



STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Vytauto Didžiojo universiteto
STUDIJŲ PROGRAMOS TAIKOMOJI MATEMATIKA
(valstybinis kodas - 621G12001)
VERTINIMO IŠVADOS

EVALUATION REPORT
OF APPLIED MATHEMATICS (*state code -621G12001*)
STUDY PROGRAMME
at Vytautas Magnus University

Experts' team:

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Išvados parengtos anglų kalba
Report language – English

DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	<i>Taikomoji matematika</i>
Valstybinis kodas	621G12001
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	1997-06-04

INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	<i>Applied mathematics</i>
State code	621G12001
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	1997-06-04

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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 Applied Mathematics Master Programme in the field of Mathematics is carried out by the 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 Applied Mathematics Master Programme in the field of Mathematics is carried out by the Department of Mathematics and Statistics, and the Department of Applied 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 needs analysis presented in self evaluation report is realistic and convincing. The title of the programme *Applied Mathematics* well reflects the goals of the programme. The degree awarded is „Master of Mathematics” instead of Master of Applied Mathematics, but the review team acknowledges the fact that this is due to national legislations, which are currently under revision.

The Master is aiming at improving student's competences gained during the first cycle study programmes, focusing on systems risk and reliability analysis, data analysis, mathematical modelling and mathematics applications, as it is stated in the Programme description. The review team finds these objectives realistic and well included in the overall programme structure.

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 English website of the University <http://www.vdu.lt/en/study/program/search/>. The issue was introduced during the first meeting with administration and it was taken care. The 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 know, interpret and explain the theoretical concepts of applicable mathematical methods, have skills for systems risk and reliability analysis, data analysis, mathematical modelling, development of mathematical models, understand and interpret new forms of IT-supported collaboration and management. The learning outcomes are well assigned with courses, which is credible.

There are two parts in this Programme: after finishing the core subjects one can choose elective courses, which helps student to further specialize the gain knowledge. 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. Beside the degree awarded, a diploma supplement with the description of the elective courses is attached to the diploma, which is an asset in this regard.

To summarise the review team found the learning outcomes and the main programme aim very well formulated and seamlessly integrated in the programme structure which is an asset.

2.2. Curriculum design

The master degree study programme Applied Mathematics is in line with the Lithuanian legal acts regulating the structure of study programme. 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, and other legislative requirements. It has full time 2 years for. The study programme scope is of 120 ECTS. The core and compulsory subjects of the study field make 48 ECTS. In order to provide students with the possibilities of deepening their knowledge in fields of mathematical methods application (e.g. signal processing and recognition, neural networks, economics, business, etc) and IT study subjects, the elective study subjects are envisaged. For optional courses 24 ECTS are given. Three research projects No. 1,2,3 (18 ECTS) are foreseen in the programme for research working abilities training. For Final Degree project preparation and its defence are allocated 30 ECTS. Number of subjects taught per semester is 5 and each subject is of 6 ECTS. Such programme structure and indicated number of credits is appropriate for students to achieve successfully the objectives of the studies.

The Programme is designed to meet the demand of professionals with skills in risk and reliability analysis and in data analysis. This is realized by the Programme structure consisting of compulsory subjects that cover a broad list of topics important to above-mentioned fields and by groups of elective subjects. The compulsory study subjects of the Programme include eight Applied Mathematics study subjects: Queuing Theory, Econometrics, Applications of Differential Equations, Operations Research, Sample Theory, Risk and Reliability Analysis, Dynamical Systems, Probabilistic Distributions in Statistics.

Subjects of study (modules) are taught in a consistent manner. The frame of subjects description has been well prepared. It involves all details (prerequisites, course learning outcomes, programme learning outcomes, teaching/learning methods, assessment methods, etc.) However, analyzing subjects description in SER, Annex 2, the review team has discovered some areas of improvement. For example: prerequisites for the subject Data Visualization are basic knowledge of mathematics (it is not clear/ specific enough what it means); there does not exist knowledge of some programming language, some projection methods, etc. The aim of subject Dynamical Systems is to develop understanding in dynamical systems (the same as the subject title); the aim of the subject Probabilistic Distributions in Statistics is to provide understanding of probabilistic distributions in statistics, etc. Short course annotation of the subject Dynamical

Systems consists Fractals and fractals dimensions. But in the content does not exist this theme explicitly. Analyzing some themes in subjects (e.g. Linear programming models. Simplex models in Operational Research; different data visualization methods for simple and multidimensional (big) data, starting from simple line, bar, box and other plots, and moving to trees, graphs and projection techniques in the subject Data Visualization). The review team concludes that understanding of these themes need a deeper knowledge of geometry of n-dimensional spaces.

Teaching/learning methods as well as assessment methods are well chosen including classical way and new ones: homework tasks with analyzing and discussion using team work, its presentation, etc. (e.g. Data Visualisation subject). During the meeting with students the review team learned that students develop scientific research abilities in projects whose leaders are teaching staff of VDU or researchers from Institute of Energy Safety. Students succeed to publish their results in the scientific journals. They are encouraged to be interested in the research by teaching staff and social partners organizing meetings to discuss problems and students' results. Alumni representatives informed the review team that they acquired very good theoretical background and software skills. Graduates emphasized need for more applied mathematics.

Social partners informed the review team that they cooperate with VDU in various fields, but especially emphasized good cooperation in proposing master degree thesis themes, participating in assessment commissions of thesis, recommending new important subjects, etc. They pointed out also graduates of this study programme are well prepared for all work challenges in their companies and research institutes, including enlargement in their education.

The review team also concluded that several important actions in order to respond the recommendation in the previous evaluation report as well as graduates opinion have been successfully realized. E.g. study subjects: Asymptotic Methods in Probability Theory, Numerical Methods for Nonlinear Problems, Experiment Design, Applied Stochastic Processes have been replaced with Applications of Differential Equations, Operations Research, Sample Theory, Probabilistic Distributions in Statistics. (more details one can find in SER, p.12).

Consequently, the review team concludes content of subjects (modules) and study methods enable to achieve the intended learning outcomes. The content of the programme correspond to the latest academic and technological achievements. The part of the curriculum related to the subjects on risk and reliability analysis is unique in the context of similar Master's programmes in Lithuania.

2.3. Teaching staff

In total there are 19 lecturers affiliated with the Programme; 12 lecturers are full time and 7 not full time employees at VDU, there are 11 professors and 5 associate professors. Comparing with the previous evaluation period there are big changes: during the 2012-2016 period 9 teachers have left the Programme and 8 new teachers have joined the Programme, the main reason being restructuring of the Programme. Three of the teachers are over 65 years old and within the next few years need replacement. However, VDU has a contingency plan for their replacement in the future, as their former students with the same research interest and necessary qualification are already affiliated. This is a very positive development.

The vast majority (95%) of lecturers teaching mathematical disciplines have doctor degree in mathematics (no less than 80% required). 80% of all subjects are taught by professors (no less than 20% required). The legal requirement therefore are well met.

The 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, the applications of probability theory in practice, uncertainty and sensitivity analysis, categorical data analysis, sparse data analysis, statistical linguistics, and

applied statistics, application of statistical methods in medicine, biology and genetics, directional statistics, 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, studies of ICT infrastructure development, studies of design and implementation of IS in organizations, standard making processes in the field of ICT, studies of technology innovation, signal processing, learning (including neuronal) systems, neuronal system modelling, applications of the principles in robotics, statistical and machine learning, language technologies and scientific infrastructure, data mining and natural language processing.

89% of courses are taught by teachers, who perform research in the field of taught subject (no less than 80% required). Some external lecturers from other academic institutions and industry are invited for certain courses, mainly elective ones.

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. A substantial number of teachers participate in the LLP/Erasmus programme or use other possibilities for academic mobility (yearly average of 42%). In the period of 2012-2016, the teachers of the Programme participated in 43 national and 31 international projects. 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 very 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 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: 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 accessible 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.

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 Research Council organized competitions for students' scientific practice.

2.5. Study process and students' performance assessment

The admission to the programme is organised by the University. All entrance requirements and procedures are clear and public in VDU internet page. Graduates of other programmes, possessing a degree in related branches (mentioned in the SER), can participate in the contest after finishing a special individually tailored supplementary study programme. The competitive mark consist of an average of all exam marks in the Bachelor's diploma (30% of the mark), an average of all speciality subjects in Bachelor's diploma (60% of the mark) and a mark of the Bachelor's thesis (10% of the mark). A motivation check or scientific research achievements are not included, which is typical for other universities. The total number of admitted students is consistent during last 5 years and balance around 10. The highest scores of admitted students are very high, but slightly decreasing annually (from 9,91 in 2012 to 8,83 in 2016). The statistics of admitted students' average scores shows, that programme attracts students with good results. The rate of students graduated on time is good for postgraduate studies' programme, it is increasing yearly and reached 80% last year. Overall, the admission criteria and process is consistent, transparent and well-founded.

The studies seems to be flexible and liberal, orientated to the students' needs with possibility to choose a part of studies' subjects, individual study plans. Students are introduced to each subject of the programme at the first lecture, consequently, important academic information is spread. There is a well-developed feedback system between students and lecturers, both in formal and informal ways. In conclusion, organisation of the study process is progressive, it ensures proper implementation of the programme and achievement of the intended learning outcomes.

Students are encouraged to take part in scientific research. First of all, students are encouraged to learn to make reasoned decisions, analyse and assess their research during research projects and other homework. Students are also encouraged to participate and present their research works at joint conference by Vytautas Magnus University, Vilnius University and Kaunas University of Technology as well as in other scientific events. Students have plenty of information about possibilities of deeper scientific research. Students with high scientific achievements may get scholarships or employment in laboratories of the University. Students of the programme writes a lot of scientific papers (approximately 17 per year). To conclude, students' encouragement and their participation in scientific activities are well developed.

Students are provided with possibility 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 demonstrate very high academic mobility too (36% of them work on short time basis abroad every year). However, students noticed, that still there is a lack of information about mobility programs.

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 great development is possibility of communication 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. This is in fact true. 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 appellation of exam's results are foreseen. The Master's Thesis is mentioned as the most important proof of the student's qualification, which should reveal the knowledge of theories, methods, and techniques, the application of them in practice. The list of 2012-2016 thesis and marks of them shows, that these outcomes are reached.

A high graduates' employment rate reveals, that professional activities of the majority of programme graduates correspond to the expectations of programme operators and employers. It 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, if it is possible.

The University organises data collection about graduates' tendencies of the employment from labour exchange, alumni and students' surveys, which shows that University tries to fulfil the expectations of employers, as well as the need of the labour market to correspond to the state economic, social and cultural needs.

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.

Students are provided opportunities to make complaints and lodge appeals in accordance with clear, public and transparent procedures. 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 Master Programme 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 results, Programme structure and contents, study organization processes, the dynamics of student number, academic personnel and other Programme related resources. Student 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 is 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 **Applied Mathematics study programme** is presented in the yearly VDU publication "Study at the Vytautas Magnus University", as well as in other publications introducing the studies at Lithuanian Universities. A student can also get the necessary information via the communication channels of the VMU Marketing and Communication Office, VMU (<http://www.vdu.lt>) and VMU IF (<http://if.vdu.lt>) websites. These websites present relevant event announcements, Programme descriptions and other important information is published in other specialized publications and websites as well as corresponding press releases are prepared. However during the visit English version of website was not working properly.

2.7. Examples of excellence *

* if there are any to be shared as a good practice

Core definition: Excellence means exhibiting characteristics that are very good and, implicitly, not achievable by all.

Explanatory context Excellence enshrines one meaning of quality: a traditional view that associates quality with the exceptional

III. RECOMMENDATIONS*

1. Subjects description need to be more precisely defined in compliance with analysis of curriculum design presented above.
2. Efforts should be made to present the information about possible mobility programmes as clearly as possible.
3. The description of the Programme should make clear distinction between learning outcomes gained by core subjects and by elective courses. Such distinction would be valuable for students.

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 are assigned with courses. The needs analysis is convincing.

In terms of Curriculum design, Programme structure and indicated number of credits is appropriate for students to achieve successfully the objectives of the studies. The Programme is designed to meet the demand of professionals with skills in risk and reliability analysis and in data analysis. Subjects of study (modules) are taught in a consistent manner. Alumni representatives reported very good theoretical background and software skills acquired. The part of the curriculum related to the subjects on risk and reliability analysis is unique in the context of similar Master's programmes in Lithuania. However, the Expert Team has discovered some lacks in detailed of subjects, their aims and prerequisites. The frame of subjects description is correct, but the espied lacks in subjects description are necessary to consider and improve in all details. Graduates emphasized needs of more proper examples from real-life to motivate students being interested in theoretical knowledge.

The academic staff is highly qualified and competent: 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. High percentage of professors and associated professors. Some lecturers do research together with the industrial and academic organizations in the regions. Student research is encouraged by lecturers, which is also a plus.

However, great percentage (37%) of teaching staff are not full time employees at VDU. There is lack of experience in certain topical areas and therefore several study subjects are being taught by part-time teachers from other study or research institutions. 3 very high qualified academic staff members are approaching retirement nearest years and need replacement. Not enough oral exams and presentations are in place; it can lead to a lack of communication skills.

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 e-books and e-textbooks (e.g. Springer EBooks Collections).

In terms of study process and students' performance assessment comprehensive academic and social support is present for students. There is a well-developed internationalization strategy and students mobility statistics, however further improvement is necessary, especially in providing information about mobility programs. Good cooperation and communication with social partners and alumni, and good graduates' employment rate and career possibilities are reported, which is a plus. Students are being successfully encouraged to take part in scientific activities, there are good results of these activities. However, there is a lack of non-traditional teaching methods and everyday usage of IT elements, no consistent usage of Moodle. Studies should be mores oriented to practical work - more group-based and project-based approach.

In terms of Programme management, quality management structure is defined clearly in the internal documentation of the University. Good cooperation with non-educational partners is present. Close cooperation between students and teachers is a plus. Analysis of QA is supported by statistical data.

V. GENERAL ASSESSMENT

The study programme Applied mathematics (state code – 621G12001) 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	4
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:	19

*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 ANTROSIOS PAKOPOS STUDIJŲ PROGRAMOS
 TAIKOMOJI MATEMATIKA (VALSTYBINIS KODAS - 621G12001)
 2017-09-14 EKSPERTINIO VERTINIMO IŠVADŲ NR. SV4-194 IŠRAŠAS**

<...>

V. APIBENDRINAMASIS ĮVERTINIMAS

Vytauto Didžiojo universiteto studijų programa *Taikomoji matematika* (valstybinis kodas – 621G12001) vertinama **teigiamai**.

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

*1 - Nepatenkinamai (yra esminių trūkumų, kuriuos būtina pašalinti)

2 - Patenkinamai (tenkina minimalius reikalavimus, reikia tobulinti)

3 - Gerai (sistemiškai plėtojama sritis, turi savitų bruožų)

4 - Labai gerai (sritis yra išskirtinė)

<...>

IV. SANTRAUKA

Kalbant apie programos tikslus ir studijų rezultatus, Europos ir Lietuvos rekomendacijos, standartai ir teisiniai reikalavimai aukštajam mokslui įvykdyti. Studijų rezultatai aiškiai pateikiami SS, priskirti dalykams. Poreikių analizė pagrįsta.

Vertinant programos sandarą, programos struktūra ir nurodytas kreditų skaičius leidžia studentams pasiekti studijų tikslus. Programa sudaryta taip, kad būtų paruošti specialistai, turintys rizikos ir patikimumo analizės bei duomenų analizės įgūdžių. Studijų dalykai (moduliai) dėstomi nuosekliai. Absolventų atstovai nurodė labai geras įgytas teorines žinias ir programinės įrangos naudojimo įgūdžius. Studijų programos dalis, susijusi su rizikos ir patikimumo analize, yra unikali palyginti su analogiškais magistrantūros programomis Lietuvoje. Tačiau ekspertų grupė nustatė ir keletą dalykų aprašymų, tikslų ir pasirengimo reikalavimų trūkumų. Dalykų aprašymai teisingos formos, bet reikia apsvarstyti ir pašalinti jų trūkumus. Absolventai pabrėžė, kad reikia daugiau tinkamų realaus gyvenimo pavyzdžių, kurie skatintų studentų domėjimąsi teorija.

Akademinis personalas turi aukšto lygio kvalifikacijas ir yra kompetentingas: dėstytojai aktyviai dalyvauja mokslinių tyrimų veikloje, yra išleidę nemažai mokslinių publikacijų ir atlikę keletą mokslinių tyrimų projektų. Akademinis personalas dalyvauja tarptautinėse konferencijose, mokslinių tyrimų stažuotėse, tarptautinėse mainų programose. Didelė profesorių ir docentų procentinė dalis. Kai kurie dėstytojai atlieka tyrimus kartu su pramonės ir akademinėmis

organizacijomis regione. Dar vienas plusas tas, kad dėstytojai skatina studentus vykdyti mokslinius tyrimus.

Tačiau didelė dalis (37 %) dėstytojų nedirba VDU visu etatu. Tam tikrose aktualiose srityse trūksta patirties, todėl kai kuriuos studijų dalykus dėsto puse etato dirbantys dėstytojai iš kitų studijų ar mokslinių tyrimų įstaigų. Trys labai aukštą kvalifikaciją turintys akademiniai darbuotojai per artimiausius metus išeis į pensiją, juos reikės pakeisti. Nepakankamas skaičius egzaminų žodžiu ir pristatymų. Dėl to gali nukentėti bendravimo įgūdžiai.

Vertinant materialiuosius išteklius, visos dėstytojų skirtos darbo vietos tinkamai įrengtos. 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, studentams siūloma 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, skelbiamas geras absolventų įsidarbinimo rodiklis bei karjeros galimybės – tai teigiamas dalykas. Studentai sėkmingai skatinami dalyvauti mokslinėje veikloje, šios veiklos rezultatai yra geri. Tačiau trūksta netradicinių dėstytojų metodų, kasdienėje studijų veikloje nėra pakankamai naudojami IT elementai, trūksta nuoseklaus „Moodle“ naudojimo. Studijos turėtų būti labiau orientuotos į praktinį darbą – daugiau grupinių ir projektinių darbų.

Vertinant programos vadybą, universiteto vidaus dokumentuose aiškiai apibrėžta kokybės valdymo struktūra. Geras bendradarbiavimas su ne švietimo srityje veikiančiais partneriais. Glaudus studentų ir dėstytojų bendradarbiavimas. Kokybės užtikrinimo sistemos analizė pagrįsta statistiniais duomenimis.

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III. REKOMENDACIJOS

1. Dalykų apibūdinimai turi būti patikslinti pagal pirmiau pateiktą programos sandaros analizę.
2. Reikėtų stengtis aiškiau teikti informaciją apie vykdomas judumo programas.
3. Programos aprašyme turėtų būti aiškiai atskirti privalomųjų dalykų ir pasirenkamųjų dalykų studijų rezultatai. Tai praverstų studentams.

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