriculum design

The curriculum design of the study programme Mathematics and its Application BSc is in line with the Lithuanian legal acts regulating the structure of studies programmes. It has 4 years form. Study programme scope is of 240 ECTS. According to SER all study subjects of the Programme are grouped into General study subjects, Subjects in the study field and Subjects for specialization and elective subjects. Volume of: subjects in the study field is 188 ECTS, general university study subjects is 16 ECTS, subjects for specialization and elective subjects is 51 ECTS, internship is 15 ECTS. For final thesis is assigned 12 ECTS. The workload of students expressed in terms in number of subjects in each semester is 5-6. Therefore the review team concludes the study programme scope, structure, subjects meet the legislative requirements of the Mathematics Study Field Description and the General Description of the Requirements on the Degree Granting for the First Cycle and Integrated Study Programmes.

Subjects of study (modules) are taught in a consistent manner. Topics in majority of subjects are not repeated. However, the review team may emphasize that there exist some overlapping in certain number of courses. For example: least square method exists in both subjects: Mathematical Analysis 3 and Algebra; mathematical logic is a theme in Discrete Mathematics course and there exist also the subject Mathematical Logic with prerequisites Mathematical Analysis (without Discrete Mathematics to provide a continuation in study process of mathematical logic); indefinite integral appears in Mathematical Analysis 2 and Measure and Integral Theory; continuous functions appear in Mathematical Analysis 1, 3 and Measure and Integral Theory, basic operations on sets, mappings on sets, Lebesgue measure appear in subjects Functional analysis and Measure and Integral Theory.

Study programmes outcomes found in SER states: Identify the problem, collect and analyse real/theoretical data using various mathematical tools, methods and IT technologies. But it is not clear which IT technologies are used in majority of courses, in spite of fact that this learning outcomes is achieved. Nevertheless, there exists separately a course Software for Mathematics. During the meeting with students' representatives the review team learned that majority of subjects in theoretical mathematics are taught in a classical way, but not all of them. As a good example by students opinion e.g. is Number Theory subject where the teacher uses project-based method and team work.

Analysing subjects description in SER, Annex 2, the review team find prerequisites are not always in compliance with the content of some courses. For example: for Mathematical Logic is a prerequisites Mathematical Analysis (it is unclear which one: 1,2,3, or 4), but not

Discrete Mathematics, where Mathematical Logic is one of themes; Mathematical Analysis is among prerequisites of Differential equation, but it is not necessary to know Mathematical Analysis 3,4 where double, triple integrals are considered, Fourier Analysis.

Learning outcomes of study programmes and some subjects should be reformulated. For example: Professional Language for Students of Physical Sciences is a subject to acquire learning outcome 15. (Plan self-learning based on personal needs and the on-going professional development) corresponding to Personal Skills. But in Annex 2 of SER learning outcomes 1,2,...,8 which correspond to Knowledge and its Application and Skills to Research appear in the list for the same subject Professional Language for Students of Physical Sciences.

Review team would also recommend to introduce subject of Topology, as one of base knowledge in mathematics, important for applications. The review team discussed the subjects description with the teaching staff. The teaching staff agreed with the comments and remarks presented during the meeting. Therefore the common conclusion is the frame of subjects description is correct, but there are lacks in subjects description and are necessary to consider and improve further.

Students' and Alumni representatives informed the review team that theoretical background is very good for their purposes, software skill to use new one are well supported. However, students would like to have teaching material either in printed version or online, in advance, to discuss some theme with teachers. To develop communication skill, by the opinion of the review team, is necessary to have in addition oral part of exams.

The review team also concluded that several important actions in order to respond the recommendations in the previous evaluation report have been successfully realized. New subjects of Discrete Mathematics and Algebra have been introduced, as well as four specializations and three courses (in each specialization) devoted to applied mathematics have been added (more details one can find in SER, p.15). The review team recommends also to introduce some subjects of geometry and topology because of a proper development of applied mathematics (e.g. big data, complex systems, bioinformatics, etc.) and consistent manner of some subjects teaching (e.g. to introduce in a correct way line, surface, double, triple integrals it is necessary knowledge acquired at least in geometry of curves and surfaces).

The content of subjects (modules) corresponds to the type of mathematics studies and its application as well as to the 1st cycle of studies. General study subjects offer students an opportunity to develop their general erudition and deepen their worldview. Subjects of the study field lay out the theoretical and practical foundations for acquiring knowledge and skills necessary to qualify for the Bachelor Degree in Mathematics. The aim of the subjects in Informatics is to provide students with IT background, which is necessary for a Bachelor

graduate. There exist four specializations: Financial and Insurance Mathematics, Mathematics in Energy, Statistics in Biomedicine, Teaching Mathematics. At the end of the studies the specialization is indicated in the Bachelor's diploma. During the meeting with social partners the review team learned that they cooperate with VDU in various fields, but especially emphasized good cooperation in proposing of themes for bachelor degree thesis, participating in assessment commissions of thesis, etc. They pointed out also graduates of this study programme are well prepared for all challenges of work in their companies and research institutes.

Hence, the review team concludes the content of subjects (modules) and study methods enable to achieve the intended learning outcomes; the scope of programme is sufficient to achieve the learning outcomes and the content of the programme corresponds to the latest academic and technological achievements.

2.3. Teaching staff

In total there are 25 lecturers affiliated with the Programme; besides 20 lecturers are full time employees at VDU, there are 8 professors and 8 associate professors. Previous Evaluation Report (09/01/2013, No. SV5-11) recommended to increase the share of full-time employees in The Programme. Therefore, comparing with the previous evaluation period there are big changes: then only 15 lecturers were affiliated with the Programme, only 11 teachers were full time employees at VDU, and during the 2012-2016 period 15 new teachers have joined the Programme. Previous Evaluation Report also suggests to attract young academics for teaching, because within the next few years some professors will retire. Hence, since 2013 three PhD students and 2 young associated professors (with age under 40) have been employed to the Programme.

The requirement that not less than 50% of study subjects are delivered by scientists is fulfilled, since 84% of the subjects are taught by persons having a scientific degree. 35% of all subjects are taught by professors; 46% of all subjects are taught by assoc. professors; 19% - taught by lecturers.

The study programme to a great extent corresponds to the research interests of the teaching staff. The research areas are mathematical modelling, systems' reliability and risk modelling, analysis and evaluation, multidimensional theorems in probability theory, mathematical statistics, statistical data analysis, Monte Carlo method in nonlinearity simulation, analytical and probabilistic number theory, differential equations and numerical methods, inverse problems, quant mechanical methods. 81% of courses are taught by teachers, who perform research in the field of taught subject (no less than 80% required). However, there exists lack of experience in few topical areas, for example, VDU has no a specialist in geometry.

During the assessment period, the essential part of teaching staff participated in various activities to raise their teaching skills in research and development of taught disciplines. Around 36% of teachers yearly participate in teaching and research visits to foreign universities. Seminars, covering different research and practical aspects in mathematics, business and applied informatics are constantly organized by VDU, where researchers and industry specialists from different Lithuanian and foreign universities share their research interests. In the period of 2012-2016, around 50 lectures, seminars and lecture cycles were organized at VDU, with speakers coming from VDU, other Lithuanian universities and companies, guests from abroad.

Summarizing, the qualifications of the current academic staff is good for achieving 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 Informatics has a sufficient number of classrooms and laboratories for the study Programme. The same material resources are used by master 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.

All teaching workplaces are equipped in appropriate level: the life-cycle of computers in computer classes is approx. 4–5 years, equipped by video - audio equipment and large blackboards suitable for teaching mathematics. Additionally, 2 classrooms are equipped with professional distance learning and conferencing equipment. Seven specialized laboratories and one centre are supporting the study process and research work. Classrooms, computer classes and main public areas in the faculty and other VDU buildings are covered with wi-fi connectivity. 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.

The teaching materials and accessibility to the students are suitable. Moodle learning environment is used for this purpose. All study subjects are supported by electronic teaching material, either using Moodle environment, or material from e-book and e-textbook collections via VDU library. In addition, VDU being a part of Lithuanian Research Library Consortium (<http://www.lmba.lt>), has an access not only to the databases of scientific articles, but also a capability to access e-books and e-textbooks (e.g. Springer Ebooks Collections <http://link.springer.com/>). The reading room in the faculty presents most useful literature as well as the mainly used scientific databases. Students mostly use scientific database resources

which are extensive. Finally students did not express any comments relating to improvement of literature or lack of it. However the review team advice to continue developing facilities. The laboratory space with virtual reality, 3d printing and other equipment can be considered as one of the areas worth developing.

Students' voluntary can use the Erasmus+ program for summer practice or they can participate individually in Lithuanian Research Council organized competitions for students' scientific practice. Strong support from partners for professional internship, especially from the Lithuanian Energy Institute.

2.5. Study process and students' performance assessment

The admission process is clear and transparent organised and conducted by the Association of Lithuanian higher education institution for organization of general admittance (lith. Acronym LAMA BPO). General admission system ensures even conditions, confidentiality for all applicants, guarantees a correct calculation of competition score and line-up of applicants to the study programme. A wide variety of informational sources (internet pages of LAMA BPO and VDU, annual information publications) about the programme allows to find entrance requirements for all interested entrants. The competitive score consist of results of national exams multiplied by weight coefficient: 0.4 for mathematics exam mark, 0.2 for Lithuanian language exam mark, 0.2 for exam or study year mark optionally of information technologies or physics, and 0.2 for exam or study year mark optionally of history, geography, information technologies, physics, chemistry, biology or foreign language.

There is a tendency of interested applicants decrease: the total number of applicants by any priority is constantly dropping and in 2016 was 3 times smaller than 2012 (respectively 242 and 81), the number of applicants with 1-6 priority decreased about 2 times (respectively 149 and 63). As result, the total number of students in the programme is significantly decreasing from 95 students in 2012 to 34 in 2016. However, the number of applicants with the first priority is stable (19 in 2012, 12 in 2013, 13 in 2014, 7 in 2015 and 13 in 2016), as well as a total number of admitted students, therefore the programme can proceed fluently (approximately 7 state funded students every year). The average competitive score is moderate (5,22 in 2014, 4,94 in 2015 and 5,94 in 2016), the lowest competitive scores are low (about 3 in past three years). All in all, the entrance requirements are clear and transparent, as well as admission process itself, but the results of admission evidence challenges of students' attraction.

The studies are flexible and liberal, orientated to the students' needs with possibility to choose a part of studies' subjects, individual study plans. Students even have an

ability to choose a workload of the semester from 24 to 36 ECTS, the schedule is compatible with other personal activities. Another strong side of the programme is an advanced students' introduction to the University and the programme – the first week of the autumn semester at VDU is dedicated for first year students' acquaintance to the academic environment. Students are introduced to each subject of the programme at the first lecture, consequently, important academic information is spread.

As the organisation of internships shows, the programme is orientated to studies' application in labour market, ensures the basic work experience for students. The dropout of students is about 10.3%, the reason of most of them are unfulfilled tasks of the studies. Therefore, the dropout rate is normal, the University analyses reasons and deal with them. There is a well-developed feedback system between students and lecturers, both in formal and informal ways. Students have conditions to take an internship, there is a possibility to find it personally or with a help of University, they are satisfied about the quality of internships.

Students are encouraged to take part in scientific research. First of all, students state, that they have plenty of information about possibilities of deeper scientific research. There are conditions to join scientific projects, students with high scientific achievements may get scholarships or employment in laboratories of the University. Students of the programme writes scientific papers (approximately 2 per year), despite the fact that they are only bachelor students. To conclude, students' encouragement and their participation in scientific activities are well developed.

Students are provided conditions to take part in mobility programs. It is indicated by relatively high academic mobility of students (5-7% of them participates in mobility programs). Moreover, the lecturers of the programme are in very high academic mobility too. There is a financing system of students taking studies abroad, students feel confident with their English skills, they can share experiences in annual "Erasmus Day". However, students expressed that still there is a lack of information about mobility programs, which sometimes may reduce students mobility.

The University emphasises the importance of understanding and cooperation between students and teachers, based on liberal values. The University supports academic information through different sources, in use of virtual communication tools. Consultations in study-related issues are granted, a good development is possibility of communications through on-line forms. Students of the programme are granted with carrier planning, consultations. An active Career Centre's, Alumni members' and staff of Faculty effort should provide appropriate career support for students. 65% of the interested students of the faculty get dormitory placements, whereas the aim should be a complete fulfil of the need. According to the SER,

University provides suitable psychological support, an ability to practise sports, Students' Representative Council represents interests of the students.

The system of assessing student achievements is clear, public and appropriate to assess the learning outcomes. The SER states, that assessment criteria for each study subject correspond to the learning outcomes, in addition, are matched with general outcomes for the programme. The system of assessment and requirements are clearly described in internal regulations, students are introduced to them at the first lecture of the subject, as well as with other important information of subject's evaluation. All regulations and criteria are public and can be accessed in a several sources. The final mark consist of mid-term exam, practical work or other intermediate assessment and the exam. In this way, more objective and to outcomes related assessment is guaranteed. The list of final thesis reveals, that students are able to apply their mathematical knowledge in a wide range of spheres, as well as make a deeper research in the field of mathematics.

A high graduates' employment rate reveals, that professional activities of the majority of programme graduates correspond to the expectations of programme operators and employers. There was noticed, that there is a good communication between University and social partners as well as alumni. That should guarantee, that programme will develop correctly and correspond to the needs of employers in the future. The direction of improvement - employers expects graduates to be more oriented to application of knowledge.

The University develops various means to ensure academic honesty. The prevention of unfair behaviour is ensured by regulations, lecturers supervise the exams in order to prevent the usage of information sources during exams, laboratory assignments are defended and finally, all final projects are checked with anti-plagiarism software. In addition students may be involved in the process of academic dishonesty detection, results of assessments and final thesis are analysed in the end of semesters. Eventually, in all known cases of academic dishonesty strict punishments were used. To conclude, the University makes serious efforts to guarantee fair learning environment.

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 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 study programme management is conducted by Study Programme Committee (SPC). The SPC includes qualified and experienced teachers, students and representatives of social partners, external experts and alumni. Administrating units, participating in the implementation of the Bachelor Program are: Department of Mathematics and Statistics, Dean of the Faculty of Informatics and the Faculty Board. The SPC organizes planning, quality assessment and changes in the Programme, Faculty Dean, Faculty Board as well as the University Academic Commission of the Physical Sciences approve them and the responsible Departments control and execute through an appointed Programme coordinator.

The internal quality assurance measures are effective, it is also supported by statistical data. The internal study programme quality evaluation process is continuous (SPC performs Programme analysis in every spring semester, collects and analyses Programme quality related information from students, teachers, social partners and alumni. Detailed self-assessment have been organized at least once in three years, evaluating the Programme goals and purpose, Programme needs, pursued study result, Programme structure and contents, study organization processes, the dynamics of student number, academic personnel and other Programme related resources).

Students opinion is delivered by student representatives in the SPC, after organizing corresponding discussions with the Programme students, via student surveys, or via direct communication to the teachers and Programme coordinator. Student's and teacher's feedback on teaching quality and the utilization of the obtained results for teacher professional development and attestation, as well as for teaching quality improvement are regularly collected. Also electronic teaching quality surveys are conducted. Students are invited to fill-out electronic surveys for each study subject every semester. Survey results are summarized in the Department of Studies and provided to the corresponding departments responsible for the quality of these study subjects. Different alumni and social partner surveys on the quality of the study programme as a whole are being conducted.

The information about the Programme is public, relevant and easily accessible. Information about the studies in Mathematics and its Application Programme is presented in the yearly VDU publication "Study at the Vytautas Magnus University", and, also, communicated using the Internet and other relevant channels. University and Faculty websites present related event announcements, study programme descriptions and other important information. Information on the study programmes and entrance rules is published in other specialized publications and websites. This information is also presented during meetings at schools.

III. RECOMMENDATIONS*

1. Specializations and their specific objectives should already appear in the description of learning outcomes, therefore we suggest to separate those outcomes which belong to the core part of the Programme, and those ones which are planned to be acquired during the specialization phase.
2. Subjects description need to be more precisely defined in compliance with analysis of curriculum design presented above.
3. Non-traditional teaching/learning methods and everyday usage of IT elements need to involve more intensive, especially in teaching of fundamental subjects in mathematics
4. It is recommended to have more oral exams and presentations to develop communication skills
5. Teaching materials and sources are recommended to be more presented, especially using Moodle platform to develop discussing of problems solutions.
6. To better equip students with knowledge to meet today's research and applications development it is recommended to design one or two courses on geometry and topology. If two courses are considered then they could be alternated every two years in order not to loose the good balance that the programme already has.

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 well assigned with courses. The needs analysis is convincing.

However, the Expert Team observed some weaknesses as well. The degree awarded is „Bachelor of Mathematics” instead of Bachelor of Applied Mathematics, which would better describe the gained knowledge, especially in the light of specializations. The description of overall learning outcomes is a bit confusing: e.g. “skills in energy, biomedicine systems analysis” are not necessarily acquired by those students who choose “Teaching Mathematics” specialization. Information on this programme is provided at VDU website (in Lithuanian) and VDU Faculty of Informatics website (in Lithuanian); <http://if.vdu.lt/en/studies/bachelor-studies-programmes/mathematics-and-its-application/> (in English).

In terms of curriculum design subjects of study (modules) are taught in a consistent manner. Students’ and Alumni representatives informed the review team that theoretical background is very good for their purposes, software skill to use new one are well supported. Several important actions in order to respond the recommendations in the previous evaluation report have been successfully realized. The scope of programme is sufficient to achieve the learning outcomes and the content of the programme corresponds to the latest academic and technological achievements. However, there exist some overlapping in certain number of courses. During the meeting with students’ representatives the review team learned that majority of subjects in theoretical mathematics are taught in a classical way. Prerequisites are not in compliance with the content of some courses. Learning outcomes of study programmes and some subjects are not fully in compliance. The frame of subject description is correct, but the espied lacks in subjects description are necessary to consider and improve in all details. To develop communication skill, by the opinion of the review team, is necessary to have in addition oral part of exams.

The academic staff is qualified and competent: most of the lecturers are active in the research work and have published many scientific publications and performed some research projects. Academic staff members participate in international conferences, research traineeships, international exchange programs; During the 2012-2016 period several young perspective researchers have joined the Programme. Some lecturers do research together with the industrial and academic organizations in the regions. 81% of courses are taught by teachers who perform research in the field of the taught subject. Several study subjects are being taught by part-time

teachers (17.4%) from other study or research institutions. Some high qualified and very productive academic staff members are approaching retirement nearest years and need replacement. **However, some young qualified teachers are preparing to overtake the courses, taught by these staff members.** Teaching materials and sources are insufficiently presented for some subjects.

In terms of facilities and learning resources, all teaching workplaces are equipped in appropriate level. Some classrooms are equipped with professional distance learning and conferencing equipment. Software and programming tools used in the learning process are adequate and sufficient. All study subjects are supported by electronic teaching material, either using Moodle environment, or material from e-book and e-textbook collections accessible via VDU library. In addition, VDU being a part of Lithuanian Research Library Consortium has an access to e-books and e-textbooks (e.g. Springer EBooks Collections).

In terms of study process and students' performance assessment, flexible and highly individualised studies are assured: availability of minor studies and optional subjects, studies schedule harmonisation with students. Comprehensive academic and social support for students is present. Well-developed internationalization strategy and students mobility statistics are presented, however further improvement is necessary, especially in providing information about mobility programs. Good cooperation and communication with social partners and alumni, as well as good graduates' employment rate and career possibilities are presented. There are plans of actions for increase of number of recruited students, some means of attraction are already used. However, complicated current situation with students attraction to the programme is observed.

In terms of Programme management, quality management structure is defined clearly in the internal documentation of the University. There have been planned and started efforts in order to increase number of recruited students. Close cooperation between students and teachers is a plus, analysis of QA is supported by statistical data. However, not all areas are covered by specialists. There is a lack of supportive instruments (e.g., trainings on teaching skills) in order to implement non-traditional teaching methods and everyday usage of IT elements in teaching process.

V. GENERAL ASSESSMENT

The study programme Mathematics and its application (state code – 612G10004) at Vytautas Magnus University is given **positive** evaluation.

Study programme assessment in points by evaluation areas.

No.	Evaluation Area	Evaluation of an area in points*
1.	Programme aims and learning outcomes	3
2.	Curriculum design	3
3.	Teaching staff	3
4.	Facilities and learning resources	3
5.	Study process and students' performance assessment	3
6.	Programme management	3
	Total:	18

*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. Miklós Hoffmann
Grupės nariai: Team members:	Prof. Neda Bokan
	Assoc. Prof. Ants Aasma
	Mr. Marijus Mikalauskas
	Mr. Henrikas Vaickus

**VYTAUTO DIDŽIOJO UNIVERSITETO PIRMOSIOS PAKOPOS STUDIJŲ PROGRAMOS
MATEMATIKA IR JOS TAIKYMAS (VALSTYBINIS KODAS - 612G10004)
2017-09-14 EKSPERTINIO VERTINIMO IŠVADŲ NR. SV4-195 IŠRAŠAS**

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V. APIBENDRINAMASIS ĮVERTINIMAS

Vytauto Didžiojo universiteto studijų programa *Matematika ir jos taikymas* (valstybinis kodas – 612G10004) vertinama **teigiamai**.

Eil. Nr.	Vertinimo sritis	Srities įvertinimas, balais*
1.	Programos tikslai ir numatomi studijų rezultatai	3
2.	Programos sandara	3
3.	Personalas	3
4.	Materialieji ištekliai	3
5.	Studijų eiga ir jos vertinimas	3
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	Iš viso:	18

*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 gerai suderinti su studijų dalykais. Poreikių analizė pagrįsta.

Tačiau ekspertų grupė pastebėjo ir trūkumų. Suteikiamas matematikos bakalauro, o ne taikomosios matematikos bakalauro laipsnis, nors pastarasis geriau apibūdina studijuojant įgytas žinias, ypač atsižvelgiant į specializacijas. Bendrų studijų rezultatų aprašymas šiek tiek painus: pvz., „energetikos, biomedicinos sistemų analizės įgūdžius“ nebūtinai įgyja tie studentai, kurie pasirenka „Matematikos dėstymo“ specializaciją. Informacija apie šią programą pateikta VDU svetainėje (lietuvių kalba) ir VDU Informatikos fakulteto tinklalapyje (lietuvių kalba); <http://if.vdu.lt/en/studies/bachelor-studies-programmes/mathematics-and-its-application/> (anglų k.).

Vertinant programos sandarą, studijų dalykai (moduliai) dėstomi nuosekliai. Studentų ir absolventų atstovai ekspertų grupei nurodė, kad teorinės žinios labai gerai atitinka dalykų tikslus, puikiai ugdomi programinės įrangos naudojimo įgūdžiai. Atsižvelgiant į ankstesnėje vertinimo ataskaitoje pateiktas rekomendacijas, sėkmingai įgyvendinti keletas svarbių veiksmų. Programos apimtis pakankama studijų rezultatams pasiekti, o programos turinys suderintas su naujausiais akademiniais ir technologiniais pokyčiais. Tačiau kai kurie dalykai dubliuojasi. Kalbėdama su

studentų atstovais, ekspertų grupė išsiaiškino, kad dauguma teorinės matematikos dalykų dėstomi klasikiniu būdu. Pasirengimo reikalavimai neatitinka kai kurių dalykų turinio. Studijų programų ir kai kurių dalykų studijų rezultatai ne visiškai suderinti. Dalykų aprašymai teisingos formos, bet reikia apsvarstyti ir pašalinti jų trūkumus. Ekspertų grupės nuomone, kad būtų lavinami bendravimo įgūdžiai, reikia organizuoti egzaminus žodžiu.

Akademinis personalas turi aukšto lygio kvalifikacijas ir yra kompetentingas: daugelis dėstytojų aktyviai dalyvauja mokslinių tyrimų veikloje, yra išleidę nemažai mokslinių publikacijų ir atlikę keletą mokslinių tyrimų projektų. Akademiniai darbuotojai dalyvauja tarptautinėse konferencijose, mokslinių tyrimų stažuotėse, tarptautinėse mainų programose. 2012–2016 m. prie programos prisijungė keli jauni perspektyvūs mokslininkai. Kai kurie dėstytojai atlieka tyrimus kartu su pramonės ir akademinėmis organizacijomis regione. 81 % dalykų dėsto dėstytojai, kurie atlieka mokslinius tyrimus savo dalyko srityje. Dalį dalykų (17,4 %) dėsto puse etato dirbantys dėstytojai iš kitų studijų ar mokslinių tyrimų įstaigų. Kai kurie aukštą kvalifikaciją turintys ir labai produktyvūs akademiniai darbuotojai per artimiausius metus išeis į pensiją, juos reikės pakeisti. Šių darbuotojų dėstomus dalykus rengiasi perimti jauni kvalifikuoti dėstytojai. Kai kuriuose dalykuose nepakankamai plačiai pateikiami metodiniai ištekliai.

Vertinant materialiuosius išteklius, visos dėstytojų skirtos darbo vietos įrengtos tinkamai. Kai kuriose klasėse įrengta profesionali įranga nuotolinėms studijoms ir konferencijoms. Studijų laikotarpiu naudojama programinė įranga ir programavimo priemonės yra tinkamos, jų užtenka. Visuose studijų dalykuose suteikiama prieiga prie elektroninių metodinių išteklių „Moodle“ aplinkoje arba el. knygų ir el. vadovėlių sancaupuose, kurios pasiekiamos per VDU biblioteką. Be to, VDU priklauso Lietuvos mokslinių bibliotekų asociacijai, todėl turi prieigą prie el. knygų ir el. vadovėlių (pvz., „Springer EBooks Collections“).

Vertinant studijų eigą ir studentų pasiekimų vertinimą, užtikrinamas studijų lankstumas ir galimybė didelę studijų dalį individualizuoti renkant iš gretutinių studijų ir pasirenkamųjų dalykų, derinant studijų grafiką. Studentams teikiama visapusiška akademinė ir socialinė parama. Teikiama gera internacionalizacijos strategija ir studentų judumo statistika, tačiau jų teikimą reikia ir toliau gerinti (ypač informacijos apie judumo programas). Vyksta geras bendradarbiavimas ir bendravimas su socialiniais dalininkais ir absolventais, geras absolventų įsidarbinimo rodiklis bei karjeros galimybės. Parengti planai didinti priimamų studentų skaičių, kai kurios pritraukimo priemonės jau naudojamos. Nepaisant to, šiuo metu pastebima situacija, kai studentų pritraukimas į programą vyksta sunkiai.

Vertinant programos vadybą, universiteto vidaus dokumentuose aiškiai apibrėžta kokybės valdymo struktūra. Suplanuoti ir pradėti veiksmai, skirti didinti priimamų studentų skaičių. Glaudus studentų ir dėstytojų bendradarbiavimas, kokybės užtikrinimo sistemos analizė pagrįsta statistiniais duomenimis. Tačiau ne visose srityse dirba specialistai. Trūksta palaikomųjų priemonių (pvz., dėstytojų įgūdžių mokymų), skirtų įgyvendinti netradicinius dėstytojų metodus, taip pat kasdienio IT elementų naudojimo studijų laikotarpiu.

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III. REKOMENDACIJOS

1. Specializacijos ir jų konkretūs tikslai turi būti nurodyti studijų rezultatų aprašyme, todėl siūlome išskirti rezultatus į tuos, kurie priklauso bendrai programos daliai, ir tuos, kuriuos planuojama pasiekti specializacijos etape.
2. Dalykų apibūdinimai turi būti patikslinti pagal pirmiau pateiktą programos sandaros analizę.

3. Reikia daugiau naudoti netradicinių dėstymo ir studijavimo metodų, į kasdienę mokymo(si) veiklą įtraukti daugiau IT elementų, ypač dėstant pagrindinius matematikos dalykus.
4. Rekomenduojama dažniau organizuoti egzaminus žodžiu bei pristatymus bendravimo įgūdžiams lavinti.
5. Rekomenduojama geriau pateikti metodinius išteklius ir šaltinius, ypač per „Moodle“ platformą, kad būtų lengviau aptarti problemų sprendimus.
6. Siekiant geriau paruošti studentus šiuolaikiniams moksliniams tyrimams ir taikymams, rekomenduojama parengti vieną ar du geometrijos ir topologijos modulius. Jei rengiami du moduliai, juos galima kaitalioti kas dvejus metus, kad būtų išlaikyta gerai suderinta programos sandara.

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