VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

MATHEMATIC FIELD OF STUDIES (G100)
STUDY PROGRAMME

TECHNOMATHEMATICS
(State code: 612G16001)

SELF-ASSESSMENT REPORT

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Vilnius, March 2014

Study programme profile

Title of the study programme	*technomathematics*
State code	612G16001
Study programme type	university studies
Study cycle	first
Mode of studies (duration in years)	Full-time (4)
Scope of the study programme in credits	240
Awarded degree and (or) professional qualification	Bachelor of mathematics
Study programme registration year	2004

List of the self-assessment report development group

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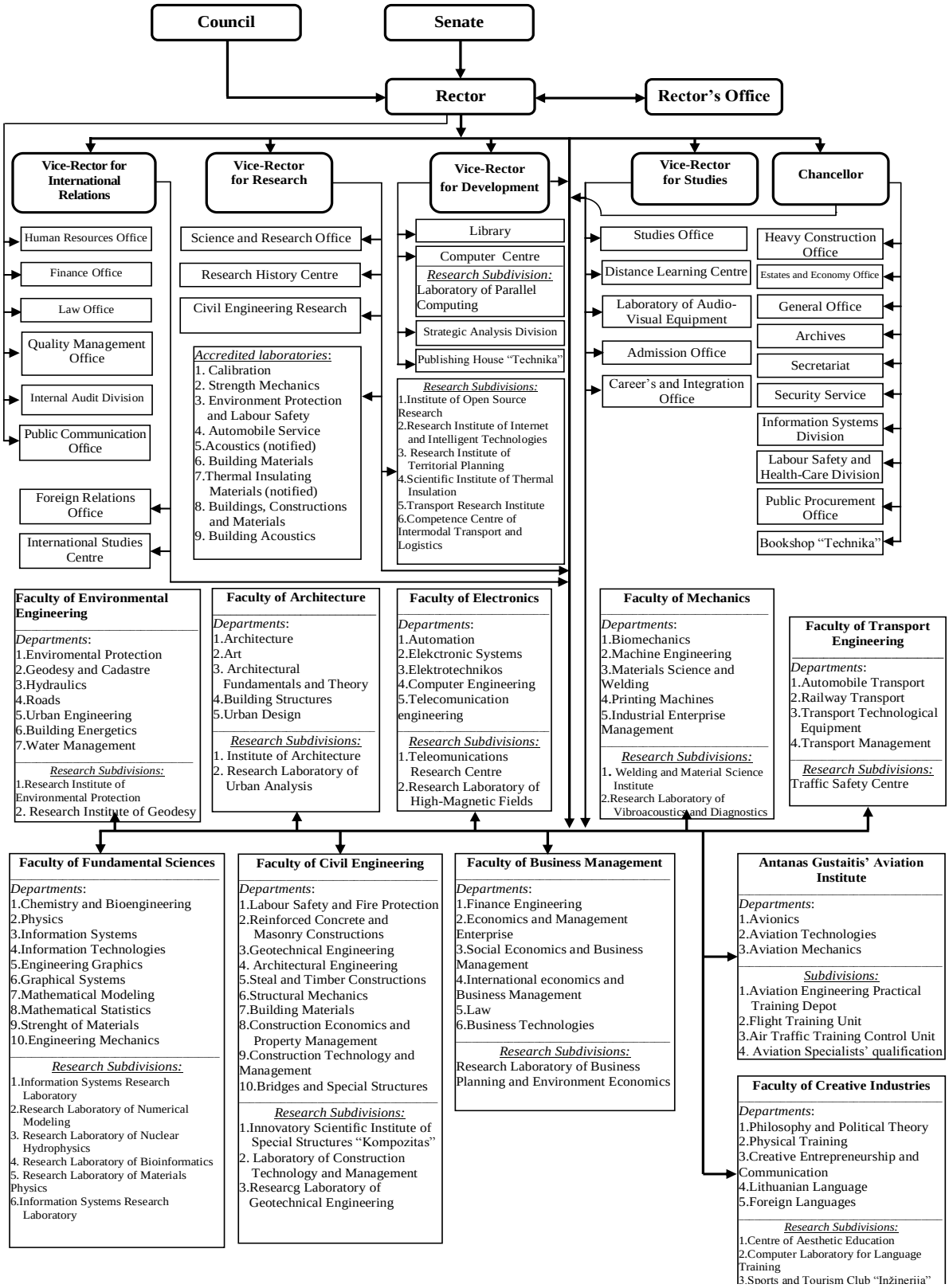
1. INTRODUCTION

1.1 University structure, subdivisions, their management and interrelations, the appropriateness and weaknesses of the structure

1. The university is made of faculties, departments, research and educational laboratories, research and academic institutes and centers, library, publishing house, administration and other subdivisions (Figure 1.1). The Council of university approves and changes the university structure presented by the Rector. Subdivision regulations determine the purpose and competence of the university subdivisions.
2. The main subdivision of university studies and education is department. Department independently solves the objectives of education and studies determined by university and faculty. A department has subordinate laboratories and other subdivisions. A department is supervised by the head of department. The position of the head of department may be assumed by a scientist of the study field, the competence of which corresponds to the determined requirements. The candidature of the head of the department is proposed by the department; the Dean either offers the candidature proposed by the department or proposes another candidature for the approval of the Rector. Rector either offers the candidature of the Dean proposed by the Faculty Council or another candidature for approval of the Senate.
3. A faculty or any other research institute or centre exercising the rights of a faculty is the most important subdivision of study organization. The Faculty is headed by the Faculty Dean. The Dean is assisted by the Dean's Office that is comprised of the Dean, the chair of the Faculty Council, vice-deans, and heads of departments. The term of Dean and the office of the head of the department amount to five years. The Faculty Council is a collegial management body. It is elected for five years by the electoral conference. The Faculty Council approves plans for reorganization of the University structure, scientific, economical and financial actions, takes decisions with regard to studies and scientific research at the Faculty, proposes a candidate for the position of the Faculty Dean to the Rector, considers the annual operating report presented by the Dean, proposes candidates for pedagogical degrees and honorary titles to the Senate.
4. The University has collegial management bodies – the Council and the University Senate. The Council approves the vision and mission of the University; approves the strategic activity plan presented by the Rector; approves principles for selection and assessment of employees of the University; elects, appoints and dismisses the Rector; takes care of the University support. The Council controls and approves University budget and finance, as well as strategic activity (development) plan. The Senate is the collegial management body of the University. The Senate is headed by the Chair of the Senate and the Deputy Chair of the Senate. In Senate work five permanent commissions: research, studies, students, finance, law and ethics. Rector heads the University and is responsible for the results of the University work. The orders of Rector are mandatory for the University employees and students. Part of the Rector's functions is taken by the vice-rectors and the chancellor. The number of vice-rectors and their functions proposed by the Rector are approved by the Council. The general issues related to studies are considered by the Rector's Office which is governed by the Rector. The Rector's Office comprises of vice-rectors, deans and representatives of other subdivisions. The issues related to studies are periodically solved in the Rector's Office with the heads of the departments. Important issues can be as well discussed in the Council, the Senate and the Councils of faculties or in the university and faculty study committees. This structure and interrelations are sufficient in order to carry out study programmes properly.

1.2 Members and schedule of the self-assessment workgroup

5. A workgroup was establish to conduct self-assessment of technomathematics study programme and prepare the self-assessment report (approved by order of VGTU rector of 2013/09/13 No. 810). Members of the workgroup and other critical information is provided in the bottom of the second title-page.
   Self-assessment group members' work areas and the schedule for carrying out the self-assessment activities, approved by the VGTU vice-rector for academic affair on 2013/09/13, are presented in the table in Annex 1.
6. The self-assessment of technomathematics study programme was not conducted previously. This is the first assessment throughout the entire period of programme implementation. By the order of the director of the Quality Assessment Centre in Higher Education of 17 August 2009, No. 1 – 73 "On Accreditation of Study Programmes" (Annex 13) the programme was accredited until 31 December 2014.



1.1. Scheme of VGTU structure

2. PROGRAMME AIMS AND LEARNING OUTCOMES

2.1 Programme aims and learning outcomes

7. Technomathematics study programme is designed for training highly qualified specialists, who can easily adapt in the innovative technologies-oriented society. Mathematical modelling plays an important role in the modern world. Therefore, one of the main aims of the technomathematics study programme is training mathematics specialists, able to merge science, technologies and innovations, on the basis of the sciences of mathematics, informatics and engineering.

   Study programme aims:

   1. Train mathematics bachelors with good fundamentals in mathematics, and deep knowledge of applied mathematics.
   2. Who knows up-to-date mathematical-statistical methods and algorithms, and is able to apply them for solving practical tasks, is able to modify and generalise task profiles, apply advanced technologies for solving complicated tasks.
   3. Has deep knowledge in a particular area of technical sciences and is trained to cooperate with engineers from that area, is interested in mathematics and constantly improves his abilities.

8. The learning outcomes of the study programme reflect the programme aims and market trends. The entire study programme is consistently developed in a way that allows reaching programme aims. Technomathematics study programme learning outcomes are harmonized with the outcomes enumerated in the Mathematics Subject Benchmark Statement, which are to be reached by the mathematics field of studies first cycle graduates. Learning outcomes of the study programme are divided into groups: knowledge and its application, abilities to conduct scientific research, special abilities, social and personal abilities. The results which are achieved by studying the chosen (mathematical modelling or technometrics) specialization are presented for each group.

   Knowledge and its application:

   K1. Students acquire theoretical knowledge of mathematics, informatics and technical sciences.
   K2. Know the interaction of theory and practical application.
   K3. Get acquainted with and master different computer programmes.
   Mathematical modelling specialization
   K4. Know and master different mathematical models and their application possibilities.
   Technometrics specialization
   K5. Know basic mathematical-statistical economic indices' analysis methods and models, applicable in planning, analysis and evaluation of state or enterprise economic indices.

   Abilities to conduct scientific research:

   RA1. Understand the general mathematical laws and are able to apply them for practical activities.
   RA2. Are able to foresee and evaluate the cause-effect correlation, choose adequate economic or engineering problem models.
   RA3. Are able to individually evaluate different mathematical methods and their advantages and drawbacks.
   Mathematical modelling specialization
   RA4. Are able to analyse mathematical models, perform numerical experiments.
   Technometrics specialization
   RA5. Are able to choose and evaluate different economic problem analysis methods and models, are able to plan, model activities, accumulate statistical data.

   Special abilities:

   SA1. Are able to work with abstract notions, think systematically and logically, are able to explain, reveal and ground certain regularities.
   SA2. Are able to model and analyse different processes, harmonize knowledge of mathematics, information technologies and technical subjects.
   SA3. Are able to select and individually improve, realize and analyse mathematical models for solving different problems.
   Mathematical modelling specialization
   SA4. Are able to conduct virtual experiments, analyse industrial mathematical models.
   Technometrics specialization
   SA5. Are able to use up-to-date technologies and special computer software to develop, analyse and evaluate economic performance models.

   Social abilities:

   SC1. Are able to critically evaluate the situation, make decisions, individually carry out the delegated

tasks, analyse and present the results.
SC2. Are able to work in a team, communicate with colleagues, exchange information, discuss, seek compromises and assume responsibility for mistakes.
SC3. Are able to adapt to changes.
Mathematical modelling specialization
SC4. Are able to analyse, evaluate, develop and present new calculus products and improve already existing ones.
Technometrics specialization
SC5. Are able to analyse and evaluate economic indices, generalise them and present evidence-based conclusions and insights, improve already existing models.
Personal abilities:
PA1. Are able to distinguish essential problem-solving moments, work responsibly.
PA2. Are able to master new information and constantly develop their abilities, study individually.
PA3. Are able to plan their activities.
Mathematical modelling specialization
PA4. Are able to communicate on mathematical subjects, are able to adequately convey mathematical models to specialists from other areas.
Technometrics specialization
PA5. Are able to analyse economic indices and present them in the language of mathematics.
The above-mentioned study programme aims and learning outcomes are pursued throughout the entire study process.

9. The aims and learning outcomes of Technomathematics study programme are announced on VGTU website on https://medeine.vgtu.lt/programos/programa.jsp?fak=10&prog=27&sid=F&rus=U and on technomathematics study programme website http://www.techmat.vgtu.lt/. The abridged version of the study programme aims and learning outcomes is included in student's diploma supplement. On top of that, websites visited by pupils, students and other social partners have hyperlinks to VGTU website, therefore, study programme aims and learning outcomes are easily accessible. For instance, they can be easily accessed from the website of Lithuanian Higher Education Institutions Association for General Admission (LAMA BPO) http://www.lamabpo.lt/ and Open Information and Consulting System (AIKOS) http://www.aikos.smm.lt/aikos/index.htm . The pupils from schools that are in close cooperation with the lecturers of the department and students of the technomathematics study programme are introduced to the aims and learning outcomes of the programme. The information is also publicised during the fairs devoted to studies, open door events, classes for pupils.

2.2 Learning outcomes' review periodicity and their compliance with legislation

10. Since Technomathematics study programme merges science, business, technologies and industry, as well as focuses on meeting the demands of this areas, it is significantly reflected while formulating requirements for the technomathematics study programme. With the ever-changing demands of the society and the market, study process regulating legal acts, learning outcomes are constantly reviewed and updated. The learning outcomes of the study programme are discussed during regular meetings of the study programme committee with programme executives and students. The information on the meetings is announced on the programme's website http://www.techmat.vgtu.lt/.
11. In 2013, technomathematics study programme aims and learning outcomes were updated in accordance with the Law on Science and Studies of the Republic of Lithuania (2009-04-30 No. XI-242), Decree of the Government of the Republic of Lithuania "On Approval of Lithuanian Qualification Structure Description" (2010-05-04 No. 535), Order of the Minister of Education and Science of the Republic of Lithuania "On Approval of Study Cycles Description" (2011-11-21 No. V-2212), project of the currently developed Description of Mathematics Field of Studies (SKVC, 2013), decree of the Senate of Vilnius Gediminas Technical University "General Principles for Development of the First Cycle Study Programmes" (2012-05-29 Nr. 57-1.8). The compliance of the programme's learning outcomes is presented in Table 2.1.

Table 2.1. Compliance of Technomathematics study programme with the cycle of studies

	First cycle of studies learning outcomes	Learning outcomes of the programme
Knowledge and its application	Versatile theoretical and complex professional knowledge of the studied area and the professional activities, based on fundamental and scientific research results, which students apply in wide interdisciplinary studies or professional activity areas.	K1. Students acquire theoretical knowledge of mathematics, informatics and technical sciences. K 2. Know the correlation of theory and practical application. K 3. Get acquainted with and master various software. *Mathematical modelling specialization* K 4. Know and master various mathematical models and their application possibilities. *Technometrics specialization* K 5. Know basic mathematical-statistical economic indices' analysis methods and models, applicable in planning, analysis and evaluation of state or enterprise economic indices.
Abilities to conduct scientific research	Are able to collect and analyse data, necessary for solving important scientific, professional problems, cultural and artistic creativity employing methods and achievements of fundamental and applied scientific research.	RA1. Understand the general mathematical laws and are able to apply them for practical activities. RA 2. Are able to foresee and evaluate the cause-effect correlation, choose adequate economic or engineering problem models. RA 3. Are able to individually evaluate different mathematical methods and their advantages and drawbacks. *Mathematical modelling specialization* RA 4. Are able to analyse mathematical models, perform numerical experiments. *Technometrics specialization* RA 5. Are able to choose and evaluate different economic problem analysis methods and models, are able to plan, model activities, accumulate statistical data.
Special abilities	Are able to plan, organize, implement and assess activities in professional study context, having individually chosen complex technological, organizational and methodological tools.	SA1. Are able to work with abstract notions, think systematically and logically, are able to explain, reveal and ground certain regularities. SA 2. Are able to model and analyse different processes, harmonize knowledge of mathematics, information technologies and technical subjects. SA 3. Are able to select and individually improve, realize and analyse mathematical models for solving different problems. *Mathematical modelling specialization* SA 4. Are able to conduct virtual experiments, analyse industrial mathematical models. *Technometrics specialization* SA 5. Are able to use up-to-date technologies and special computer software to develop, analyse and evaluate economic performance models.
Social abilities	Are able to communicate with specialists and the public while solving problems of professional or study areas, presenting the conducted activities and its results. Assumes responsibility for the performance quality of own and their subordinates, as well as its assessment in accordance	SC1. Are able to critically evaluate the situation, make decisions, individually carry out the delegated tasks, analyse and present the results. SC 2. Are able to work in a team, communicate with colleagues, exchange information, discuss, seek compromises and assume responsibility for mistakes. SC 3. Are able to adapt to changes. *Mathematical modelling specialization* SC 4. Are able to analyse, evaluate, develop and present new calculus products and improve already

	with professional ethics and principles of citizenship. Are able to convey knowledge and expertise of the study area to specialists and his peers.	existing ones. *Technometrics specialization* SC 5. Are able to analyse and evaluate economic indices, generalise them and present evidence-based conclusions and insights, improve already existing models.
Personal abilities	Are able to individually study their professional and study activities and plan learning the process. Understand moral responsibility for their activities and results of these activities on the social, economic, cultural development, wellbeing and the environment.	PA1. Are able to distinguish essential problem-solving moments, work responsibly. PA 2. Are able to master new information and constantly develop their abilities, study individually. PA 3. Are able to plan their activities. *Mathematical modelling specialization* PA 4. Are able to communicate on mathematical subjects, are able to adequately convey mathematical models to specialists from other areas. *Technometrics specialization* PA 5. Are able to analyse economic indices and present them in the language of mathematics.

2.3 Results of the professional activities research and areas for which the specialists are trained

12. The fact that the programme with the abovementioned aims and learning outcomes is important for contemporary society is also reflected by the labour market trends both in Lithuania and Europe. It was mentioned in review of Lithuanian study conditions, published on the webpage of the ministry of Education and Science of The Republic of Lithuania that "new workplaces, during the abovementioned period, were actively created by the sectors of business operating on the basis of modern knowledge (http://www.smm.lt/uploads/documents/Teises_aktai/Lietuvos_studiju_bukles_apzvalga.pdf): computer programming (2300), financial services (1800), consulting management (1700), legal and accounting services (1300), information services (400), scientific research and applied activities (200). The changes in the market and forecasts encourage higher education institutions to train highly qualified workforce, able to adapt to the ever-changing environment, which is needed in the market of today and will be needed in the market of tomorrow. Such demands of the economy and demand of the workforce is likely to have influence on the choice of prospective students and the change of the curriculum." It is also stressed that "even though Lithuania, in comparison to other EU member states, has a rather high rate of people with higher education, the employment in the manufacturing branches of advanced technologies and medium-advanced technologies remains among the lowest in the EU."
13. Technomathematics study programme is exactly the kind of programme aimed at training specialists for the promising fields of advanced technologies. This is the only programme in Lithuania registered under such title, and the only programme in the area of natural sciences in the field of mathematics (G100) at VGTU which awards the mathematics bachelor's degree.
14. The strengths, weaknesses and improvement actions of Technomathematics study programme aims and intended learning outcomes are presented in Table 2.2.

Table 2.2. Strengths, weaknesses and improvement actions of study programme aims and intended learning outcomes

Strengths	Weaknesses	Improvement actions
The specialists trained in the programme have not only mathematical education, but also knowledge of informatics and technical sciences.	More attention should be paid to relations with other subjects while delivering theoretical courses, emphasize practical implementation of theoretical knowledge.	Pay more attention to practical analysis of the problems. Encourage students' interest in practical application of mathematics; involve representatives of enterprises in the study programme committees.
Students of the technomathematics study programme are provided with a lot of carefully selected, structured, verified information.	Students find it difficult to process such vast amount of information. It sometimes leads to dropping out of the university.	Initiate discussion among lecturers, among lecturers and students on selection of relevant information, on capacities of information processing, mechanisms of mastering new tools and new information.

Mathematical modelling and virtual experiments allow training specialists, who analyse situations, foresee results of the activities.	The graduates usually find employment as specialists of information technologies, and their mathematical training is exploited insufficiently or not exploited at all. This is influenced by a small supply of workplaces for mathematicians in Lithuania. Only the best of graduates can compete for such workplaces.	Maintaining closer direct touch with enterprises, participation in common scientific and technological projects, enabling students of senior years to participate in such projects.
Students are acquainted with up-to-date mathematical-statistical methods and know where to apply them.	Lack of contacts with enterprises.	Popularize workshops of the department among students by inviting representatives of enterprises to them.
By analysing industrial and economic activity models students are able to use specialised computer software.	Lack of laboratory experiments, investigations or computing presentations.	Seek possibilities for laboratory experiments, field trips to enterprises.
The programme is periodically updated, in accordance with the market changes.	Lack of meetings with prospective employers.	Organize meetings with the employers and graduates.

3. STUDY PROGRAMME STRUCTURE

3.1 Scope of the study programme and its compliance with the legal requirements

15. The Technomathematics study programme has been developed and registered in 2004. The programme was first implemented on September 1st, 2004. The study programme was developed according to Lithuania's legal acts regulating the structure of study programmes applicable at that time and VGTU programme framing rules. The programme is constantly updated in accordance with the changes in legal acts and changes in the market trends. Technomathematics study programme Committee of the VGTU Faculty of Fundamental Sciences, departments of Mathematical Modelling, Strength of Materials and Theoretical Mechanics all constantly supervise and monitor the programme and its implementation. The Department of Mathematical Modelling is responsible for supervision of the Mathematics-related courses of the study programme, while the departments of Strength of Materials and Theoretical Mechanics monitor the Engineering and Informatics-related courses.
16. The study programme belongs to the Technomathematics Studies branch (G160) and is attributed to the Physical Sciences' Mathematics field (G100) of studies. The programme's structure meets the requirements for first cycle programmes (Lithuania's Education and Science Minister's decree No. V-501 of 2010-04-09 "On Approval of Description of the General Requirements for First Cycle and Integrated Study Programmes"). The Technomathematics study programme's compliance with the requirements for first cycle study programmes is presented in Table 3.1.
17. Technomathematics study programme is available for students with secondary education. The duration of the first cycle studies is 4 years. The credit volume of the study programme is 240 credits. One credit corresponds to 26.67 hours. Studies are divided into semesters. Duration of a semester is 16 weeks. One semester's credit volume is 30 credits. One week from this number is allocated for individual work. The 6^{th} and 8^{th} semesters constitute an exception, both of which last for 13 weeks. The duration of the sixth semester is influenced by an 8-week practice period, and a part of the eighth semester is allocated for preparation of the final thesis. No more than seven subjects are studied in each semester. Not more than five E-type examinations are scheduled for a 4-week examination session, not more that three E-type examinations are scheduled for a 2-week examination session. A one-week winter break is scheduled after the fall examination session and a continuous break of no less than a month is scheduled in the summer.

Table 3.1. Compliance of Technomathematics study programme with the set requirements

	Intended in the programme	Legal requirements
Major field courses	191 credits	No less than 165 credits
General university study courses	19 credits	No less than 15 credits
Optional courses, provided by the university and chosen by the students, elective subjects	18 credits of specialization and 12 credits for elective subjects	Not more than 60 credits
Practice	15 credits	No less than 15 credits
Thesis	18 credits	No less than 12 credits
Number of courses studied in a semester that require assessment	Not more than 7	Not more than 7 credits
Number of credit points per year	60 credits	Not more than 60 credits
Percentage of scientists or acclaimed artists, lecturing major field course units	more than 70 %	Not less than 50 %.
Total programme volume	240 credits	210-240 credits
In-class work volume	39 % of the programme's volume	Not less than 20 %.

3.2 Logic behind the study programme's structure. Study methods and knowledge assessment methods

18. Study results are sought through a consistent Technomathematics study programme, during which core subjects and general university study courses are taught first, and then a deeper understanding of certain problems of Mathematics branches is attained.
19. Subjects, scheduled within the study programme, are taught according to the lectures' timetable, published on the University's website (https://medeine.vgtu.lt/paskaitos/paskaitosDest.jsp). The goals, composition and methods of the subjects studied are consistent with the goals of the study programme. Studied subjects are constantly updated. The last update was performed in 2011-2012. Summaries of all study programme courses are published on the website of the Technomathematics study programme http://www.techmat.vgtu.lt/.
20. Various study methods are applied when delivering courses. The lecturer of the module decides which methods will be used for separate course units. **The following methods** are implemented in the Technomathematics study programme:
    SM1. Theory lectures (traditional and deliverd using interactive medium and modern information technologies).
    SM2. Practice (practical classes with academic groups: the lecturer explains the problem-solving methodology and examples, the students solve the problems by themselves and on the blackboard, discussion of results and general discussion is possible).
    SM3. Laboratory work (held in computer classes, equipped with required software (Maple, MatLab and other); students can also complete the assignments on their own using personal computers; certain laboratory work assignments can be completed in groups).
    SM4. Gathering and analysing information (the student searches for information, related to the topic provided by the lecturer in literature and other information sources, e.g. software, statistical data and so on).
    SM5. Independent reading and analysis of literature (the student studies literature and other information sources, provided by the lecturer).
    SM6. Homework (the student completes assignments given by the lecturer during classes, e.g. solves problems).
    SM7. Individual written assignments (the student receives a version of an individual assignments set to solve during the semester).
    SM8. Consultations (group and individual).
    SM9. Case study (research, course paper, project; possible group projects).
    SM10. Preparation for examinations, colloquium exams, laboratory work defence, presentation of conducted research, etc.
    SM11. Preparation of academic work report (for course work, laboratory work, etc.).
21. The evaluation of the students' knowledge is regulated by the VGTU student knowledge evaluation procedure description, approved by the VGTU Senate's resolution No. 51-2.4 of 2011-05-31.4).
    Methods of knowledge assessment:
    AM1. Examination (session, early exam, midterm). A decimal evaluation scale is used according to VGTU studies protocol. Evaluation formula is listed in the course module card.
    AM2. Test (independent solving of practical problems in the classroom).

AM3. Colloquium exam (can be treated as an interim exam; not only practical assignments, but also a test of theoretical knowledge is scheduled).
AM4. Preparation of academic work report (for yearly papers, laboratory work, etc.).
AM5. Defence (the student orally explains the process of the conducted research to the lecturer).
AM6. Evaluation of the public delivery (presentation) of the research.

22. In order for the students to not only acquire fundamental knowledge of Mathematics, but also to be able to apply it, and collaborate with specialists from other fields, courses on Informatics, Engineering and other fields are studied alongside Mathematics-related courses. This allows the students to understand the interaction of different sciences and apply the acquired theoretical knowledge in practical computations. The study programme is composed in a way that encourages the students to constantly think, relate their current knowledge with acquired new knowledge, summarize and draw conclusions. Theoretical and applied courses encourage creativity and independent activity, foster the feeling of responsibility and the ability to make decisions, analyse and present results. Practical assignments help strengthen the acquired skills of information technologies application. A part of the courses of the study programme are selected from several options. This gives the student the opportunity to independently decide and choose courses that, according to him or her, will be useful in his/her further endeavours. Elective courses are also scheduled as part of the programme. Students can choose them from all courses provided by the University (usually from other faculties). All these factors create conditions to train specialists that are able to work in an ever-changing environment, adapt and professionally assess the situation. Internship opportunities scheduled in the programme also encourage to practically apply theoretical knowledge.
23. The majority of the students conduct their introductory internship in the Lithuania's Parliament Office. Others choose various IT and business enterprises.
24. Industry internship is conducted in various companies and institutions: insurance firms, logistics, software development companies, Lithuania's ministries. Industry internship is also conducted at social partners' establishments - at the Europe B. V. branch of Bentley Systems, Lithuania's Parliament Office, Synergium Ltd.
25. Some students have their internships abroad, for example in HSG-IMIT (Institut für Mikro- und Informationstechnik), Germany.
26. Upon the beginning of the fifth semester the study programme splits into two specializations – Mathematical Modelling and Technometry. ***Mathematical Modelling*** specialization provides knowledge required for the analysis of various applied tasks (engineering, business, insurance, finance, etc.), forms the skills to choose the best solutions. Mathematical models of the industry are studied, various experiments are conducted, students are taught to assess and develop new products for computation and improve theexisting ones. Knowledge gained from the ***Technometry*** specialization allows to analyse, model and assess the economic indicators of a country or a company. Using modern technologies and special software students get to know basic mathematical methods of economic indicator analysis, learn to create and analyse economic activity models, plan activity, gather and analyse statistical information.
27. Four-year first cycle studies are finalised by the preparation and defence of the final thesis. While preparing and defending his or her final thesis, the student shows the ability to apply knowledge acquired throughout the study process in a new area, demonstrates the readiness for independent work and the ability to present results.
28. All subject modules of the Technomathematics study programme are distributed between terms in a way so as not to deviate from the requirements for VGTU first cycle degree university study programmes (Approved by the VGTU Rector's resolution No. 471 of 2010-06-29 and the amendment of resolution No. 349 of 2011-04-21) and to comply with the requirements formulated in the decree of the Minister of Education and Science of the Republic of Lithuania No. V-501 of 2010-04-09 "On Approval of the Description of Main Requirements for First Cycle and Integrated Study Programmes" and its later versions). The Technomathematics study programme's plan is presented in Table 3.2. During the programme's execution period, it was periodically revised and, if such a need arose, adjusted. The changes have been initiated by members of the study programme committee, who analysed the programme. Other changes had been influenced by changes in legal acts. The distribution of study programme's courses between semesters is presented in Annex 2, modules of the study courses – in Annex 3.
29. First, general university study courses and theoretical fundamental courses are studied in the programme. General fundamental courses are supplemented by specialization-related courses from the 4^{th} semester, students can choose their desired specialization in the 5^{th}. Throughout the 7^{th} and 8^{th} semesters only major field courses, specialization-related courses are studied, and the final thesis is prepared.

Table 3.2. Study plan of Technomathematics study programme

Course code	Course unit	Scope of studies per semester																	
		I		II		III		IV		V		VI		VII		VIII		Total	
		hrs	credits	hrs	credits	hrs	credits	hrs	credits	hrs	credits	hrs	credits	hrs	credits	hrs	credits	hrs	credits
A. Part of general university course units (*no less than **15** credits*)																			
A 1. Fundamental outlook courses																			
Elective courses																			
KIHSB11120	Philosophy	45	3,0															45	3,0
KIHSB11108	Philosophy of technology	45	3,0															45	3,0
A 2. Humanitarian, social or art course units																			
Mandatory courses																			
KILKB11005	Speciality language culture													30	3,0			30	3,0
Elective courses																			
KIKAB11124	German language 1	45	3,0															45	3,0
KIKAB11125	French language 1	45	3,0															45	3,0
KIKAB11123	English language 1	45	3,0															45	3,0
KIKAB11224	German language 2			30	3,0													30	3,0
KIKAB11225	French language 2			30	3,0													30	3,0
KIKAB11223	English language 2			30	3,0													30	3,0
Total for course units group A		**90**	**6,0**	**30**	**3,0**	**0**	**0**	**0**	**0**	**0**	**0,0**	**0**	**0**	**30**	**3,0**	**0**	**0**	**150**	**12,0**
B. Course units of the field of studies (*no less than **165** credits*)																			
B 1. General theoretical fundamental course units																			
FMMMB11102	Differential calculus	105	8,0															105	8,0
FMMMB11103	Analytical geometry	60	6,0															60	6,0
FMMMB11202	Integral calculus			90	6,0													90	6,0
FMMMB11203	Linear algebra			75	6,0													75	6,0
FMFIB11306	General physics					60	4,0											60	4,0
FMGSB11605	Computer graphics											48	4,0					48	4,0

B 2. Other general course units																			
FMTMB11110	Procedural programming	60	6,0															60	6,0
FMMMB11204	Discreet mathematics			60	6,0													60	6,0
FMTMB11210	Mathematical programming software			45	4,0													45	4,0
FMTMB11211	Object-oriented programming			60	5,0													60	5,0
FMTMB11310	Theoretical mechanics					45	4,0											45	4,0
FMMMB11404	Differential equations							90	6,0									90	6,0
B 3. Main field of studies course units																			
FMMMB11104	Mathematical logics and the set theory	45	4,0															45	4,0
FMMMB11302	Special analysis chapters					75	5,0											75	5,0
FMMMB11304	Numerical methods					75	5,0											75	5,0
FMMMB12401	The theory of algorythms							90	5,0									90	5,0
FMSAB11411	The probability theory and mathematical statistics							75	5,0									75	5,0
FMGSB11502	Programme systems engineering									60	5,0 (1,0)							60	5,0 (1,0)
FMSAB11513	Applied statistics									75	6,0							75	6,0
FMMMB11602	Applied functional analysis											48	5,0					48	5,0
FMMMB11712	Mathematical physics													75	5,0			75	5,0
FMMMB11702	Applied optimization methods													75	6,0 (2,0)			75	6,0 (2,0)
B 4. Social science course units																			
VVSEB11357	Economics (for students of technomathematics)					45	4,0											45	4,0
VVSEB11452	Management							60	3,0									60	3,0
B 5. Speciality field course units																			
Mandatory courses																			
FMMMB11303	General algebra					60	4,0											60	4,0
FMMMB12501	Basics of mathematical modelling									75	6,0							75	6,0
FMMMB11504	Dynamic systems and chaos									75	5,0							75	5,0

FMMMB11601	Investigation of a real phenomenon's mathematical model (complex project)											24	5,0					24	5,0
FMMMB11703	Special numerical methods													75	5,0			75	5,0
FMMMB11801	Mathematical models in industry															60	4,0	60	4,0
FMTMB11810	Databases															60	5,0	60	5,0
Elective course units																			
FMFIB11450	Electricity and magnetism							60	4,0									60	4,0
FMMAB11408	Mechanics of a deformed body							60	4,0									60	4,0
FMMMB11403	Basics of economic modelling							60	4,0									60	4,0
FMMMB11706	Variational calculus													60	4,0			60	4,0
FMMMB11713	Fuzzy discreet structures and decision making													60	4,0			60	4,0
B 6. Professional internships																			
FMTMB11410	Introductory internship							0	3,0									0	3,0
FMTMB11610	Industrial internship											0	12,0					0	12,0
B 7. Preparation, drafting and defence of the final project/thesis																			
FMMAB11701	Final thesis 1													0	3,0			0	3,0
FMMMB11708	Final thesis 1													0	3,0			0	3,0
FMTMB11710	Final thesis 1													0	3,0			0	3,0
FMFIB11746	Final thesis 1													0	3,0			0	3,0
FMMAB11805	Final thesis 2															0	7,0	0	7,0
FMMMB11802	Final thesis 2															0	7,0	0	7,0
FMTMB11811	Final thesis 2															0	7,0	0	7,0
FMFIB11847	Final thesis 2															0	7,0	0	7,0
FMMAB11804	Final thesis 3															0	8,0	0	8,0
FMMMB11803	Final thesis 3															0	8,0	0	8,0
FMTMB11812	Final thesis 3															0	8,0	0	8,0
FMFIB11848	Final thesis 3															0	8,0	0	8,0
Total for course units group B		270	24,0	330	27,0	360	26,0	375	26,0	285	22,0 (1,0)	120	26,0	285	23,0 (2,0)	120	24,0	2145	198,0 (3,0)

C. Specialization part (*no more than **60** credits*)																			
Mandatory course units																			
FMTMB11510	Finite element methods									60	4,0							60	4,0
FMMMB11505	Econometry basics									60	4,0							60	4,0
FMMMB11605	Integral equations											60	4,0					60	4,0
FMMMB11604	Finance engineering and modelling											60	4,0					60	4,0
FMMMB11711	Incorrect mathematical tasks													45	4,0			45	4,0
FMMMB11709	Economic indices statistics													45	4,0			45	4,0
FMMAB11803	Calculus mechanics															60	6,0	60	6,0
FMMMB11804	Optimization in economics															60	6,0	60	6,0
Elective course units																			
Total for course units group C										60	4,0	60	4,0	45	4,0	60	6,0	225	18,0
Scope of elective course units							4,0		4,0		4,0							0	12,0
Programme total		**360**	**30,0**	**360**	**30,0**	**360**	**30,0**	**375**	**30,0**	**345**	**30,0 (1,0)**	**180**	**30,0**	**360**	**30,0 (2,0)**	**180**	**30,0**	**2520**	**240 (3,0)**

30. Technomathematics study programme consists of three main parts: general university courses (A), major field courses (B) and specialization-related courses (C).
31. General university courses are meant to improve general erudition. For the Technomathematics study programme such courses are selected from humanities and social sciences.
32. Major field courses provide knowledge and skills, required to receive a Bachelor's degree in Mathematics. Two practice periods, assigned to the major field courses are scheduled in the programme: introductory 2-week practice (3 credit points) in the 4th semester and an 8-week production practice (12 credit points) in the 6th semester. A yearly project, executed by two departments, is scheduled in the sixth semester of the programme. Courses, requiring yearly papers, are taught in the 5th and 7th semesters. Preparation and defence of the final thesis is also attributed to the major field part of the programme. The final thesis is prepared during two semesters and consists of 18 credit points. Thesis preparation is finalised by a public thesis defence.
33. Specialization-related courses are intended for a more in-depth specialization in the chosen area. Two specializations – Mathematical Modelling and Technometry – are planned within the Technomathematics study programme, allowing students to increase knowledge in an area best suiting their needs. Elective courses are also attributed to this part of the programme. They are taught in semesters 3 to 5 and consist of 12 credits.
34. All courses of the study programme are logically inter-connected. The goals, composition and methods of the subjects studied are consistent with the goals of the study programme. Every study module is composed in a way that the topics within it allow to pursue the course study goals described in the module's syllabus, and the results are directly related to the study programme's results. Connections between the programme's and courses' study results are presented in the table of Annex 4.
35. The person responsible for each module periodically updates the module's content, expands the list of literature.

3.3 Requirements for student final theses

36. A graduate Bachelor's thesis must show the student's self-sufficiency, ability to apply acquired theoretical and practical knowledge, ability to formulate tasks and argumentatively substantiate the obtained results, and present them to specialists and non-specialists.
37. In the end of the sixth semester students choose topics of their theses from a list provided by the departments of Mathematical Modelling, Theoretical Mechanics, Strength of Materials and Physics, preparation of the final thesis takes a part of the seventh and eighth semesters. Topics and supervisors of final theses are approved by the Dean before the date provided in the study schedule.
38. While preparing the final thesis the student independently studies literary sources and analyses results found, gets acquainted with new methods of solving known and new problems, analyses applied assignments. Academic advisors supervise the thesis preparation process.
39. The structure of the final thesis is described in methodological outlines. All final theses must comply with the structure requirements. Theses must be orderly and written in proper Lithuanian.
40. Final Thesis 1 and Final Thesis 2 modules in 7th and 8th semesters are assessed with a Pass/Fail. A commission, confirmed by the Head of the Department assesses students' theses. During assessments of the theses students present interim results of their theses and hear comments and recommendations. A council on the theses is held in the departments prior to the public defence. Thesis reviewers are attributed after the council. The final thesis complemented with the advisor's comment and a review is submitted for defence. Final theses are defended in front of the commission, which decides whether a Bachelor's degree is granted to the students, who have defended their theses.
41. Graduate Bachelor's theses are defended in front of the thesis and defence assessment and degree granting commission, composed according to the Vilnius Gediminas Technical University's study outlines, confirmed by the VGTU Senate's resolution No. 58-3.1 of 2012-06-26. Members of the commissions are confirmed by a Rector's decree.
42. Vilnius Gediminas Technical University's study outlines regulate the composition of the final theses defence commissions. In accordance with them, the Technomathematics graduate Bachelor's theses defence commission is composed of five qualified experts – scientists or professional practitioners, prospective employers of the programme's graduates. According to the requirements, up to two thirds of the commission's members can be members of the faculty, where the study programme is conducted. Not less than three commission members must possess academic degrees or pedagogical titles. The commission's chairman must be a practicing professional, not employed by the University. A comment on the thesis is written by the thesis advisor. The final thesis is reviewed by at least one lecturer of the relevant department.

43. The thesis is assessed by a grade. The Bachelor degree granting committee assesses the theses during an open hearing and decides whether to grant the Bachelor's degree. The prepared thesis is defended once. If the student is unable to defend it, a new thesis is prepared. It is allowed to defend it in a year. A diploma and a diploma supplement are issued to the graduates of the study programme, who have completed their first cycle studies. The diploma supplement is an integral part of the diploma. It provides information on the content of the received university education. Students, who have completed the study programme and received highest evaluation, receive diplomas "With distinction", "Cum Laude" or "Magna Cum Laude" (according to the VGTU Senate's resolution No. 56-3.5. of 2012-04-03). At least one such diploma is granted yearly in the Technomathematics study programme.

Table 3.3. Programme structure's strengths, weaknesses and means for improvement

Strengths	Weaknesses	Means for improvement
Technomathematics study programme provides a high-quality modern education, the main attribute of which is the ability to apply methods of mathematics and information technology in engineering and other fields.	The Engineering studies courses of the programme are held only at the Faculty of Fundamental Sciences.	Seeking connections in other faculties. Improving the efficiency of the study process.
Content of the programme's course modules, their volume and order are completely in accordance with the goals of the programme and current opportunities to realize them.	A small number of practice places is provided to the students.	It is required to improve relations with social partners. Providing more flexible ways of conducting practice. Adjusting the study plan, if such an opportunity and need is present.

4. STAFF

44. The main goal of the present chapter is to provide information on the qualification of lecturers teaching in the Technomathematics programme. There were 31 lecturers in the Technomathematics programme in the 2012/2013 academic year: 24 lecturers taught major field courses, including optional subjects, practice sessions and specialisations, 7 lecturers taught general university study courses. Study programme-executing lecturers and their numbers differs slightly every year.

4.1 Compliance of personnel to legislative requirements. List of lecturers

45. List of lecturers, their academic interests, pedagogical titles and academic degrees, courses taught in the Technomathematics programme, practical and pedagogical experience are presented in Annex 5. Lecturer‘s activity overviews (CVs) are supplied in Annex 6.
46. Lecturers for the Technomathematics study programme are hired through an open contest. Competences and qualification aspects of the personnel forms an important part of VGTU‘s policies and strategy: attention is primarily directed to the quality of scientific publications, also to the participation in project organising and execution, participation in international scientific research, professional training courses, etc. Lecturer certification takes place every five years, it is carried out by certification committees, formed at the behest of VGTU’s Faculty of Fundamental Sciences (see the description of the procedure for organising hiring contests for positions of VGTU lecturers, academic staff and other researchers, assessing of candidates and establishing minimal qualification requirements).
47. This ensures that the lecturers' qualifications meet the requirements set for Bachelor's study programmes (Lithuania's Education and Science Minister's decree No. V-501 of 2010-04-09 "Confirmation of the general requirements' description list for first cycle and integrated study programmes). 90% of lecturers teaching the subjects of Technomathematics major field course have PhD degrees. The programme is implemented through the cooperation between the Department of Mathematical Modelling and highly qualified professionals from other VGTU’s departments – Department of Strength of Materials and Engineering Mechanics, Department of Theoretical Mechanics, Department of Mathematical Statistics. VGTU is the primary workplace of most of this study programme’s lecturers, they constitute 95% of all those lecturing in this programme.
48. It should be stressed that Technomathematics programme’s lecturers also teach general and special courses in other VGTU’s study programmes.

4.2 Lecturers' participation in scientific studies, projects, scientific activities

49. One of the principal means of raising a lecturer's professional qualification is participation in scientific studies and carrying out projects. During the last five years, lecturers of the Technomathematics first cycle study programme participated in many Lithuanian and international scientific research projects, funded by the Lithuanian State Studies Foundation, Lithuanian Research Council and economic entities. They also carried out EU-funded scientific, study and development projects. During the years 2008-2013, 11 lecturers of the programme participated in 16 scientific research projects. A list of completed/currently executed projects is presented in the Appendix 7.
50. Lecturers teaching in the Technomathematics programme constantly publish scientific articles, prepare textbooks and other educational books, publish various scientific research and study literature. During the period from 2008 to 2013, lecturers of the programme prepared 189 publications that are included in international databases or are meant for studies: 3 textbooks, 17 educational books, 167 scientific articles, 96 of which are included in the ISI Web of Science list, made more than 90 presentations in international scientific conferences. The programme lecturers also published some articles in other publications and periodicals. The average publication number for one lecturer is roughly 1.5 per year. More information on said publications can be found in Appendix 6 - lecturer activity overviews.

Table 4.1. Programme lecturers' publications

Scientific articles published in 2008/2013			**Study materials**	
ISI Web of Science	ISI Proceedings	Other internationals' journal databases	Textbooks	Teaching aids
96	27	44	3	19

51. Technomathematics programme's lecturers are as active as experts of national and international science committees and commissions (Lithuanian Research Council, Centre for Quality Assessment in Higher Education, other national and international expert commissions).
52. Prof. R. Čiegis was the chairman of the Lithuanian Research Council's Informatics field scientific institute activity evaluation committee in years 2009-2010, Lithuanian representative in European commission's FP7 Informatics and relations committee in years 2010-2013, member of the Latvian Centre for Quality Assessment in Higher Education mathematics, statistics and physics study programme international accreditation commission (2012) and head of Informatics study programme's international accreditation commission (2012), external evaluation expert for the project "Internationalisation of the Biomedicine and Physical sciences study programmes in Vytautas Magnus University"(VP1-2.2-ŠMM-07-K-02-055) (2013 m.), scientific advisor for the Flow and Material Simulation Department of ITWN institute in Kaiserslautern, Germany (http://www.itwm.fraunhofer.de/en/departments/flow-and-material-simulation/employees.html).
53. Lecturers of the study programme are active editorial board members and editors of international mathematics and technical journals, which are included in the ISI Web of Science list. Prof. R. Čiegis is the editor-in-chief of the "Mathematical Modelling and Analysis" journal, editorial board member of the journals "Lithuanian Mathematical Journal" and "Computational Methods in Applied Mathematics" (http://www.degruyter.com/view/j/cmam).
54. Prof. A. Krylovas is the executive editor (responsible secretary) of the "Mathematical Modelling and Analysis" journal, Assoc. Prof. M. Meilūnas, Assoc. Prof. V. Starikovičius – members of this journal's editorial board.
55. Prof. R. Kačianauskas is a member of Vilnius Gediminas Technical University's "Journal of Civil Engineering and Management" (http://www.tandfonline.com/loi/tcem20) editorial committee, also a member of Kaunas University of Technology journal's "Mechanika" (http://www.mechanika.ktu.lt/index.php/Mech.) editorial committee. Prof. R. Kačianauskas is a member of the Cracow University of Technology journal's "Mechanics and Control" (http://www.mechanics.agh.edu.pl/index.php/en/info/office) advisory board.
56. Since 2008 Prof. R. Kačianauskas is an expert member of the Lithuanian Academy of Sciences Technical Department. Since 2011 – true member of Lithuanian Academy of Sciences.
57. Prof. R. Čiegis was elected a foreign member of the Latvian Academy of Sciences.
58. Owing to the efforts of the Department of Mathematical Modelling an international Mathematical Modelling and Analysis conference is being held in Lithuania, Latvia and Estonia since 1996.
59. Mathematical modelling is very widely applied to both – research of processes of fundamental sciences, various physics, technology and biotechnology, and solving particular industrial, construction, transport and other problems, in many fields experimental studies are exchanged for a mathematical experiment.

60. As mathematical modelling methods and computational technologies develop, new branches of science emerge: computational physics, computational chemistry, computational mechanics. Relevant computational method, parallel algorithm, differential equation, mathematical modelling and statistical modelling questions, which are especially relevant in preparing and implementing the Technomathematics programme are discussed during the annual conference.
61. Lecturers of the programme actively participate in organising these conferences. During the period in question, Prof. R. Čiegis was the vice-president of the conference programme committee (2008 in Tartu, Estonia, 2009 in Daugavpils, Latvia, 2013 in Tartu, Estonia), participated in the activities of the programme committees – 2011 in Sigulda, Latvia, 2012 in Tallinn, Estonia.
62. In 2010, the Mathematical Modelling and Analysis conference took place in Druskininkai, Lithuania. Chairman of the conference programme committee was Prof. R. Čiegis, while Prof. A. Krylovas, Prof. R.Belevičius and Assoc. Prof. M.Meilūnas were its members. Assoc. Prof. M. Meilūnas also was a member of the conference programme committee during the conference that took place in Tartu in 2013.
63. Prof. R. Čiegis was a programme committee member and Mini-symposium organiser of the PRAM2009, PRAM2011 and PRAM2013 ("Parallel Processing and Applied Mathematics") scientific conferences that took place, respectively, in 2009 in Wroclaw, in 2011 in Torun and in 2013 in Warsaw (Poland). Prof. R. Čiegis was also the Mini-symposium organiser of the PARA2012 ("State-of-the-Art in Scientific and Parallel Computing") conference that took place in 2012, in Helsinki (Finland).
64. Prof. A. Krylovas was a programme committee member of these scientific conferences that took place in Mykolas Romeris university (Vilnius): "International Conference on Social Technologies '10", (2010), "International Academic Conference on Social Technologies '11: ICT for Social Transformations" (2011), "International Academic Conference on Social Technologies '12: Development of Social Technologies in the Complex World" (2012).
65. Prof. A. Krylovas and Assoc. Prof. N. Kosareva were programme committee members of the scientific conference "The 3rd International Scientific Conference "Whither Our Economies'13", (2013).
66. Prof. A. Krylovas is the chairman of the organisational committee for the Lithuanian Mathematical Society's conference which will take place in the year 2014.

4.3 Lecturer-student ratio in the study programme

67. Numbers of Technomathematics study programme's lecturers and students are supplied in table 4.2.

Table 4.2. Lecturer-student figure dynamics

Academic year	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013
Total number of lecturers	**33**	**33**	**33**	**32**	**31**
Professors	8	8	8	8	7
Associate professors	13	13	13	12	12
Lecturers	7	7	7	7	7
Junior lecturers	5	5	5	5	5
Total number of students	**108**	**110**	**101**	**92**	**71**
Total lecturer/student ratio	**0.31**	**0.30**	**0.33**	**0.35**	**0.44**
Professors/students	0.07	0.07	0.08	0.09	0.10
Associate professors/ students	0.12	0.11	0.13	0.13	0.17
Lecturers/ students	0.06	0.06	0.07	0.08	0.10
Junior lecturers/ students	0.05	0.05	0.05	0.05	0.07

4.4 Academic staff composition, structure by age groups and turnover

68. The distribution of lecturers teaching the first cycle Technomathematics study programme by position and age in 2012/2013 is presented in Table 4.3.

Table 4.3. Lecturers' distribution according to their age and position for 2012/13.

Position	Age group					Total	Total %
	≤30	31–40	41–50	51–60	>60		
Professors	0	0	0	5	2	7	**22.5**
Associate professors	0	4	1	5	2	12	**39**
Lecturers	0	1	4	2	0	7	**22.5**
Junior lecturers	5	0	0	0	0	5	**16**
Total:	**5**	**5**	**5**	**12**	**4**	**31**	**100,00**
Total %:	**16**	**16**	**16**	**39**	**13**	**100,00**	**100,00**

69. Evaluating the personnel composition in 2008-2013, a constant increase in lecturers' qualification level can be noted. I. Laukaitytė, G. Jankevičiūtė and N. Tumanova defended their doctoral theses and took the associate professor positions. In years 2008–2013, Department of Mathematical Modelling, which coordinates the programme had 5 doctoral students, 4 of whom delivered the programme's courses.
70. Median lecturer age of the first cycle Technomathematics study programme was 48.5 years in 2012/2013 (57 years for professors, 45 years for associate professors, 50 years for lecturers, 29 years for junior lecturers).
71. A slight lecturer turnover was observed in the first cycle Technomathematics study programme. Lecturers of the study field's subject matter alternated in the following order: Assoc. Prof. S. Čirba taught differential calculation in 2008-2012, and in 2013 it was taught by Assoc. Prof. T. Leonavičienė. Prof. A. Krylovas taught analytic geometry in 2008-2009, and in 2010-2013 it was taught by Assoc. Prof. E. Paliokas. Assoc. Prof. S. Čirba taught calculus in 2008-2012, and in 2013 it was taught by Assoc. Prof. G. Jankevičiūtė. Prof. R. Čiegis taught partial differential equations in 2008-2009, and in 2010-2013 it was taught by Assoc. Prof. J. Kirjackis. Prof. A. Krylovas taught mathematical modelling of real phenomena in 2008-2010, and in 2011-2013 it was taught by J. Kirjackis. Assoc. Prof. E. Paliokas taught mathematical physics in 2008-2009, and in 2010-2013 it was taught by Prof. A. Krylovas. Since 2013, Prof. R. Kačianauskas and Assoc. Prof. M. Šukšta do not teach the study programme any longer.

4.5 Lecturer participation in scientific conferences, traineeships, seminars, exchange programmes

72. Lecturers teaching in the programme actively participate in scientific conferences, various traineeships, academic exchange programmes. Visits of the first cycle Technomathematics study programme's departing lecturers are supplied in Appendix 8.
73. Visits from abroad: Prof. F. Gaspar (University of Zaragoza) visited the University in 20-24 May 2010, Erasmus visit. In 21-24 May 2013, Assoc. Prof. C. Rodriges (University of Zaragoza) came for an Erasmus visit. Prof. S. Gourjon (Paris) came annually on Erasmus exchange programme basis.

4.6 Improvement of lecturer's qualifications (pedagogical, scientific, practical)

74. Lectures are given by lecturers with experience in the field of science. Most lecturer's pedagogical experience significantly exceeds the 10 year mark, many used to teach more than one subject, had written several textbooks and educational books in their field, carried out research in that field, took internships in scientific or educational institutions.
75. Assoc. Prof. N. Kosareva took a four month English language course in VGTU in 2009, participated in the 8 hour-long seminar "Quantitative Comparative Analysis and the Fuzzy Set Method" organised by Prof. Z. Norkus in 2011. Assoc. Prof. G. Jankevičiūtė participated in the 18th Jyväskylä summer camp "SC4: Goal-Oriented Adaptivity in Finite Element Methods with Applications to Multi-Field and PDE-Constrained Optimization Problems" (2008, Finland) and Johannes Kepler University's summer camp "Fourth RISC/SCIEnce Training School in Symbolic Computation" (2009, 2010, Austria). Assoc. Prof. J. Kirjackis completed the "Study Delivery in VGTU's Virtual Study Environment (Moodle 1.9)" qualification-raising programme in 03 October 2011 – 05 May 2012 and passed the knowledge evaluation test. Assoc. Prof. N. Tumanova participated in summer schools "Current Challenges in Stability Issues for Numerical Differential Equations: CIME-EMS Summer School in Applied Mathematics. Cetraro (CS)", Italy, 2011 and "Modern Problems in Applied Dynamical Systems Theory: Jyväskylä Summer School", Jyväskylä, Finland, 2011.

4.7 Workload of the lecturers

76. In the 2012/2013 academic year lecturers' workload was regulated in accordance with general VGTU rules. The general lecturers' workload is 36 hours per week, which consists of lecturing hours and time dedicated to scientific, methodological and organisational activities. On average, lecturing lasts for 12-18 academic hours per week. The rest of the workload is planned by the lecturer, in accordance with his/her position (professor, associate professor, lecturer, junior lecturer, researcher) and types of activity, i.e., preparation of scientific articles, writing of textbooks and educational material, project work.
77. Usually lecturers work in their principal position full time, but sometimes, due to having to teach general and special mathematics courses in other VGTU programmes, they take on a higher workload. For example, full time assistant professors give 2-3 courses per semester, which amounts to 4-5 courses per year. It should be emphasised that Technomathematics programme's lecturers teach not only in this programme, but also give general and special courses in other VGTU study programmes.

Table 4.4. Strengths, weaknesses and means for improvement of the study programme's personnel

Strengths	Weaknesses	Means for improvement
Successful execution of the study programme is guaranteed by the high qualification of lecturers, which is maintained by the programme-executing departments and through individual efforts.	High lecturer workloads and limited possibilities for taking traineeships and qualification-raising courses. That also limits lecturers' ability to devote more time to individual work with students.	Regular Mathematical Modelling Department's scientific seminar, where original research by scientists from the department and elsewhere (including guest from abroad), recent developments in numerical methodology, mathematical modelling and computer science fields, application trends and methods of perspective or popular mathematics are presented. So far, these seminars are the most realistic possibility of improving the mathematical qualification of lecturers from the department and from other VGTU subdivisions.
Recently graduated doctors of physical sciences work in the Technomathematics study programme.	Limited possibility to invite young lecturers because VGTU does not offer doctoral studies in mathematics.	Efforts to institute joint doctoral mathematics studies of the two technical universities – VGTU and KTU.
Half of the programme's lecturers are younger than 50.	Due to high workloads, there is a lack of live and virtual communication with students, motivating conversations.	Conversations with students about the possibilities of mathematics, role of its methods in contemporary world, and about the objectively significant demand for experts with good education in mathematics. Endeavours to decrease the pedagogical workload of the lecturers, thereby giving them the opportunity to spend more time on scientific study and qualification raising. Endeavours to give lecturers the opportunity to take academic leave of absence and go to traineeship in other Lithuanian or foreign universities during his/her ordinary term.
		To make the activities of lecturers more effective by applying automatisation tools ever more widely.

5. FACILITIES

5.1 Information about the premises and equipment used in programme implementation

78. The facilities of VGTU Faculty of Fundamental Sciences are employed to achieve the aims and learning outcomes of technomathematics study programme. All the lectures, workshops and laboratory works take place at VGTU buildings situated at 11 Saulėtekio Ave. About 900 students can work simultaneously in the classrooms of the Faculty of Fundamental Sciences.
79. Usually, Technomathematics students have theoretical classes in classrooms SRL-I-401, SRL-I-217, SRL-I-325, and sometimes in classrooms SRK-II-102 and SRK-II-203. Each classroom has a capacity for 20-68 students. Lectures of general teaching curriculum are conducted in classrooms SRA-I-02, SRA-II-09, SRA-II-10 with capacities for 110-245 students. Each classroom has a computer and a video projector.

80. More than 100 students can work simultaneously in 5 computer rooms: SRL-I-417, SRL-I-418, SRL-I-420, SRL-I-427 and L-I-501 (20-30 students in each room). All the computer rooms are equipped with access for laptop. Students use legal Maple, Matlab and Mathcad software and mathematical packages installed on the computers. An exhaustive list of the equipment installed in the computer rooms is provided in Annex 9.
81. Students of technomathematics carry out their engineering experiments in room SRL-I-221 using the mechanical materials testing equipment. To carry out virtual experiments and calculations students use SolidWorks (in classrooms SRL-I-420,SRL-I-427) and ANSYS (in classrooms SRL-I-324 and SRL-I-325) software programmes. AutoCad and STAAD.Pro software programmes are used in room SRK-II-612.
82. During their database course students use Oracle SQL and Oracle Designer software programmes.
83. Laboratory work in physics course is carried out in science lab SRL-I -335, which has stands with special equipment. The results of the laboratory work are processed by various software.
84. 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: 15 nodes having Intel® Core™2 Quad Q6600 @ 2.4 GHz processors (4 cores) and 9 nodes with Intel® Core™ i7-860 @ 2.80 GHz processors (4 cores) connected to Gigabit Ethernet local network. The following libraries (software) of program design and visualization are available in the cluster: Fortran, C++/C, BOOST, CUDA, FFTW, GSL, HDF5, ICTCE, Intel Math Kernel, GVID, ECLIPSE, Netbeans, MPI and OpenMP. 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.
85. All the rooms, classrooms and labs meet the hygiene requirements. The rooms also comply with the workplace safety rules. The VGTU premises have adjustments for disabled students too: several lifts are installed and a parking lot is built.
86. The university has 1Gps optical backbone computer network. The network reaches the computer rooms in the Faculty of Fundamental Sciences and the dormitories in Saulėtekio Avenue with the same capacity. All the university buildings are equipped with wireless computer network EDUROAM (*educational roaming*) which can be accessed by all the university students having their personal laptops or smartphones. EDUROAM is the European academic institutions roaming service. The university is also equipped with a unified authorization system for students providing them with an access to their e-mail boxes, EDUROAM network, as well as computers in computer rooms, by using the same login name and password.

5.2 Information on the methodological resources required for programme implementation

87. The study materials are stored in a modern library of VGTU (at Saulėtekio Ave. 14), in the reading room of the Faculty and in university departments (at Saulėtekio Ave. 11). The Central library funds include more than 500 000 publications. The central library also provides an opportunity to order publications from VGTU library funds or other Lithuanian libraries. The reading room is open during the working hours of the central library, and the Internet Reading Room is open 24 hours a day. Therefore, students are able to search for information, whenever they need it.
88. The university students and teachers can use the databases of scientific publications (including Science Direct, Springer LINK , Taylor & Francis**,** The Electronic Library of Mathematics and others), subscribed by the VGTU library, as well as electronic books of various fields of science. An exhaustive list of the databases can be found at http://biblioteka.vgtu.lt/el--istekliai/duomenu-bazes-/.
89. The National Open Access Science Communication and Information Centre (MKIC), established in 2013 in Saulėtekis area, has the latest and most contemporary library, which services can be used by all the residents of Lithuania.
90. Technomathematics students can also use the reading room in the Faculty of Fundamental Sciences with capacity of 17 workplaces, 9 of which are equipped with computers. The reading room stores 3476 publications.
91. Since the reading room in the Faculty of Fundamental Sciences is not big, and there is a shortage of rooms for teaching (additional rooms are planned in the new corps which is now under construction), as much information as possible is uploaded to the Internet. Students can find the information required for their studies and the material of study subjects, on the website http://www.techmat.vgtu.lt/konspektai.html.
92. VGTU library electronic teaching and learning tools are also available online (http://biblioteka.vgtu.lt). The teachers of technomathematics publish their lecture notes and information for students in the *Moodle* virtual learning environment (http://moodle.vgtu.lt/).
93. The teachers of technomathematics have written a number of textbooks, comprising topics of all the study modules: data algorithm and analysis, parallel algorithms, computational mathematics, differential

equations and their applications, discrete mathematics, data visualization and finite element methods (see teacher activity descriptions in Annex 6).

94. The teaching resources published by VGTU publishing house 'Technika'can be found in the website of the publishing househttp://www.ebooks.vgtu.lt/, which is accessible from the local network.
95. Although the teachers have been preparing various teaching tools and textbooks for this study programme, there is still a shortage of teaching material. The departments implementing the programme have purchased some textbooks and teaching resources covering various topics (engineering mathematics, optimization, differential equations, numerical methods, parallel computing) not only in Lithuanian, but also in foreign languages. This teaching material is successfully used in the study process too.
96. All the material base is constantly updated: redecoration of classrooms, acquisition of hardware and software and purchase of new textbooks, using available financial resources, are constantly carried out. The VGTU library subscribes to a variety of scientific publication databases. The teachers working under the technomathematic programme prepare and update their lecture notes, create methodological material and write textbooks.

Table 5.1. The strengths and weaknesses of the study programme material resources and the actions for their improvement

Strenghts	Weaknesses	Improvement actions
The students and teachers can use parallel computation laboratory services.	There are too few tasks requiring parallel computation and other modern technologies.	The interdisciplinary ties should be strengthened and the material of the projects conducted currently.
The programme is supplied with various software.	There is a shortage of laboratories for carrying out experiments of complex project.	New partners should be found to create the experimental basis.
The students can use spacious and modern libraries.	There is a lack of teachers' activeness in ordering the latest publications.	Teachers should participate in the process of ordering literature, to use and encourage their students to use the material published in virtual learning environment.

6. STUDY PROCESS

6.1 The data about the results of admission to the study programme

97. The general admission to Lithuanian higher schools is organized and carried out by the Association of Lithuanian Higher Education Institutions for Organising General Admission (LAMA BPO) (http://www.lamabpo.lt/turinys/apie-mus), which is the institution authorized by the Ministry of Education and Science of the Republic of Lithuania. Applicants can apply to state-funded places or places that are not state-funded. Applicants must have completed secondary education.
98. The information on the admission procedure, study programmes and specializations, study forms and the structure of the competition score is published on the website of VGTU (http://stojantiesiems.vgtu.lt/) and it is constantly updated.
99. Technomathematics degree programme is a full-time study programme. The entrance to technomathematics degree programme does not require any additional examinations. The competition score is calculated by recounting the results of maturity exam and the required annual grade and adding their products to the weighted coefficients. The competition score is calculated by adding maturity exam results (or annual grades) according to the formula: CS=(Mathematics (maturity exam grade) *0,4+ Information Technology/Physics (maturity exam result or annual grade) *0,2+ History/Geography/ Information Technology/Physics/Chemistry/Biology/Mathematics/Foreign Language (maturity exam grade) *0,2+ Lithuanian Language and Literature (maturity exam result) *0,2)+P. Here P stands for additional points for prize winners in international olympiads or national olympiads and competitions.
100. The results of admission to technomathematics study programme are provided in Table 6.1.

Table 6.1. The competition scores of the students admitted to the study programme

Admission and selection		2008	2009	2010	2011	2012
Applied to state-funded place/ not state-funded place		216/28	211/67	211/39	143/10	122/19
Number of applications with the study programme marked as number one to state- funded place/ not state-funded place		16/1	17/2	22/2	14/0	7/0
Number of admitted students to state- funded place/ not state-funded places		31/0	29/3	34/0	15/2	10/1
The competition scores of the admitted students	The highest score	20,71	21,86	20,44	20,32	19,3
	The lowest score	9,5	10,06	14,72	14,24	15,24
	The average score	15,52	14,82	16,9	16,85	17,07

101. The admission results show that during the years 2008-2012 all the applicants, who marked technomatematics studies as number one in ther applications, were admitted to the studies. From 2008-2010 a big number of applicants, who had put technomathematics studies under other numbers in their applications, were also admitted to technomatematics study programme. However, the number of students admitted to the study programme is still decreasing every year. Significant decline of school graduates leads to decrease in the number of higher school students. Students choose other study programmes because of insufficient attention paid to the promotion of science subjects at schools and because of the 'fashion' trends, currently prevailing in the labour market. School graduates prefer study programmes preparing specialists who are nowadays in demand in the labour market, or those study programmes which are considered to be easier to study.
102. The analysis of the competition scores suggests that there are no any significant changes. The average score has changed during the period of five years, however, over the last years it remained close to 16,9 points. It is also important to note, that the difference between the highest and the lowest competition scores has decreased, which means that technomathematics studies are chosen by graduates having similar level of preparation.

6.2 Data about the current students' progress and the students who completed the study programme

103. The pre-accession differences make impact on the university studies. The data about the progress made by current students of technomathematics during the year 2010/2013 is provided in Table 6.2.

Table 6.2. Data about the current student progress in the year 2010-2013

Year of study		Autumn semester	Spring semester
Year I	Minimum grade point average	5,70	5,43
	Maximum grade point average	9,90	10,00
	Overall average rate	7,48	7,25
Year II	Minimum grade point average	5,00	5,15
	Maximum grade point average	9,87	10,00
	Overall average rate	7,41	7,53
Year III	Minimum grade point average	5,64	5,38
	Maximum grade point average	8,62	9,44
	Overall average rate	7,24	7,56
Year IV	Minimum grade point average	5,00	5,00
	Maximum grade point average	9,39	9,60
	Overall average rate	6,77	7,40

104. Weaker students have learning difficulties and usually terminate their studies. Apart from pre-accession differences, there are usually more factors which result in termination of studies. Most often, students terminate their studies of their own volition, explaining their decision by naming personal reasons, financial difficulties or a wish to change a study programme.
105. Table 6.3 shows the numbers of students admitted to the study programme and students who have completed the studies, as well as the weighted average of the graduates.

Table 6.3. The ratio of the number of admitted students to the number of students who successfully finished their studies, the weighted averages of the graduates

The year of admission	2008	2009
The year of graduation	**2012**	**2013**
The number of admitted students	30	32
The year of students who completed their studies	27	18
The ratio of the number of admitted students to the number of students who finished their studies	**0,9**	**0,56**
The number of students who did not complete their studies	3	14
The weighted average of the graduates	**7,3**	**7,01**

106. The higher 2013 year graduates' dropout rate was probably a result of significant difference between the highest and the lowest competition scores and the lower weighted average.

6.3 Student participation in scientific, artistic and applied activities

107. During the entire study period, the students of this study programme are encouraged to actively participate in scientific activity: to attend seminars organized by the Department of Mathematical Modelling and to participate in conference 'Science is the Future of Lithuania', annually held in VGTU. The brightest students prepare and read their reports at the conference. These types of activites enhance students to take responsibility for their studies and work purposefully, they also create opportunities for students to: learn about their teachers' scientific activities; develop the ability to present the results of their own work; get to know and understand the latest scientific achievements. The skills and abilities developed by doing these activities help students prepare and publicly present their final theses.
108. Students, wishing to participate in sporting and cultural activities, can attend the choir 'Gabija', the theatre studio 'Palėpė', the folk dance ensemble 'Vingis', the sports and tourism club 'Inžinerija' and the VGTU tourist club 'Turistas'.
109. The 'Techmaths Olimpiad' is held on the initiative of students of technomathematics. This activity, linking free time activities and studies, enhances students' development, communication and cooperation.
110. Students of technomathematics actively disseminate the information on the studies. They actively participate in various events and promote the study programme.
111. An article introducing the study programme was written and published in the journal 'Kur Stoti' on the initiative of several technomathematics students.

6.4 The principles of student achievement assessment and the ways of ensuring fair studies

112. Students of technomathematics study in accordance with the undergraduate study organization procedures regulated by the VGTU Rector's orders. The schedules of lectures, workshops and laboratory work are designed by a responsible person of the Faculty and approved by the Dean of the Faculty of Fundamental Sciences and the Directorate of Studies. Approved study schedules are published on the VGTU website https://medeine.vgtu.lt/paskaitos/paskaitos.jsp .
113. The schedules of exam sessions are also published on the website. The monitor of each group designs the schedules of exam sessions in accordance with the description of session orgainzation procedure and coordinates the schedule with the students and the teachers of the group. Before the start of the session, students must have performed the tasks of the curriculum, assigned to individual students or groups to be performed during the semester. The assessment of the tasks is performed according to the cummulative assessment formula indicated on the subject module card. During each semester, students can accumulate up to 50 % of the final grade. Each time a student submits his research paper, project or complex project, he signs the Declaration of Academic Integrity, to confirm that the paper is not plagiarized. In cases of students' dishonesty, the decision on furher study is adopted by the Dean of the Faculty.
114. Exams are conducted in accordance with the established session organization procedures which are published on the website(http://www.vgtu.lt/media/files/5/2013-2014-sesijos-tvarkos-ir-priedai/egzaminu-sesiju-ir-baigiamuju-darbu-rengimo-bei-gynimo-organizavimo-tvarka-685-pdf.pdf). Students' knowledge is assessed in accordance with the description of Vilnius Gediminas Technical University student knowledge assessment procedures, adopted by the VGTU Senate on 31 May, 2011. The description of session organization procedures provides all the information related to examinations, register filling and re-examination.

6.5 Students' final theses

115. The procedures of setting up a commission for final thesis evaluation, thesis defence evaluation and degree awarding, as well as the procedures of final thesis defence, are provided in the description of session organization procedures.
116. The list of student final theses of the year 2012 and the year 2013, including the themes of the theses, the names of the students , the names of supervisors and evaluation of theses, is provided in Annex 10. The themes of theses correspond to the aims and results of the study programmes.

6.6 The data about the opportunities for students to choose subjects. The distribution of hours provided for lectures, workshops and individual work

117. In the course of the study process, students may not only choose one of the two specializations foreseen in the study programme, but they can also choose some of the study subjects from the list providing several alternatives. Students earn 21 credits for the optional subjects of the study programme. Free elective subjects are also included in the study programme (12 credits during the entire study period), which are chosen by students according to their needs and preferences.
118. The total duration of technomathematics study programme is 6400,8 hours. This time includes the duration of contact hours (39,37%) and the duration of consultations and individual studies (60,63 %). The total duration of lectures is 1323 hours (20,67 %), the total duration of workshops is 774 hours (12,1 %) and the total duration of laboratory work is 423 hours (6,6 %). The total number of hours planned for work in classrooms is 2520 and 3880,8 hours are intended for individual work. Such time distribution is appropriate to achieve goals and results of the study programme.

6.7 Data about students' participation in mobility programmes

119. Students of technomathematics have an opportunity to improve their knowledge by pursuing partial studies at foreign universities. Students trips abroad under the ERASMUS exchange programme is organized by the VGTU Directorate of International Relations.
120. The Faculty of Fundamental Sciences have concluded student and teacher exchange agreements under the ERASMUS exchange programme with 56 European and 6 Turkish universities.
121. Students of technomathematics are oferred to study at the following universities: Universidad de Zaragoza (Spain), Universitá degli Studi Tuscia (Italy), Avans University of Applied Science (Breda) (The Netherlands), Universite Paris XII Val de Marne (France), Technische Universität Kaiserslautern (Germany), University Karlsruhe (Germany), HTWK Leipzig (Germany), Fachhochschule Nordhausen (Germany), Universitat Rostock (Germany). The list of students who went abroad to pursue their partial studies is provided in Table 6.5.

Table 6.5. The list of students who pursued their partial studies at foreign universities

Name, surname	Higher education institution	Year
Urtė Radvilaitė	Technishe Universität Kaiserslautern, Germany	2008/2009
Marija Šanina	Technishe Universität Kaiserslautern, Germany	2008/2009
Donatas Kunigonis	Southampton Solent University, Great Britain	2008/2009
Justinas Račkauskas	Southampton Solent University, Great Britain	2008/2009
Jevgenija Pantiuchina	Free University of Bozen-Bolzano, Italy	2009/2010
Sergej Kaleničenko	Free University of Bozen-Bolzano, Italy	2010/2011
Ieva Aksenavičiūtė	Rostock University, Germany	2010/2011
Jadvyga Pocej	HSG-IMIT (The Institute of Microtechniques and Information Technologies), Germany	2010/2011
Ieva Aksenavičiūtė	Systems GmbH, Germany	2011/2012
Tomas Červinskij	HSG-IMIT (The Institute of Microtechniques and Information Technologies), Germany	2011/2012
Ivan Lebedev	HSG-IMIT (The Institute of Microtechniques and Information Technologies), Germany	2011/2012
Gabriel Oršev̌ski	HSG-IMIT (The Institute of Microtechniques and Information Technologies), Germany	2011/2012
Gabriel Oršev̌ski	Free University of Bozen-Bolzano, Italy	2012/2013
Gabriel Oršev̌ski	Hanyang University, South Korea	2012/2013

6.8 Forms of support for students

122. The information on the study programme is provided for students in publications on studies, on VGTU website and technomathemitics study website. On the initiative of the study programme executors, meetings with students are held every year where various current academic issues are discussed. During these discussions, students express their comments and make suggestions regarding the study process organization, the ways of enhancing students' motivation and other issues.
123. Both the teachers of the study programme and the supervisors of final theses constantly communicate with students and provide them with all necessary help related to studies. They also provide academic advisement during their office hours every week and by communicating with students via the Internet. Current information is published on study programme website http://www.techmat.vgtu.lt/ .
124. The teachers and students of technomathematics communicate and cooperate, share advice and help each others in social network 'Facebook': (https://www.facebook.com/pages/Technomatematika/174310625932263?v=wall).
125. The Student Representative Body takes care of students and provide them with all kinds of information and help. The Student Representative Body also organizes cultural and entertainment events. Students of technomathematics are active members of The Student Representative Body of the Faculty of Fundamental Sciences.
126. Already during their studies, students are encouraged to get interested in their career opportunities. Therefore, VGTU organizes a special event 'Career Days' every year. All the information on career prospects and job offers is published on the website of the study programme http://www.techmat.vgtu.lt/ . Both VGTU Directorate of Integration and Career and the Dean of the faculty give advise for students on employment issues. The staff of the Faculty of Fundamental Sciences administration also provide consultations to students on the study organization and social issues.
127. In accordance with scholarship granting procedures, VGTU provides three sorts of grant (http://mano.vgtu.lt/informacija-studentams/stipendijos/): social grants, named grants and one-time grants.
128. Social grant is for students corresponding to certain criteria (those who come from needy families or single residents having the right to a financial social assistance according to Resolution No. 1801 (Official Gazette 2009, 158-7178) of 23 December 2009 of the Government of the Republic of Lithuania. This sort of grant is provided by the State Studies Foundation. The social grant amounts to 3 BSB (basic social benefit) (1 BSB is LTL 130).
129. Named grants (named grants and grants for good study results) are awarded by the Rector's order for outstanding performance in studies and research achievements. The grants are awarded to students according to the grant competition procedures. 1st Degree Gediminas' Grant (6 BSB) and 2nd Degree Daumantas Maciulevičius' Grant (3,5 BSB) are awarded to Students of the Faculty of Fundamental Sciences.
130. In the academic year 2012/2013 2nd Degree Daumantas Maciulevičius' Grant was awarded to Ieva Ramanauskaitė, a second year student of technomathematics.
131. One-time scholarship (which amounts up to 3 BSB) is granted for active cultural, sports and other social activities in the university and faculty interest.
132. Sudents can get a loan from the Lithuanian State Science and Studies Foundation (www.vmsfondas.lt) to pay their tuition fees, cover their living expenses and pay for their part-time studies.
133. Dormitory accommodation is provided to students in accordance with the procedures approved by VGTU, in proportion to the need and students' social and material situation.

6.9 Data about graduate employment and the professionals needed in the labour market

134. Apart from other information multipliers, graduates who did not use Lithuanian Labour Exchage services from 2008-2013 also disseminate information on the study programme. Often students find jobs during their studies already.
135. Most usually, graduates from the study programme have occupations corresponding to their education. Graduates from technomathematics studies get employed in both state institutions and businesses, and educational institutions. They successfully work in the fields related to information technologies and their application as computer programmers, IT specialists and data analysis specialists. Some of them work in state institutions, others work in information technology companies, several graduates were employed in scientific research institutes, one graduate chose to work as a teacher.
136. The need for high-tech engineering, information technology and biotechnology professionals is tend to grow in the nearest future. There is a shortage of professionals with narrow specialization. (electronic magazine 'Veidas.lt', 2011-01-31). The article 'Deficitu tampa IT specialistas' (an IT specialist is becoming a deficit) by Sigita Migonytė, published in daily newspaper 'Verslo žinios' (Business News) of

2 March, 2011, provides the author's forecast, based on the data of 'Infobalt' investigation, that the Lithuanian market is going to feel a shortage of IT specialists in the coming years. However, according to the author of the article, by 2020 Lithuanian higher schools will have prepared only half the number of ICT specialists released today.

137. Professionals with mathematical education are constantly searched by scientific research institutes operating in Lithuania. Highly qualified professionals having work experience and knowledge of latest technology are also in demand.

138. Recently, engineering and science studies are increasingly identified as priority studies by representatives of Lithuanian government too. Scientific researches related to mathematical modelling, mathematics application in industry, biomedicine and business are conducted in the Mathematical Modelling Department. In our view, these scientific researches correspond to the modern trends prevailing in the labour market.

Table 6.6. The process of studies and the assessment strengths, weaknesses and improvement actions

Strengths	Weaknesses	Improvement actions
Rather good opportunities to get jobs in the field of technomathematics or in neighbouring fields (e.g. informatics, engineering).	A small number of gymnasium graduates willing to choose technomathematics speciality. Unfortunately, the significance of fundamental education has not been adequately understood so far.	Promoting of technomathematics speciality; introducing the target audience (senior class students and their teachers and the general public) to the opportunities and advantages of the speciality.
Favorable attitude of employers to technomathematics graduates.	The school students, able to study in technomathematics study programme, most usually choose to become specialists in social sciences or informatics fields, which are currently in demand or simply fashionable.	Publishing and updating information on technomathematics study website; publishing the information in the press; participating in open day events in the university; establishing personal contacts and visiting gymnasiums.
	Insufficient mathematical preparation of applicants for the study programme and not always sufficient student motivation to extend their knowledge of the study programme subjects, including mathematics.	Improving efficiency of the learning process by focusing on the selection of relevant information and by developing the ability to go into details only when necessary

7. PROGRAMME MANAGEMENT

7.1 The structure of management and decision-making

139. The programme management, decision-making and control are implemented at various levels:
    1. At state level: The Ministry of Science and Education of the Republic of Lithuania acts at state level by adopting the regulatory provisions.
    2. At university level: the Senate and the Rector of VGTU act at university level by adapting state regulatory provisions governing the organization of studies for university and adopting relevant documents.
    3. At faculty level: the FMF Dean and, within the delegated functions, the Vice Dean and the FMF Council act at faculty level. The faculty has established a Committee for solving study issues. The study Committee is concerned with the discussion and approval of the newly developed or improved programs and their courses. The specific study programme process is organized and controlled by the faculty: the schedules of semester lectures and exam sessions are approved, studies of elective subjects are coordinated, interdepartmental study relations are controlled, proposals regarding the performance of studies and their quality improvement are submitted to the Senate. The FMF Council adopts resolutions regulating the study organization in the faculty, scientific researches and other kinds of activity. The Council also approves the amendments to the study programme.
    4. At department level: the management and decision-making is implemented by the Technomathematics Study Programme Committee (The Committee) and the teachers of the study programme. The Committee consists of 7 members: representatives of the Department of Mathematical Modelling, the Department of Strenght of Materials, the Department of Theoretical Mechanics, social partners and students. This level deals with specific issues of: study process organization, material and

methodological provision, education quality improvement, teacher workload distribution, study programme course change, relations with the social partners, the course programme and description preparation and validation , thesis supervisor and reviewer appointment and others. The Committee is responsible for programme oversight in accordance with regulatory provision requirements. If programme changes are planned, they are first submitted for approval to the Faculty Studies Committee, and after it is approved, the study programme is updated and the information is published on the VGTU website https://medeine.vgtu.lt/programos/profakult.jsp?pg=f&kva=B&metai=2013. Presently, the Committee consists of the following members: Prof. Dr Habil Raimondas Čiegis, Prof. Dr Habil Rimantas Belevičius, Assoc. Prof. Dr Teresė Leonavičienė, Assoc. Prof. Dr Jevgenijus Kirjackis, Assoc. Prof. Dr Stanislav Stupak, Dr Ramūnas Šablinskas (social partner) and Anastasija Borisevič (students' representative).

140. The interests of students are represented by their delegated representatives in the Programme Study Committee, in the Faculty Study Committee and the Council.

7.2 Quality assurance methods and the documents regulating the internal quality assurance

141. The process of the VGTU study programme and quality assurance, as well as programme executors' responsibilities, are described in the documents of various levels: the VGTU vision and mission; the description of the model of science and study quality management system; the long-term development plans; the Statute; the study provisions; the provisions of the Study Programme Committee; the common university procedures; the department policy on the quality of the programme; the descriptions of the programme and its modules; the methodologies, the arrangements and other internal and external documents regulating studies and scientific activity.
142. The quality of the studies is ensured by the VGTU Senate resolutions listed below:
    - Vilnius Gediminas Technical University Study Programme Provisions (Resolution No. 62-2.2 of 19 February 2012);
    - Vilnius Gediminas Technical University Study Committee Provisions (Resolution No. 6-2.5 of 2 March, 2005);
    - Vilnius Gediminas Technical University Study Provisions (Resolution No. 58-3.1 of 26 June 2012);
    - The General Faculty Provisions of Vilnius Gediminas Technical University (Resolution No. 57-1.4 of 29 May 2012);
    - The Provisions of the Faculty Study Committee of Vilnius Gediminas Technical University (Resolution No. 6-2.6 of 2 March 2005);
    - The General Faculty Council Provisions of Vilnius Gediminas Technical University (Resolution No. 57-1.5 of 29 May 2012);
    - The General Department Regulations of Vilnius Gediminas Technical University (No. 57-1.6 of May, 2012);
    - The General Principles of Undergraduate Level Study Programme Design (Resolution No. 57-1.8 of 29 May 2012);
    - The Description of Full-time and Part-time Study Performance (Resolution No. 57-1.7 of 29 May 2012);
    - The Description of Curricula Reform Procedures (Resolution No. 57-1.10 of 29 May, 2012);
    - Vilnius Gediminas Technical University Planned Curricula Internal Assessment Regulations (Resolution No. 8-2.1 of 25 2005);
    - The Description of Crediting of the Study Results in Vilnius Gediminas Technical University (Resolution No. 55-3.2 of 31 January, 2012);
    - The Description of Vilnius Gediminas Technical University Teacher Traineeship Procedures (Resolution No. 44-1 of 4 May, 2010);
    - The Description of the Temporary Procedures of Student Survey (Student Survey Questionnaire) Organized by the Senate of Vilnius Gediminas Technical University (Resolution No. 41-4.4 of 17 November 2009);
    - The Description of Vilnius Gediminas Technical University Students' Knowledge Assessment Procedure (Resolution No. 51-2.4 of 31 May 2011);
    - Vilnius Gediminas Technical University Teachers' Code of Ethics (Resolution No. 14-2.5 of 10 May 2006);
    - VGTU Teacher Training Procedures (Resolution No. 22-4 of 25 June 2003);
143. The quality of the studies is ensured by acting in accordance with VGTU Rector's orders:
    - The Description of the Organization of Examination Session, Final Thesis Preparation and Defence in Vilnius Gediminas Technical University of the academic year 2011-2012(Resolution No. 542 of 16 June 2011 which is a new version of Resolution No. 412 of 5 April, 2012);

- •The Description of the Organization of Examination Session, Final Thesis Preparation and Defence in Vilnius Gediminas Technical University of the academic year 2012-2013 (Resolution No. 576 of 25 May, 2012);
- •The Description of Vilnius Gediminas Technical University Students Appeal Submittion and Examination (Resolution No. 545 of 21 May, 2012);
- • The Description of Vilnius Gediminas Technical University Students Departing Abroad by Cultural Exchange and Work Programmes, Early Testing Procedure (Resolution No. 459 of 23 April, 2012).

144. All the information, related to the programme execution, is stored in the VGTU information system ‘Alma Informatika’. Additional informationt is stored in the Department, the Faculty Dean’s Office and the VGTU Studies Directorate. The programme review and evaluation protocols are also stored in these subdivisions.
145. University study quality assurance system is based on the provisions of the European Higher Education Area Quality Assurance. The internal quality management system ensures the quality of implementation of the University’s mission and the objectives of the study area: to train and develop socially responsible, creative, entrepreneurial personalities, receptive to science, knowledge of the latest technologies and cultural values; to carry out studies that provide individuals with contemporary university degree and higher education qualification.
146. In 2012 University launched the project ‘The VGTU Internal Study Quality Management System Implementation’. The main objective of the project is to ensure the efficient and effective use of management tools to improve the quality of services provided by the university.
147. Students can also contribute to improving the quality of their studies. They are provided with the opportunity to express their opinion by filling out university student surveys.
148. 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.
    4. In 2012 University launched a survey on the study conditions.

7.3 Teacher, student and graduate opinions on the programme implementation. The inclusion of social co-partners

149. Technomathematics Study Programme Committee examines study quality issues during the meetings with the teachers and students working onder the study programme. The information about students’ careers and their feedback on the completed studies is periodically collected. After each session, Technomathematics students’ study results are discussed, the achievement indicators are analyzed, the causes of the decline in the number of students are ddiscussed and the activities for programme development are foreseen.
150.
151. We receive graduates’ feedback on the studies. They are pleased with the education they have acquired. Good knowledge of mathematics, as well as the fusion of mathematics, engineering and informatics subjects, is referred to as the benefits of the programme. The ability to model and analyze a variety of problems, independence and constant desire to develop allows graduates to establish themselves in various companies and institutions.
152. The graduates indicate that the program of study should be extended by including new informatics subjects; to reveal more the interconnection between the theoretical and practical applications.
153. The impact on the study quality improvement is also made by the social partners, who are involved in thesis development and are included in the Study Programme Committee. The social partners provide university students with opportunities to carry out their practical training at the institutions or companies represented by the social partners.
154. The programme assessment results, the information about the study programme and its changes are publicly presented on the technomathematics study programme websites, in seminars and meetings. The information about the programme is disseminated through a variety of channels: it is published in the electronic space and the press, it is also provided to visitors of open day events, science exhibitions and other occurrences of social importance.

Table 7.1. Study programme management strenghts, weaknesses and improvement actions

Strengths	Weaknesses	Improvement actions
The process of study programme implementation is periodically discussed both with the teachers and students	Lack of communication with the social partners.	To reinforce the current relations with the social partners and search for new contacts.
Students actively participate in the promotion of the study programme and take the initiative in analyzing and promoting the programme.	The optimization process of the program contents and subject layout are not easy to perform because the programme covers different fields and it faces various restrictions.	To consider programme development opportunities actively, to find appropriate solutions at the level of faculty and at the level of university.