STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

VILNIAUS GEDIMINO TECHNIKOS UNIVERSITETO

STUDIJŲ PROGRAMOS *TECHNOMATEMATIKA (621G16001)* VERTINIMO IŠVADOS

EVALUATION REPORT OF *TECHNOMATHEMATICS* (*621G16001*) STUDY PROGRAMME

at VILNIUS GEDIMINAS TECHNICALUNIVERSITY

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Išvados parengtos anglų kalba
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Vilnius
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DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	***Technomatematika***
Valstybinis kodas	621G16001
Studijų sritis	Fiziniai mokslai
Studijų kryptis	Matematika
Studijų programos rūšis	Universitetinės studijos
Studijų pakopa	Antroji
Studijų forma (trukmė metais)	Nuolatinė (2 metai)
Studijų programos apimtis kreditais	120
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Matematikos magistras
Studijų programos įregistravimo data	2008-06-24

INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	***Technomathematics***
State code	621G16001
Study area	Physical Sciences
Study field	Mathematics
Kind of the study programme	University studies
Study cycle	Second
Study mode (length in years)	Full-time (2 years)
Volume of the study programme in credits	120
Degree and (or) professional qualifications awarded	Master in Mathematics
Date of registration of the study programme	2008-06-24

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I. INTRODUCTION

1.1.Background of the evaluation process

The evaluation of on-going study programme is based on **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 (further – SKVC).

The evaluation is intended to help higher education institutions to improve constantly 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 (further - HEI); 2) visit of the expert team at the higher education institution; 3) production of the evaluation report by the expert team and its publication; 4) follow-up activities.*

On the basis of external evaluation report of the study programme SKVC takes decision to accredit study programme either for 6 years or for 3 years. If the programme evaluation is negative such a programme is not being 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 area 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 provided by HEI before, during and/or after the site-visit:

No.	Name of the document
1.	Examples of written tests
2.	Two textbooks written by Professor Raimondas Čiegis

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

The Departments of Mathematical Modelling, Strength of Materials and Theoretical Mechanics located in the Faculty of Fundamental Sciences of the Vilnius Gediminas Technical University (VGTU) are directly responsible for the programme, overseeing its delivery and monitoring. VGTU is an institution of higher education whose start is deemed to be September 1, 1956, when Vilnius Evening Division of the Evening of Kaunas Polytechnic Institute (KPI) was established. Now VGTU belongs to the top four per cent of the best universities of the world according to the data of the international university rating '2013-2014 QS World University Rankings'. It consists of 9 faculties and 1 institute of studies: "A. Gustaitis" Aviation Institute, the Faculty of Environmental Engineering, Architecture, Electronics, Fundamental Sciences, Creative Industries, Mechanics, Civil Engineering, Transport Engineering and Business Management. The structure includes 60 departments. Research is conducted in 6 University research subdivisions, 22 faculty research centres and 9 accredited laboratories. Other departments, such as Department of Philosophy and Political Theory, Foreign Languages, etc. are also involved in the Study programme development and implementation. VGTU also consists of library, publishing house, administration and other subdivisions.

Technomathematics study programme of Master level with 120 credits belongs to the Technomathematics Studies branch (G160) and is attributed to the Physical Sciences' Mathematics field (G100) of studies.

1.4.The Review Team

The review team was completed according to *Description of experts' recruitment*, approved by order No 1-55 of 19 March 2007 of the Director of the Centre for Quality Assessment in Higher Education, as amended on 11 November 2011. The Review Visit to HEI was conducted by the team on *16th October, 2014.*

1. **Prof. Dr. Neda Bokan (team leader),** *full Professor at State University of Novi Pazar, Serbia.*
2. **Prof. Dr. Carl Winslow,** *full Professor of didactics of mathematics, Deputy Head of research at Dept. of Science Education, University of Copenhagen, Denmark.*
3. **Prof. Dr. Tomaž Pisanski,** *Professor of Discrete and Computational Mathematics, University of Ljubljana, Slovenia.*
4. **Prof. Habil. Dr. Alfredas Račkauskas,** *Professor in Faculty of Mathematics and Informatics, Head of the Department of Econometric Analysis, Vilnius University, Lithuania.*
5. **Mr. Žilvinas Kalvanas,** *student at Kaunas University of Technology, Faculty of Economics and Business, Lithuania.*

II. PROGRAMME ANALYSIS

2.1. Programme aims and learning outcomes

The intended learning outcomes of the programme are formulated on the basis of the VTGU Senate Resolution No. 57-1.7 of May 29, 2012 "On Description of the Full-time and Part-time Study Implementation Procedures". They are also available at the University information system "Alma Informatica", on the website of the Department of Mathematical Modelling, at AIKOS, LAMABPO, and presented annually at VGTU "Open Doors" event.

The programme aims and learning outcomes are based on the academic and/or professional requirements, public needs and the needs of the labour market. Social partners stress the need of strong presence of mathematics in the curriculum. However, they also point out that some subjects and skills that could have been achieved are not present in current curriculum. In particular they wanted to have more scheduling theory, operations research present as well as mastering computer engineering skills, like unit testing that could be mastered via a seminar partnership between teaching staff, social partners and students. There are other means where knowledge transfer and specialization for Master students can be organized: seminars, final theses (joint supervision, one academic advisor and social partner co-advisor), elective courses, work practice (internship), specialized scholarships by social partners, possible with constraints imposed by social partners, e.g. in direction of specialization field or choice of specific co-advisor from the social partner. If some topic (e.g. Markov chains, graph theory, bio-technology) is better covered by some partner university, the student could use Erasmus program to learn it abroad.

The programme has been designed according to the guidelines set up in Dresden in 2003 by the "Position Paper Concerning the Study Programme Technomathematics".

"Technomathematics" is a term that is used in university programmes of several European countries, mainly Germany, Austria and some Scandinavian countries. It covers partof applied mathematics focused around numerical computing and partial differential equations. The name of the programme, its learning outcomes, content and the qualifications offered are compatible with each other. Since this programme is unique in Lithuania and no comparison with Technomathematics programmes in other European Universities is provided it is very difficult to tell if the Masters will be indeed comparable with other Masters completing their studies in other European universities. This is an interdisciplinary programme (mathematics, informatics or computer science and engineering). The programme aims should clearly and publicly indicate which doctoral studies are accessible to Technomathematics Master students. In particular, it should be pointed out that some graduates of the programme have successfully completed PhD programs in mathematics, engineering and informatics. On the other hand, the information about entrance conditions to this Master programme should be advertised in public.

The intended learning outcomes are very well designed and presented in SER where they are divided into five groups: Knowledge and Its applications (K1-K7), Abilities to conduct research (RA1-RA5), Special Abilities (SP1-SP3), Social abilities (SA1-SA4) and Personal Abilities (PA1-PA3).

2.2. Curriculum design

The study programme was developed according to Lithuania’s legal acts regulating the structure of study programmes and VGTU programme framing rules. One credit in this programme

corresponds to 26.67 hours. It keeps within bounds as in other countries within EHEA. The methodology of distribution of credits among courses is modified from time to time after the analysis of students results as showed in the evaluation of their knowledge and other abilities.

The curriculum is designed in a very interdisciplinary way in order to give students basic knowledge in applied mathematics, related informatics and basics of engineering. The emphasis resides in numerical solutions of differential equations related to mechanics. Other study subjects are spread very widely covering some specific topics like data visualization. It would be much better to have several branches that go deeper and would give student a choice of selecting a speciality.

In SER Table 2.1 very well describes the correlation of the programme and courses' learning outcomes. It may be difficult to verify if the checks in the table indeed correspond to the "Description of the study subjects" (Appendix 2 of the SER). The order of the lines in Table 2.1 does not correspond to the order in which the courses are listed in the Appendix 2. The names of the courses are not the same, probably due to the fact that different people have translated the course names into English. There is also some confusion since some Courses (according to Table 3.2 of SER) such as Final Thesis 1 carry a single course code, such as FMMMM1103, but they are called "study subject module" in Appendix 2 and may appear several times, depending on the department at which they are offered. Methods for the assessment of student achievements are quite diverse but mostly given as a linear combination of partial scores sometimes involving close to 10 terms. The question arises whether such diversity is due to the nature of the course or is it more linked to the teacher's preferences. The problem is that the students get too wide and too shallow knowledge. It would be much better if the programme would offer several specialized directions, such as bioengineering, software engineering, IKT, etc.

Most courses are upper level courses that bring advanced knowledge to students. Other courses give students broader knowledge of non-mathematical topics (e.g. Design of Engineering Objects, Information Visualization Technology, Management of IT Projects, Scientific Research and Innovations).It is not clear whether the methods and content of the subjects and modules are appropriate for the achievement of the intended learning outcomes. For instance, RA2 speaks of "biological objects", yet it is not clear where the background on bioinformatics or bioengineering could come from. Also, SA1 assures that the student is capable to convey information orally and to find the information resources. Usually weekly seminars where students have to prepare a presentation and have to deliver it in classroom is the best test that students are capable of oral dissemination of their knowledge. The fact that students are able to find information resources is visible in the list of references in their Master theses. On the other hand citations to the references are mostly missing in the texts of their Theses. Generally, the modelling and measurement of learning outcomes is a hard and new problem in the concept of student-centred learning approach in higher education. Hence, the academic staff needs to cooperate mutually to improve the content and methods for the achievement of the intended learning outcomes. This can be achieved in periodic meeting following the progress of the program and also in the stage of preparation of the SER for the next evaluation. For any learning outcome a member of the program management should meet all teachers of courses contributing towards that specific learning outcome and discuss the details of achieving that learning outcome.

It is very hard to verify if the scope of the programme is sufficient to ensure all learning outcomes. In particular, it is not clear whether the offered subjects indeed prepare a student to reach the intended outcome. For instance, RA2 states "Are able to develop mathematical models of physical, technical and biological objects following the basic principles of mathematical modelling methods." The review team could not find any course that would give the student the

necessary background in modern biological, bioinformatics or biotechnological principles. This could probably be achieved by offering at least some elective courses in the wider area of molecular biology.

The content of the programme reflects the latest achievements in science and technology. For instance, there is a course on information visualization technology. Also, parallel algorithms are considered and the academic staff has facilities for parallel computations at their disposal and has all necessary know-how with original textbooks written by members of the teaching staff of the VGTU. However, the latest knowledge can only be transferred to the students when the teachers are active in research in the topics covered by the programme. The crucial problem with this Master degree programme is that it is too broad and does not give each student a possibility to specialize. It should be redesigned by introducing advanced elective courses, such as Markov Chains, Software Engineering, etc. that would enable any student to specialize accordingly.

2.3. Teaching staff

The study programme is provided by the staff meeting legal requirements. There are 13 teachers engaged in the programme: 6 Professors, 7 Associate Professors and 1 Lecturer. The teacher-student ratio is constantly increasing 0,35 - 0,43 - 0,72 - 0,93 - 1,00. Unfortunately, this is lately due to the fact that the student population is decreasing from 30 in the peak year 2009/2010 to 13 in the latest year 2012/2013, covered by SER.

The qualifications of the teaching staff are adequate to ensure learning outcomes. They all have necessary degrees from the correct specialities, e.g. branches of mathematics. The only possible exception is the lack of knowledge of the biological sciences as set up in learning outcome RA2 of SER.

The number of the teaching staff (13)is adequate to ensure learning outcomes. The teacher-student ratio is very favourable and it would be difficult to argue that an increase of the number of the teaching staff is necessary. However, the review panel learned from teachers themselves during the on-site visit that teachers have very high teaching load (over 20 weekly contact hours) since they have to teach also in other programmes.

The age structure of the teaching staff is not optimal for internal replacement since the number of senior teachers outnumbers the number of junior teachers. There are 7 over 50 and 6 under 50 years. But this is an excellent opportunity for the external replacement which may maintain or even increase the average quality of the teaching staff when senior researchers reach retirement age.

The higher education institution at the faculty and programme level is trying to create conditions for the professional development of the teaching staff necessary for the provision of the programme on the expense of mathematicians. However, these efforts are undermined at higher levels. Namely, teachers have heavy teaching load and no sabbaticals due to the university policy that is outside of the decision making at the faculty level.

Most of the teaching staff of the programme is involved in research directly related to the study programme being reviewed. This is true for the senior researchers. They publish research articles in the international journals and they also summarize their work and knowledge in publishing advanced level textbooks. The international cooperation and the visibility of the research could be improved in particular for the junior researchers. This should be achieved by increasing the

exchange visits of scholars and students, increase of international projects, by introducing sabbatical leaves that are spent abroad, by attracting international students and teachers.

2.4. Facilities and learning resources

At site visit it was possible to verify that VGTU is equipped with classrooms, laboratories, computer rooms, libraries, reading rooms, etc. which are adequate both in their size and quality for studies. These facts have been checked during the visit of VGTU.

VGTU is equipped with equipment important for experiments in the engineering frame, various legal software (Maple, AutoCad, Matlab, Mathcad, etc.). Students of Technomathematics can also use the technology installed in Parallel computing lab. The lab has a PC cluster VILKAS with nodes of two types. Let us mention only few software libraries for programme design and visualization available in the cluster: Fortran, C++/C, BOOST, CUDA, FFTW, GSL, HDF5, ICTCE, etc. The lab also has several EGEE certified GRID clusters, fully integrated into the European GRID infrastructure (EGI). Modern technologies 'Clouds' are investigated and tested in the lab too. Two graduates of Technomathematics programme are employed in this lab. Students carry out their engineering experiments using the mechanical materials testing equipment. Students use Oracle SQL and Oracle Designer software programmes. The University has 1Gps optical backbone computer network which reaches the computer rooms in the Faculty of Fundamental Science and the dormitories. All the university buildings are equipped with wireless computer network EDUROM. All classrooms equipped with video projectors are adequate both in size and quality. An exhaustive list of the equipment installed in the computer rooms is provided in Annex 9. Partially mentioned teaching and learning equipment allow to conclude that students have the approach to modern technologies and consequently good conditions for high quality studies.

By establishing a good link with social partners the faculty and the programme mangers could set up a system of advanced practice in which Master students could conduct their final thesis preparation under a partial guidance of experts from social partners. Social partners could attract such collaboration if they would offer scholarships to Master students. In this way final theses could serve as a bridge from studies to the beginning of a job.

In the Annex 3 the list of main bibliography (no more than 3 sources) and additional bibliography (no more than 10 sources) for each study subject module is presented. It is well prepared and concentrates on reading only the most important data for all issues (title, name of the author, publishing company, etc). Textbooks and other teaching materials written by the VGTU academic staff are also available for other users (either in the electronic form or classical one).

The library of VGTU at this moment subscribes 28 databases such as: Springer LINK, Science Direct, Oxford University Press Journals Collection, etc. Library has 3 journal archives: Cambridge Journals Online (2003-2006) archive, IOP Publishing Archive collection 1874-1999, Springer Link Archive.

The study programme Technomathematics has 993 e-journals and 1588 e-books. The review team refers to the site www.ebooks.vgtu.lt for more details.

2.5. Study process and students‘ performance assessment

There are no entrance examinations for the Technomathematics Master study programme. This enables more students to start the Master studies. The number of entrants to this Master programme is as follows: 2009: 14, 2010: 11, 2011: 7, 2012: 9, 2013: 6. This means that the number of students is dropping. More than one half of students having entered in 2009 and 2010 did not complete their studies. It is assumed that the university admits weaker, less motivated students in order to fill the financed places. The evaluation group would like to point out that the experts had a joint meeting with student representatives of Bachelor and Master degree programmes of Technomathematics. During this meeting the group learned that several Bachelor level students plan to enrol to Maser level programmes in a more specialized way, either in mathematics, informatics or engineering. This is one of reasons why it is necessary to make some changes in the design of the Master level curriculum.

In order to increase the motivation of students and attraction of these studies, the study programme feasibility study was prepared together with foreign universities, see http://www.techmat.vgtu.lt/skelb_files/JM_GalimybiuStudija.pdf. The plans are to get involved in the activities of the ECMI (European Consortium of Mathematics in Industry).

The students are encouraged to actively participate in scientific conferences this help them to prepare their final theses.

The students are consulted on various study issues, for example career possibilities, etc. They can also get different scholarships – motivating scholarships (nominal and other scholarships for good study results), one-time scholarships and benefits. The students may leave according to mobility programs but this opportunity is hardly used (only one student, who went to Riga, Latvia is mentioned in the self-evaluation report); the reason is that students from the Master studies already have jobs.

The assessment system of students is clearly regulated and the knowledge assessment system is criteria-proportional. The knowledge of students is assessed in the ten-score system. The assessment formula is only indicated in the module card; the information on the assessment criteria of the students’ results is announced in the website of the university and is accessible in public in the website for the students. The students are familiarized with the assessment and recitation order in the first lectures of every module.

According to the self-evaluation report, almost all students from the Master studies work and study at the same time and their jobs are related with their study programme partially or a little.The graduates of the study programme mostly start working for public institutions, business companies and scientific institutions, e.g. UAB "Affecto Lieuva", UAB "Atea",AB, "SEB bankas", UAB "Dauda", UAB "Diginet LT", UAB "Pigu", VI "GIS - Centras", Vilnius University Institute of Mathematics and Informatics.

The topics of Master theses are relevant in modern situations. During the on-site visit one of the social partners said: "The keyword is mathematics". This means that the topics studied in various mathematics courses make students able to abstract thinking and thus adaptable to most diverse real-life situations. Special topics such as engineering are also useful but it would be better to have student select just one of them and learn it more in-depth.

2.6. Programme management

The programme management, decision-making and control are implemented at various levels: from the state level, through the University level, the Faculty level to the Department level. All procedures are clearly defined in details. The interests of students are represented by their delegated representatives in the Programme Study Committee in the Faculty Study Committee and the Council. All details are presented in the corresponding website.

Information and data on the implementation of the programme are regularly collected. It is stored in the VGTU information system "Alma Informatika". It is also upgraded at the Dean's and Rector's level. Particular accent is given to quality assurance. For this purpose the university started to implement the project "Introduction to the Internal Study Quality Management System."

External evaluation of this programme has not been realized so far. The process of the VGTU study programme and quality assurance, as well as programme executors' responsibilities, are described in the documents of various level: Statute, Strategy, resolutions, etc. VGTU is constantly conducting three types of surveys:

1. The survey aimed at all the students of the University on the study subjects they had been taught and the teachers who taught those subjects;
2. First-year undergraduate student opinion survey on the choice of the studies in the University;
3. First-year postgraduate student survey on the quality of Bachelor's study programme.

For the Master programme, in addition to 1-3, a survey of alumni and social partners should be carried out.

In 2012 the University launched a survey on the study conditions. Anyhow, by the opinion of student representatives, a feedback of students assessment is not enough recognizable. It should be improved for instance by making the teachers-students coordination more formal. A coordination of teaching staff in this frame is more or less non-formal. Students should get written response how their suggestions and observations were addressed.

The representatives of social partners are involved in the design of Technomathematics study programme, for instance by giving feedback of what skills are needed for a working place. Namely social partners are members of the programme monitoring committee. Observing the specificity of this programme with these representatives the review team can conclude that these representatives are chosen in a proper way. They understand the world with rapid increasing of information, quick development of technologies and possible adoption of this programme to these circumstances. The Alumni organization for these purposes need to be established in a formal way as well as the partnership with other stakeholders developed.

The internal quality assurance measures are effective and efficient in various aspects. The most delicate process of modelling and measurement of students' competencies might be improved to achieve the character of student-centred learning approach in the implementation of this programme in a proper way.

III. RECOMMENDATIONS

1. Clearly specify and publicly announce prerequisites at the Bachelor's level for students enrolled in this programme and organize consultations and training schedules for students who have difficulties following the programme.

2. Form a team composed of representatives of teaching staff and potential employers to identify which acquired abilities of students can be used in their future working place and the needs of employers that are currently not addressed in the programme.

3. Make scientific seminar part of the curriculum and get students actively involved in the seminar activities. Open this seminar to the public, in particular invite representatives of social partners to exchange ideas with teaching staff, visiting scientists and students at the seminar.

4. Students should present their final theses at regular, weekly, informal seminars. Seminars can also be used as a testing ground for University staff to present preliminary versions of their talks (in English) for scientific conferences. Social partners and industrial representatives should be invited to the seminars for possible cooperation in research and joint projects.

5. The graduate programme is focused entirely on the continuous aspects of applied mathematics and their applications in differential equations and stochastic. It would make the students more employable if they would gain more knowledge of informatics, discrete mathematics with graph theory, operations research and combinatorial optimization. These topics could be offered as elective courses if needed in connection with other faculties or even with some other university and would certainly attract more students.

6. The age distribution of staff members show that there are over 55% in the age group >50. For younger staff members the danger is inbreeding. Since there are over 20 universities in Lithuania, mobility within the country is a viable option. The Department should set up a clear hiring policy with international open calls trying to acquire best researchers from Lithuania and other Baltic or neighbouring countries. The command of English should be a necessary condition for future employments.

7. The number of students is very low and has an alarming decreasing trend. Develop joint Technomathematics study with other universities in Lithuania and other Baltic States.

8. Teaching load is too big and should be reduced in order to give teachers time for research that is required by law.

9. A system of sabbatical leaves should be introduced also for mathematicians.

10. Curriculum at the Master level should be improved by making some courses elective and thereby giving the chance for advanced specialization. For instance, engineering could be replaced by software engineering or bio-engineering.

11. The programme would need to redesign in such a way to have more specializations, compatible with descriptors of this study level.

12. Simplify the formula for students' examination score during the studies. Current formula is not very practical, since it is a sophisticated linear combination of several partial scores.

13. Formalize the partnership with social partners to have better and well-defined cooperation.

14. Establish an alumni organization due to possible promotion of this study programme and better cooperation in many respects.

15. Intensify the promotion of this study programme through the Mathematicians associations to have enrolled students in the future.

IV. EXAMPLES OF EXCELLENCE (GOOD PRACTICE)*

V. SUMMARY

The programme aims are consistent with the learning outcomes. Learning outcomes are divided into 5 groups: knowledge and its application, abilities to conduct research, special abilities, social and personal abilities. The achievement of the learning outcomes allows graduates to adopt themselves in the job, especially due to the solid key mathematical knowledge. Moreover, the employability of graduates is very good and most of them are employed during their studies or immediately after finishing their study.

Curriculum design is the weakest part of the programme. It gives students good knowledge of mathematics, however, the rest of topics are not very deeply covered. It would be better to redesign the study programme with elective courses that would help students specialize at Master's level. During the joint meeting with student representatives of Bachelor and Master degree programmes of Technomathematics the review team learned that several Bachelor level students plan to enrol to Master level programmes in a more specialized way, either in mathematics, informatics or engineering. This is also one of reasons why it is necessary to make some changes in the design of the Master level curriculum.

The influence of well developed international cooperation and research activities of the main part of academic staff, especially publishing of results in the international journals, is very recognizable in the quality of Technomathematics study programme. The academic staff also pays attention on publishing high-quality textbooks that are used in other universities. The workload in teaching does not allow all academic staff members to be active enough in research and international cooperation.

Facilities and learning resources are of very good quality. Students can use the technology installed in Parallel computing laboratory and many others.Library is adequate and allows access to several international databases. Students can assess pedagogical abilities of teachers, their workload, study quality, etc. The review team has learned that students expect better feedback of their assessments. At the university level there exists a general formula for assessing students' performance which is sometimes too complicated and hard to adjust to specific needs of a course.

Social partners are well chosen and help students to realize to find a job. Their representatives are active in a proper way in the design of the programme as they understand the world with rapid increase of information, quick development of technologies and possible adoption of this

programme to these circumstances. Unfortunately, the formalization of the relationship of VGTU with social partnership does not exist.

The teaching load of academic staff is very high. The plan for sabbatical leave does not exist for academic staff. The administrative staff is not active to motivate and encourage academic staff members to be active in research and international cooperation.

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

VI. GENERAL ASSESSMENT

The study programme *Technomathematics* (state code – 621G16001) at Vilnius Gediminas Technical 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	2
3.	Teaching staff	3
4.	Facilities and learning resources	4
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. Dr. Neda Bokan
Grupės nariai: Team members:	Prof. Dr. Carl Winslow
	Prof. Dr. Tomaz Pisanski
	Prof. Habil. Dr. Alfredas Račkauskas
	Žilvinas Kalvanas

Vertimas iš anglų kalbos

VILNIAUS GEDIMINO TECHNIKOS UNIVERSITETO ANTROSIOS PAKOPOS STUDIJŲ PROGRAMOS *TECHNOMATEMATIKA* (VALSTYBINIS KODAS – 621G16001) 2014-12-03 EKSPERTINIO VERTINIMO IŠVADŲ NR. SV4-589 IŠRAŠAS

<...>

VI. APIBENDRINAMASIS ĮVERTINIMAS

Vilniaus Gedimino technikos universiteto studijų programa *Technomatematika* (valstybinis kodas – 621G16001) vertinama **teigiamai**.

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

<...>

V. SANTRAUKA

Programos tikslai dera su studijų rezultatais. Studijų rezultatai yra suskirstyti į 5 grupes: žinios ir jų taikymas, gebėjimai vykdyti tyrimus, specialieji gebėjimai, socialiniai gebėjimai ir asmeniniai gebėjimai. Pasiekę studijų rezultatų absolventai geba juos prisitaikyti darbe, ypač dėl turimų svarių pagrindinių matematikos žinių. Be to, absolventų įsidarbinimo rodiklis yra labai geras ir dauguma jų randa darbą dar studijuodami arba iš karto pabaigę studijas.

Programos sandara yra silpniausia programos dalis. Studijuodami programoje studentai įgyja gerų matematikos žinių, tačiau kitos temos nėra labai išsamiai nagrinėjamos. Būtų gerai pakeisti studijų programos sandarą ir pasiūlyti tokių pasirenkamųjų dalykų, kurie leistų studentams specializuotis. Per susitikimą su Technomatematikos bakalauro ir magistro laipsnių programų studentų atstovais, vertinimo grupė sužinojo, kad keli bakalauro studijų studentai planuoja stoti į

magistro laipsnio studijų programą, tačiau gilintųsi į matematikos, informatikos arba inžinerijos dalykus. Tai dar viena iš priežasčių, dėl kurių būtina šiek tiek keisti magistro laipsnio programos sandarą.

Technomatematikos studijų programos kokybei akivaizdžiai turi įtakos gerai išplėtotas tarptautinis bendradarbiavimas ir pagrindinės akademinio personalo dalies mokslinė veikla, ypač rezultatų publikavimas tarptautiniuose žurnaluose. Akademinis personalas taip pat stengiasi spausdinti aukštos kokybės vadovėlius, kuriais naudojasi ir kiti universitetai. Didelis dėstymo krūvis neleidžia visam personalui pakankamai aktyviai dalyvauti mokslinėje ir tarptautinio bendradarbiavimo veikloje.

Materialieji ištekliai yra labai geros kokybės. Studentai gali naudotis Lygiagrečiųjų skaičiavimų laboratorijos ir daugelio kitų laboratorijų įranga. Bibliotekos ištekliai yra pakankami, joje galima prisijungti prie kelių tarptautinių duomenų bazių. Studentai gali įvertinti dėstytojų pedagoginius gebėjimus, darbo krūvį, studijų kokybę ir pan. Vertinimo grupė sužinojo, kad studentai tikisi geresnio grįžtamojo ryšio, susijusio su jų pasiekimų vertinimu. Visame universitete taikoma bendra studentų pasiekimų vertinimo formulė, kuri kartais yra pernelyg sudėtinga ir sunkiai pritaikoma specifiniams dalyko poreikiams.

Socialiniai partneriai yra gerai parinkti ir padeda studentams atlikti praktiką bei susirasti darbą. Socialinių partnerių atstovai aktyviai ir tinkamai dalyvauja rengiant programą. Jie supranta pasaulį, kuriame greitai didėja informacijos kiekis, sparčiai vystosi technologijos, taip pat tai, kaip būtų galima šią programą pritaikyti prie šių aplinkybių. Deja, šie VGTU santykiai su socialiniais partneriais nėra oficialiai įforminti.

Akademinio personalo dėstymo krūvis yra labai didelis. Nėra akademinio personalo mokslininko atostogų plano. Administracijos personalas nesiima iniciatyvos motyvuoti ir skatinti visą akademinį personalą aktyviai dalyvauti mokslinėje ir tarptautinio bendradarbiavimo veikloje.

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III. REKOMENDACIJOS

1. Aiškiai išdėstyti ir viešai paskelbti, kokie yra bakalauro laipsnio išsilavinimo reikalavimai stojant į šią studijų programą, rengti konsultacijas ir mokymosi planus studentams, kuriems kyla sunkumų studijuojant pagal šioje programoje.

2. Suburti dėstytojų bei potencialių darbdavių atstovų grupę ir nustatyti, kuriuos įgytus studentų gebėjimus galima būtų panaudoti būsimoje jų darbo vietoje, taip pat darbdavių poreikius, kurių programa šiuo metu nepatenkina.

3. Į studijų turinį įtraukti mokslinį seminarą ir užtikrinti, kad studentai aktyviai dalyvautų seminaro veiklose. Seminaras turėtų būti atviras visuomenei, ir ypač socialinių partnerių atstovams, kurie būtų kviečiami dalytis idėjomis su dėstytojais, kviestiniais mokslininkais ir seminare dalyvaujančiais studentais.

4. Studentai turėtų pristatyti savo baigiamuosius darbus reguliariuose, pavyzdžiui, kassavaitiniuose, neoficialiuose seminaruose. Seminarai taip pat galėtų pasitarnauti kaip bandomoji terpė universiteto personalui pristatyti preliminarias savo pranešimų mokslinėse konferencijose versijas (anglų kalba). Socialiniai partneriai ir pramonės

atstovai turėtų būti kviečiami į seminarus, siekiant galimo bendradarbiavimo moksliniuose ir bendruose projektuose.

5. Magistrantūros programoje dėmesys skiriamas išimtinai taikomosios matematikos tęstiniams aspektams ir jų taikymui diferencialinėse lygtyse, taip pat stochastikai. Studentų galimybės įsidarbinti pagerėtų, jei jie įgytų daugiau informatikos, diskrečiosios matematikos ir grafų teorijos, operacijų tyrimų ir kombinatorinio optimizavimo žinių. Šias temas būtų galima pasiūlyti kaip pasirenkamuosius dalykus, jei reikia, bendradarbiaujant su kitais fakultetais ar net kitu universitetu. Tai tikrai pritrauktų daugiau studentų.

6. Personalo pasiskirstymas pagal amžių rodo, kad daugiau nei 55 % darbuotojų patenka į vyresnių nei 50 metų amžiaus grupę. Jaunesniems personalo nariams kyla akademinio nepotizmo grėsmė. Kadangi Lietuvoje yra daugiau nei 20 universitetų, judumas šalies viduje yra reali galimybė. Katedra turėtų suformuoti aiškią samdymo politiką, įskaitant atvirus tarptautinius kvietimus, kad pritrauktų geriausius Lietuvos ir kitų Baltijos ar kaimyninių šalių tyrėjus. Ateityje geras anglų kalbos mokėjimas turėtų tapti būtina įsidarbinimo sąlyga.

7. Studentų skaičius yra labai mažas, o studentų skaičiaus mažėjimo tendencija kelią nerimą. Parengti bendrą Technomatematikos studijų programą su kitais Lietuvos ir kitų Baltijos šalių universitetais.

8. Dėstymo krūvis yra per didelis ir turėtų būti sumažintas, kad dėstytojai turėtų laiko vykdyti teisiniame reglamentavime numatytus mokslinius tyrimus.

9. Matematikams taip pat turėtų būti suteikiamos mokslininko atostogos.

10. Magistro laipsnio programos studijų turinį būtų galima patobulinti, kai kuriuos dalykus siūlant kaip pasirenkamuosius, taip būtų suteikiama galimybė studentams toliau specializuotis. Pavyzdžiui, inžineriją galima būtų pakeisti programinės įrangos inžinerija ar bioinžinerija.

11. Programos sandarą reiktų pakeisti taip, kad atsirastų daugiau specializacijų, suderintų su šio studijų lygmens aprašais.

12. Supaprastinti studentų egzaminų balo skaičiavimo formulę. Dabartinė formulė nėra labai praktiška, nes yra sudėtingas linijinis kelių tarpinių balų derinys.

13. Oficialiai įforminti partnerystę su socialiniais partneriais siekiant geresnio ir geriau apibrėžto bendradarbiavimo.

14. Įsteigti alumnų klubą, siekiant populiarinti programą ir tobulinti bendradarbiavimą daugeliu aspektų.

15. Intensyviau populiarinti šią studijų programą per matematikų asosiacijas, kad padidėtų stojančiųjų skaičius ateityje.

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Paslaugos teikėjas patvirtina, jog yra susipažinęs su Lietuvos Respublikos baudžiamojo kodekso 235 straipsnio, numatančio atsakomybę už melagingą ar žinomai neteisingai atliktą vertimą, reikalavimais.

Vertėjos rekvizitai (vardas, pavardė, parašas)