



საქართველოს ტექნიკური უნივერსიტეტი
GEORGIAN TECHNICAL UNIVERSITY

Approved
by Academic Council of GTU
on N 1234, 16.07. 2014

The Modified Program
Approved by Academic Council of GTU
on 19.05.2016 by Decree № 2005

Bachelor's Degree Program

Program Title

პროგრამის სახელწოდება

Computational Mathematics

გამოთვლითი მათემატიკა

Faculty

ფაკულტეტი

Informatics and Control Systems

ინფორმატიკისა და მართვის სისტემების ფაკულტეტი

Program Supervisor

Professor Vaja Tarieladze

Awarded Qualification

მისანიჭებელი კვალიფიკაცია

Bachelor of Mathematics

will be awarded in case of passing a 210 credits of educational program and free components or/and by combination of additional specialty components (Minimum 240 credits)

Language

English

Program Objective

The objective of the bachelor's curriculum is to provide students with the mathematical language and terminology, the technique of mathematical proof, mathematical methods, description by use of mathematical models of applied type problems and an independent development of these models in theoretical or/and applied framework, as well as the evaluation skills.

Program prerequisites

Applicant is admitted in compliance with the Georgian Legislation. At the same time, students in foreign language must have passed the English language.

Program description

The program follows the ECTS system, 1 credit equals to 27 hours, which includes the contact hours, as well as the hours of independent work. The distribution of hours is presented in the educational plan. The duration of the program is 4 years (8 semesters) and it contains 240 credits.

The annual learning process: (21-21 weeks of two semesters) is distributed as follows: VII and XIV weeks are devoted to intermediate exams; i.e. the learning process and two intermediate estimates will be realized during 17 weeks (I—XVII weeks). From XVIII week till to XXI week (included) are devoted to exams (the basic and additional exams).

The first, second and third annual learning process: during the semester a student learns six subjects, each of them contains 5 credits, which in semester gives 30 credits, in the academic year is 60 credits and in sum gives in whole 180 credits.

In the first semester of the **fourth year** student takes six subjects each of them with five credits, in sum gives 30 credits. In the **second semester** student can choose six classes from free components again each subject with five credit hours that in sum gives 30 credits.

Learning Outcome/Competencies

Knowledge and understanding – Main outcome is knowledge in modern branches of mathematics. Especially in probability theory, statistics, financial mathematics, actuary mathematics, modern algebra, geometry, topology, theoretical physics.

- ✓ Perception of the basic concepts and principles of Mathematics;
- ✓ Wide theoretical knowledge of the sphere of Mathematics and perception of the complex problems of relevant directions;
- ✓ Critical estimation of current achievements and novelties in the sphere of Mathematics;
- ✓ Perception of mutual links between basic spheres of Mathematics;
- ✓ Knowledge of the terminology of Mathematics.

Applying knowledge – Students will be able to use mathematics in applied sciences and practical issues, such as computer sciences, engineering, physics, applied statistics etc.

- ✓ Critical perception of theoretical statements and principles of Mathematics;
- ✓ The ability of construction of logical argument and of clear mathematical statement of the problem;
- ✓ Application of the theoretical knowledge to the practical problems;
Skills of definition of the relevant time scopes in order to reach the stated goals;

Making judgments–Retrieval, collection and analysis of the information relevant to the topics and problems of different spheres of Mathematics, making reliable conclusions by use of standard, or original in some cases, methods.

- ✓ Ability of identification and of understanding of the problems arising in different directions of mathematics, elaboration and analysis of related information and making relevant conclusions;
- ✓ Ability of making relevant conclusions for the practical mathematical problems based on the acquired

theoretical knowledge.

Communication skills– The program will develop the ability to present scientific information in oral or written form.

- ✓ Skills of application of information-communication technological resources in order to reach the working goals;
- ✓ Argument discussion about theoretical and applied problems of Mathematics;
- ✓ Skills of presentations and compiling the written information;
- ✓ Public presentation, defend and clear documentation of own considerations;
- ✓ Skills of laconic and plainly writing about professional problems.

Learning skills– Large variety of mathematical courses of the program definitely will develop learning skills of students.

- ✓ Identify areas of self-learning in order to enrich the professional knowledge and experience in Mathematics.
- ✓ Search, analysis and interpretation of information on current developments.
- ✓ Continuous and multilateral estimation of own studying process in order to enrich the knowledge and experience, self-estimation of necessity of refreshing of the knowledge and statement of necessity of continuity of studying at the second level (master degree).
- ✓ In order to enrich the knowledge and experience in the sphere of Mathematics the skills of revealing and perception the modern materials and reception of continuous education.

Values – Students become familiar with the meaning and importance of such fundamental notions as: the truth, correct argumentation, proof, contradiction in mathematics, logic etc.

- ✓ Defend of accepted ethical and worth norms;
- ✓ Defend of accepted moral norms;
- ✓ Skills of participation in the process of formation of worth, conscience norms and aspiration of their establishment.
- ✓ Defend of professional worth (exactness, punctuality, objectivity, transparency, organization etc.) in the sphere of mathematics.

Forms and Methods of achieving the learning outcomes

Lecture Seminar (working in the group) Practice Laboratory Work Field Work Consultation
Course Work/Project Independent Work

Collaborative work. Learning by using this method means a division of students into groups and giving to each group its question to study. The members of each group investigate the question separately and simultaneously discuss their conclusions with other members of the group. Depending on the discussed questions during the working process it is possible to re-distribute the functions between the members of the group. This strategy ensures the maximal participation of each student in the learning process.

Practical methods include all forms of learning which develop the abilities of practical work of the students. In

this case a student independently performs one or another action on the basis of the obtained knowledge; for example, pedagogical and industrial practice, field work etc.

Written work method includes the following actions: to make written copies, abstracts, summaries or surveys from the considered material, etc.

Verbal or oral method includes lectures, conversations, etc. During this process the lecturer verbally explains the needed material, while the students memorize it.

Problem based learning method (PBL) as a first stage of the process of acquiring knowledge and of integration uses a concrete problem.

Heuristic method is based on the step by step solution of the posed task. This process is accomplished by means of detecting independently the facts and obtaining connections between them during the study.

Forms and Methods of achieving the learning outcomes

Assessment is based on a 100 point grading scale.

Positive assessment is:

- excellent - 91% and more of the maximum grade;
- very good - 81-90% of the maximum grade;
- good - 71-80% of the maximum grade;
- satisfactory - 61-70% of the maximum grade;
- enough - 51-60% of the maximum grade.

Negative assessment is:

- (FX) - not passed - 41-50% of the maximum grades. It means that a student needs more individual work, and is given one more possibility of make up;
- (F) - failed - 40% and less of the maximum grade. It means that work performed by a student was not enough and the subject should be learnt from the beginning;

Spheres of Employment

Graduates of mathematical major can work in higher education bodies, research centers, banks and corporations, financial sector, state-military and healthcare structures, insurance agency, private institutions and organizations working in the fields of information technology and telecommunications.

Possibilities for further education

Master's educational programs.

Required human and material resources

The program provides the appropriate human and material resources. For more information see the attached documents.

The number of attached syllabi: 58

The main 210 credits subject load of program

№	Code of discipline	Discipline	Prerequisites of admission	ECTS Credits							
				1st year		2nd year		3rd year		4th year	
				Semester							
				I	II	III	IV	V	VI	VII	
1	MAT0108	Mathematical Analysis 1	Non	5							
2	LALG108	Linear Algebra and Geometry 1	Non	5							
3	IIT0108	Introduction to Information Technologies	Non	5							
4	DIMA108	Discrete Mathematics	Non	5							
5	FAPRO08	Fundamentals of Algorithmizations and Programming	Non	5							
6	CEGRA08	Computer Engineering Graphics	Non	5							
7	MAT0208	Mathematical Analysis 2	Mathematical Analysis 1		5						
8	LALG208	Linear Algebra and Geometry 2	Linear Algebra and Geometry 1		5						
9	PAS0208	Personal Applied Systems	Introduction to Information Technologies		5						
10	FUCAO08	Fundamentals of Computer Architecture and Organization	Non		5						
11	PRVBN08	Programming in Visual Basic/Visual Basic.net	Introduction to Information Technologies		5						
12	GRTHC08	Graph theory and combinatorics	Linear Algebra and Geometry 2		5						
13	MAT0308	Mathematical Analysis 3	Mathematical Analysis 2			5					
14	CMAT108	Computer Mathematics 1	Mathematical Analysis 2; Linear Algebra and Geometry 2			5					
15	FUNAN08	Functional Analysis	Mathematical Analysis 2			5					
16	PBST108	Probability and Statistics 1	Mathematical Analysis 2			5					
17	DIFE0108	Differential Equations 1	Mathematical analysis 2, Linear			5					

№	Code of discipline	Discipline	Prerequisites of admission	ECTS Credits								
				1st year		2nd year		3rd year		4th year		
				Semester								
				I	II	III	IV	V	VI	VII		
			algebra and geometry 2									
18	TPHCR08	Theoretical Physics 1	Mathematical Analysis 2, Linear algebra and geometry 2			5						
19	MAT0408	Mathematical Analysis 4	Mathematical Analysis 3				5					
20	CMAT208	Computer Mathematics 2	Mathematical Analysis 1 Algebra 1				5					
21	PBST208	Probability and Statistics 2	Probability and Statistics 1				5					
22	DIFE208	Differential Equations 2	Differential Equations 1				5					
23	TPHQM08	Theoretical Physics 2	Theoretical Physics 1				5					
24	COMAN08	Complex Analysis	Mathematical Analysis 2				5					
25	DYNPR08	Dynamic Programming	Linear Algebra and Geometry 2; Mathematical Analysis 2					5				
26	OPMET08	Optimization Methods	Mathematical Analysis 2					5				
27	COGTH08	Computational Group Theory	Linear Algebra and Geometry 2; Computer Mathematics 2					5				
28	THINT08	Theory of Integration	Mathematical Analysis 2					5				
29.1	GAMTH08	Game Theory	Probability and Statistics 2; Linear Algebra and geometry 2					5				
29.2	FLNET08	Flows in Networks	Computer Mathematics 2; Linear Algebra and Geometry 2									
30	LMLPR08	Linear Models and Linear Programming	Linear Algebra and Geometry 2; Mathematical Analysis 2					5				

№	Code of discipline	Discipline	Prerequisites of admission	ECTS Credits						
				1st year		2nd year		3rd year		4th year
				Semester						
				I	II	III	IV	V	VI	VII
31	APST108	Applied Statistics 1	Probability and Statistics 2						5	
32	NLIMA08	Non-life Insurance Mathematics	Probability and Statistics 2;						5	
33	LMEC008	Linear Models of Economics	Linear Algebra and Geometry 2; Mathematical Analysis 2						5	
34	INNUM08	Introduction to Numerical Methods	Linear Algebra and Geometry 2; Mathematical Analysis 2						5	
35	COMAL08	Algebraic Computations	Computer Mathematics 2; Mathematical Analysis 2						5	
36.1	ITSFE08	Introduction to Time Series and Forecasting	Probability and Statistics 2						5	
36.2	STPRC08	Stochastic Processes	Probability and Statistics 2							
37	COPT008	Combinatorial (Discrete) Optimization	Probability and Statistics 2; Linear Algebra and Geometry 2							5
38	RFMOD08	Rings, Field and Modules	Computational Group Theory; Linear Algebra and Geometry 2							5
39.1	MONTE08	Monte-Carlo Methods	Probability and Statistics 2						5	
39.2	FORME08	Forecasting Methods	Probability and Statistics 2							
40	AGMIF08	Analysis, Geometry, and Modeling in finance	Applied Statistics1							5
41	APST208	Applied Statistics2	Applied Statistics1							5
42	LINMA08	Implementation of practical problems in life insurance	Applied Statistics1							5
Total Credits per Semester				30	30	30	30	30	30	30
Total Credits per Year				60		60		60		30
Total				210						

Selective Courses / Free Components

№	Code of discipline	Discipline	Prerequisites of admission	ECTS Credits
				4nd year, VIII semester
1	GAS0108	General Astronomy	Non	5
2	PRCPP08	Programming in C++	Introduction to Information Technologies	5
3	OPSFU08	Operation Systems Fundamentals	non	5
4	SYNTG08	Synthetic Geometry	Linear Algebra and Geometry 2; Computer Mathematics 2	5
5	GTOP008	General Topology	Mathematical Analysis 2	5
6	ECATH08	Elements of Category Theory	Computer Mathematics 2	5
7	SPFIF08	Stochastic Processes for Insurance and Finance	Probability and Statistics 2	5
8	MOASL08	Modular Lattices and geometry	Linear Algebra and Geometry 2	5
9	CMAPS08	Combinatorial Methods in Probability and Statistics	Probability and Statistics 2	5
10	APGT008	Applied Topology	Computer Mathematics 2	5
11	SCHTH08	Scheduling Theory	Linear Algebra and Geometry 2; Mathematical Analysis 2	5
12	MAPRO08	Mathematics and Programming	Non	5
13	MATPR08	Mathematical Programming	Linear Algebra and Geometry 2; Mathematical Analysis 2	

Map of study results

The main 210 credits subject load of program

№	Course code	Course	General and technical competencies
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			Knowledge and understanding	Applying Knowledge	Making judgments	Communication skills	Learning skills	Values
1	MAT0108	Mathematical Analysis 1	X	X	X	X	X	
2	LALG108	Linear Algebra and Geometry 1	X	X	X		X	
3	IIT0108	Introduction to Information Technologies	X	X			X	
4	DIMA108	Discrete Mathematics		X		X	X	
5	FAPRO08	Fundamentals of Algorithmizations and Programming	X	X				X
6	CEGRA08	Computer Engineering Graphics	X	X				X
7	MAT0208	Mathematical Analysis 2	X		X	X	X	
8	LALG208	Linear Algebra and Geometry 2	X	X	X		X	
9	PAS0208	Personal Applied Systems		X		X	X	
10	FUCAO08	Fundamentals of Computer Architecture and Organization	X	X			X	
11	PRVBN08	Programming in Visual Basic/Visual Basic.net		X		X	X	
12	GRTHC08	Graph theory and combinatorics	X		X			X
13	MAT0308	Mathematical Analysis 3	X		X	X	X	
14	CMAT108	Computer Mathematics 1		X	X	X	X	
15	FUNAN08	Functional Analysis	X	X	X	X	X	
16	PBST108	Probability and Statistics 1	X	X	X	X	X	
17	DIFE0108	Differential Equations 1	X	X	X	X	X	
18	TPHCR08	Theoretical Physics 1	X	X	X			
19	MAT0408	Mathematical Analysis 4	X	X	X	X	X	
20	CMAT208	Computer Mathematics 2		X	X	X	X	
21	PBST208	Probability and Statistics 2	X	X	X	X	X	
22	DIFE208	Differential Equations 2	X	X	X	X	X	
23	TPHQM08	Theoretical Physics 2	X	X	X			
24	COMAN08	Complex Analysis	X	X	X	X	X	
25	DYNPR08	Dynamic Programming		X	X	X	X	
26	OPMET08	Optimization Methods		X	X	X	X	
27	COGTH08	Computational Group Theory		X	X			X
28	THINT08	Theory of Integration	X		X	X	X	X
29.1	GAMTH08	Game Theory		X	X		X	
29.2	FLNET08	Flows in Networks		X		X	X	
30	LMLPR08	Linear Models and Linear Programming		X	X	X	X	
31	APST108	Applied Statistics 1		X	X		X	
32	NLIMA08	Non-life Insurance Mathematics		X	X	X	X	
33	LMEC008	Linear Models of Economics		X	X	X	X	
34	INNUM08	Introduction to Numerical Methods		X	X	X	X	
35	COMAL08	Algebraic Computations		X	X		X	
36.1	ITSFE08	Introduction to Time Series and Forecasting		X	X	X	X	
36.2	STPRC08	Stochastic Processes			X	X	X	X
37	COPT008	Combinatorial (Discrete) Optimization		X		X	X	

38	RFMOD08	Rings, Field and Modules	X		X	X	X	
39.1	MONTE08	Monte-Carlo Methods		X	X	X	X	
39.2	FORME08	Forecasting Methods			X	X	X	X
40	AGMIF08	Analysis, Geometry, and Modeling in finance	X	X		X	X	
41	APST208	Applied Statistics2	X	X	X			
42	LINMA08	Implementation of practical problems in life insurance		X	X	X	X	

Selective Courses/Free Components

№	Course code	Course	General and technical competencies					
			Knowledge and understanding	Applying Knowledge	Making judgments	Communication skills	Learning skills	Values
1	GAS0108	General Astronomy	X	X			X	
2	PRCPP08	Programming in C++		X		X	X	
3	OPSFU08	Operation Systems Fundamentals	X	X		X		
4	SYNTG08	Synthetic Geometry		X	X	X	X	
5	GTOP008	General Topology		X	X	X	X	
6	ECATH08	Elements of Category Theory		X		X	X	
7	SPFIF08	Stochastic Processes for Insurance and Finance	X	X	X	X		
8	MOASL08	Modular Lattices and geometry	X		X	X	X	
9	CMAPS08	Combinatorial Methods in Probability and Statistics	X	X		X	X	
10	APGT008	Applied Topology		X		X		X
11	SCHTH08	Scheduling Theory		X		X	X	
12	MAPRO08	Mathematics and Programming		X	X		X	
13	MATPR08	Mathematical Programming		X	X	X		X

The main 210 credits subject load of program

N	subject code	subject module	hours	ECTS Cr\hours	lecture	Seminar	practical	laboratory	practice	Consultation	Mid. exam	Final Exam.	Independent work

N	subject code	subject module	hours									
			ECTS Cr\hours	lecture	Seminar	practical	laboratory	practice	Consultation	Mid. exam	Final Exam.	Independent work
2	LALG108	Linear Algebra and Geometry 1	5/135	15		30			5	2	1	82
3	IIT0108	Introduction to Information Technologies	5/135	15			30		5	2	1	82
4	DIMA108	Discrete Mathematics	5/135	15	30				5	2	1	82
5	FAPRO08	Fundamentals of Algorithmizations and Programming	5/135	15		15	15		5	2	1	82
6	CEGRA08	Computer Engineering Graphics	5/135	15			30		5	2	1	82
7	MAT0208	Mathematical Analysis 2	5/135	15	30				5	2	1	82
8	LALG208	Linear Algebra and Geometry 2	5/135	15		30			5	2	1	82
9	PAS0208	Personal Applied Systems	5/135	15			30		5	2	1	82
10	FUCAO08	Fundamentals of Computer Architecture and Organization	5/135	15			30		5	2	1	82
11	PRVBN08	Programming in Visual Basic/Visual Basic.net	5/135	15			30		5	2	1	82
12	GRTHC08	Graph theory and combinatorics	5/135	15	30				5	2	1	82
13	MAT0308	Mathematical Analysis 3	5/135	15	30				5	2	1	82
14	CMAT108	Computer Mathematics 1	5/135	15	30				5	2	1	82
15	FUNAN08	Functional Analysis	5/135	15	30				5	2	1	82
16	PBST108	Probability and Statistics 1	5/135	15	30				5	2	1	82
17	DIFE0108	Differential Equations 1	5/135	15	30				5	2	1	82
18	TPHCR08	Theoretical Physics 1	5/135	15		30			5	2	1	82
19	MAT0408	Mathematical Analysis 4	5/135	15	30				5	2	1	82
20	CMAT208	Computer Mathematics 2	5/135	15	30				5	2	1	82
21	PBST208	Probability and Statistics 2	5/135	15	30				5	2	1	82
22	DIFE208	Differential Equations 2	5/135	15	30				5	2	1	82
23	TPHQM08	Theoretical Physics 2	5/135	15		30			5	2	1	82
24	COMAN08	Complex Analysis	5/135	15	30				5	2	1	82
25	DYNPR08	Dynamic Programming	5/135	15	30				15	2	1	72
26	OPMET08	Optimization Methods	5/135	15	30				15	2	1	72
27	COGTH08	Computational Group Theory	5/135	15	30				15	2	1	72
28	THINT08	Theory of Integration	5/135	15	30				15	2	1	72
29.1	GAMTH08	Game Theory	5/135	15		30			15	2	1	72
29.2	FLNET08	Flows in Networks	5/135	15	30				15	2	1	72
30	LMLPR08	Linear Models and Linear Programming	5/135	15	30				15	2	1	72

N	subject code	subject module	hours									
			ECTS Cr\hours	lecture	Seminar	practical	laboratory	practice	Consultation	Mid. exam	Final Exam.	Independent work
31	APST108	Applied Statistics 1	5/135	15		30			15	2	1	72
32	NLIMA08	Non-life Insurance Mathematics	5/135	15	30				15	2	1	72
33	LMEC008	Linear Models of Economics	5/135	15	30				15	2	1	72
34	INNUM08	Introduction to Numerical Methods	5/135	15	15		15		15	2	1	72
35	COMAL08	Algebraic Computations	5/135	15		30			15	2	1	72
36.1	ITSFE08	Introduction to Time Series and Forecasting	5/135	15	30				15	2	1	72
36.2	STPRC08	Stochastic Processes	5/135	15	30				15	2	1	72
37	COPT008	Combinatorial (Discrete) Optimization	5/135	15	30				15	2	1	72
38	RFMOD08	Rings, Field and Modules	5/135	15	30				15	2	1	72
39.1	MONTE08	Monte-Carlo Methods	5/135	15	30				15	2	1	72
39.2	FORME08	Forecasting Methods	5/135	15	30				15	2	1	72
40	AGMIF08	Analysis, Geometry, and Modeling in finance	5/135	15	30				15	2	1	72
41	APST208	Applied Statistics2	5/135	15		30			15	2	1	72
42	LINMA08	Implementation of practical problems in life insurance	5/135					30	15	2	1	87

Free Components

N	subject code	subject module	hours									
			ECTS Cr\ hours	lecture	Seminar	practical	laboratory	consultation	Mid. exam.	Exam.exam.	Independent work	
1	GAS0108	General Astronomy	5/135	15		30			15	2	1	72
2	PRCPP08	Programming in C++	5/135	15		30			15	2	1	72
3	OPSFU08	Operation Systems Fundamentals	5/135	15				30	15	2	1	72
4	SYNTG08	Synthetic Geometry	5/135	15	30				15	2	1	72
5	GTOP008	General Topology	5/135	15	30				15	2	1	72
6	ECATH08	Elements of Category Theory	5/135	15		30			15	2	1	72
7	SPFIF08	Stochastic Processes for Insurance and Finance	5/135	15	30				15	2	1	72

N	subject codeo	subject module	hours								
			ECTS Cr\ hours	lecture	Seminar	practical	laboratory	consultation	Mid. exam.	Exam. exam.	Independent work
8	MOASL08	Modular Lattices and geometry	5/135	15	30			15	2	1	72
9	CMAFS08	Combinatorial Methods in Probability and Statistics	5/135	15	30			15	2	1	72
10	APGT008	Applied Topology	5/135	15	30			15	2	1	72
11	SCHTH08	Scheduling Theory	5/135	15	30			15	2	1	72
12	MAPRO08	Mathematics and Programming	5/135	15		30		15	2	1	72
13	MATPR08	Mathematical Programming	5/135	15	30			15	2	1	72

The Head of Educational program

Vaja Tarieladze

The Head of Quality Assurance Service of the Faculty

Zurab Baiashvili

Accepted at

The Council of the Faculty of

N 6, 19.06.2014

The Head of the Faculty Council

Zurab Tsveraidze

Modify at

The Council of the Faculty of

Informatics and Control systems

Protocol #2, 13 April, 2016

The Head of the Faculty Council

Zurab Tsveraidze

Agreed with

Quality Assurance Service of GTU

Giorgi Dzidziguri