Title of the Program: International Doctoral Program in Mathematics
Academic Degree Offered/Conferred: Ph.D. in Mathematics
Management board of the program: M.Bakuradze, R.Botchorishvili, U.Goginava, R.Meyer, I.Witt
Program capacity/duration: 3 years, 180 ECTS
Instruction language: English

Goals of the Program:

- provide highly motivated students the opportunities to develop skills and knowledge in mathematical sciences
- enable students to engage in advanced study and research
- educate and train the next generation of mathematicians

Learning outcomes:
The program will enable students to attain, by the time of graduation:

Knowledge and understanding

- Cutting edge knowledge in specific research area.
- Knowledge of variety of methods and techniques in the field of research and specialization.

Applying Knowledge

- An ability to formulate mathematical problems and describe solution strategies.
- An ability to conduct independent research by applying corresponding methods and techniques.
- An ability to develop new approaches for solving problems in his field of specialization.

Making judgments

- An ability to consider results of his research in a larger context.
- An ability to make independent decision when solving problems using modern approaches.

Communication skills

- An ability of discussing current research within the frame of research oriented meetings.
- An ability of presenting own research results to an academic and external audiences.
- An ability to communicate solution ideas and obstacles.
- An ability to communicate effectively in oral and written form.

Learning skills

- Recognition of the need for continuing professional development.
- An ability to acquire knowledge based on recent developments, new ideas and approaches.

Values

- Understanding of professional ethics and responsibilities and applying it in practice.

Employment opportunities: jobs that require mathematical skills and mindset in sectors related with education, research, government and business.

Prerequisites for admission to the program:

- Masters degree in mathematics/applied mathematics or equivalent is required
- English language certificate or equivalent, level B2
- Interview with admission committee
- Supervision agreement signed by supervision committee

Degree conferring requirements:

- Completed study program
- Thesis (in English)
- Successful doctoral thesis defense

Similar programs
The doctoral program is developed by analogy of mathematics doctoral program of Georg August University of Goettingen, as well as incorporates some regulations of Graduate School GAUSS (Georg-August University School of Science)

How supervision works
Every doctoral student is guided by a supervision committee consisting of the supervisor and at least 2 further members.

At least two members of the supervision committee have to be members of the relevant program, and at least one has to be a university professor of Ivane Javakhishvili Tbilisi State University. The program requires that the doctoral student submit to the supervision committee at regular intervals, but not less than once a year, a report detailing the status of the doctoral project. The supervision committee shall certify this each time. The committee must verify whether the results are sufficient for finalizing the doctoral thesis, and consult about its completion or continuation. Supervisors and students have to obey the rules of good practice for doctoral supervision

Rules of good practice for doctoral supervision

- **Supervisors**

1. Supervisor apply his scientific expertise to promote the independence of doctoral students and to give them the opportunity for their independent achievements to be visible in the scientific community.
2. Supervisor is mentor to his doctoral students. Supervisor's dealings with his doctoral students are cooperative. Supervisor makes himself available for regular scientific discussions with doctoral students. In scientifically challenging phases of the doctoral process, supervisor actively engage his abilities and experience in the solution to the problem.
3. Supervisor shares with his doctoral students all the information that is important for the success of the PhD project.
4. Supervisor is the confidant and contact person of the doctoral students, also in relation to non-scientific issues (e.g. health or family), in particular those that could affect job performance and the success of the doctoral process. Supervisor promotes the social integration of doctoral students in the research group. In the case of foreign doctoral students, supervisor also supports their general social and cultural integration.
5. Supervisor's demands on the performance of doctoral students should promote and encourage them, but not be overwhelming. He particularly respects family responsibilities (e.g. child care). Supervisor takes into account and respects different working patterns, together with requests for further training and for the self-organization of the doctoral students. From the beginning of the PhD project, supervisor makes transparent rule that are applicable to all members of the research group. Supervisor agrees a time management plan for the doctorate with his doctoral students. If possible, supervisor name objective criteria for the progress of the doctoral thesis.
6. Supervisor progressively transfer to his students increased responsibility for the scientific success of the project. Supervisor actively supports the doctoral candidates in an independent way of work planning and provide for the necessary freedom. Supervisor provides his knowledge and experience in scientific management to the doctoral students.

- **Doctoral students**

1. Doctoral student gives his supervisor a complete picture of his scientific and personal strengths and weaknesses, so that an adequate problem formulation and an appropriate work program can be developed.
2. Doctoral student works with enthusiasm on the doctoral project. He consistently qualify further for his scientific work and keeps himself updated with the research field. He takes care to promote a collaborative working style, and is willing to discuss his work and results. He deals objectively with critical comments and suggestions and is ready to learn from them.
3. Doctoral student informs the supervisor immediately of any difficulties or problems - whether they are of a professional or a non-professional nature - particularly if these could jeopardize the success of the doctoral project or delay its progress. He keeps his supervisor regularly informed about progress and about unexpected results of his work.
4. Doctoral student integrates himself actively into the work group. He will abide by the rules of the work group with respect to sharing the use of equipment, measurement times, computer use and the use of other resources. He will treat with the greatest care the work group’s tangible or intangible valuables.
5. Doctoral student fulfills his assigned scientific and teaching tasks independently and autonomously. He will independently organize and plan the running of his research project without daily monitoring and evaluation by his supervisor.

- **Supervision committee**

1. Supervision committee critically and supportively follow the doctoral process. Its members are the contacts for the doctoral students in technical matters, career planning and cases of conflict.
2. They give the doctoral students and supervisors constructive feedback by acceptance and discussion of the progress reports.
3. They contribute their scientific knowledge, skills and experience to the support of the doctoral research.
4. In the case of conflict between doctoral students and supervisor, the search for a solution starts in the first instance with them. In doing so, they are obliged to remain neutral to all people involved in the conflict. Where this is not possible, or where no solution can be reached, they transfer the case to the board of the doctoral program.

Study program

Study program consists of 3 blocks. Mandatory module is marked by *. For completing study program 30 ECTS from 3 blocks are necessary.

1. Research modules

Math.8101	Scientific colloquiums and seminars	4 ECTS
Math.8102	Research activities at scientific colloquiums and seminars 1*	6 ECTS
Math.8103	Research activities at scientific colloquiums and seminars 2	4 ECTS

2. Study modules

Math.8201	Advanced study in the field of research I	8 ECTS, 4 WLH
Math.8202	Advanced study in the field of research II	4 ECTS, 2 WLH
Math.8203	Complementary studies	4 ECTS, 2 WLH

3. Key competences

Math.8301	Introduction to research	4 ECTS, 2 WLH
Math.8302	Scientific analysis of research questions	4 ECTS, 2 WLH
Math.8303	Documentation of mathematical issues	4 ECTS, 2 WLH
Math.8304	Key competencies in university teaching	4 ECTS, 2 WLH

Remarks concerning the study program:

1. Supervisor makes recommendation about modules and doctoral student decides which modules to attend.
2. The modules Math.8301-8303 can be substituted by other modules offered by Department of Mathematics or other Departments of TSU e.g. by the following modules: University teaching assistant, SPSS, Data analysis etc.
3. English may be mandatory subject to students with weak performance in placement test.

Description of Modules

Math.8101	Scientific colloquiums and seminars	4 ECTS
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • scientific collaboration • workup of scientific presentations	
Core skills:	After having successfully completed the module students will be able to • discuss current research within the frame of research oriented meetings • present research results in mathematics to an academic audience	
Prerequisites:	N/a	
Examination:	Approximately 60 minutes presentation with discussion	
Examination requirements:	Presentation of complex mathematical topics in current research	
Additional notes and regulations:	Permitted are seminars, symposiums, colloquiums	

Math.8102	Research activities at scientific colloquiums and seminars 1	6 ECTS
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • workup of own research results for the purpose of a presentation at scientific meetings • participation in scientific meetings on mathematical research featuring external audience	
Core skills:	After having successfully completed the module students will be able to • discuss current research within the frame of research oriented meetings • present own research results in mathematics to an external audience	
Prerequisites:	N/a	
Examination:	Approximately 30 minutes presentation with discussion	
Examination requirements:	Presentation of own research results	
Additional notes and regulations:	Permitted are seminars, symposiums, colloquiums etc. with external audience	

Math.8103	Research activities at scientific colloquiums and seminars 2	4 ECTS
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • workup of own research results for the purpose of a presentation at scientific meetings • participation in scientific meetings on mathematical research featuring external audience	
Core skills:	After having successfully completed the module students will be able to • discuss current research within the frame of research oriented meetings • present own research results in mathematics to an external audience	
Prerequisites:	N/a	
Examination:	Approximately 20 minutes presentation with discussion	
Examination requirements:	Presentation of own research results or poster presentation	
Additional notes and regulations:	Permitted are seminars, symposiums, colloquiums etc. with external audience	

Math.8201	Advanced study in the field of research 1	8 ECTS, 4WLH
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • Deepening of knowledge in the field of specialization • knowledge of methodological and thematic structure of their field of research	
Core skills:	After having successfully completed the module students will be able to • Apply methods and techniques typical in their field of research • solve problems in their field of research and present the solutions found	
Prerequisites:	N/a	
Examination:	Approximately 30 minutes of oral examination or 75 minutes presentation	
Examination requirements:	Proof of advanced knowledge in the area of the doctoral project	
Additional notes and regulations:	Permitted are seminars, lecture courses, summer schools, winter schools and compatible block courses	

Math.8202	Advanced study in the field of research 2	4 ECTS, 2WLH
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • Deepening of knowledge in the field of specialization • knowledge of methodological and thematic structure of their field of research	
Core skills:	After having successfully completed the module students will be able to • Apply methods and techniques typical in their field of research • solve problems in their field of research and present the solutions found	
Prerequisites:	N/a	
Examination:	Approximately 30 minutes of oral examination or 75 minutes presentation	
Examination requirements:	Proof of advanced knowledge in the area of the doctoral project	
Additional notes and regulations:	Permitted are seminars, lecture courses, summer schools, winter schools and compatible block courses	

Math.8203	Complementary studies	4 ECTS, 2WLH
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • expansion of knowledge in the field of specialization • advanced knowledge of methodological and thematic structure of their field of research alternatively • supervised designing of a course (lecture course, seminar or exercise classes)	
Core skills:	After having successfully completed the module students will be able to • apply methods and techniques typical in their field of research • consider results of their research in a larger context alternatively • critically reflect own teaching and scientific background	
Prerequisites:	N/a	
Examination:	Approximately 30 minutes of oral examination or 75 minutes presentation	
Examination requirements:	Proof of complementary knowledge in the field of specialization	
Additional notes and regulations:	Permitted are seminars, lecture courses, summer schools, winter schools and compatible block courses	

Math.8301	Accompanying seminars: Introduction to research	4 ECTS, 2WLH
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • overview of literature relevant to the field of specialization	
Core skills:	After having successfully completed the module students will be able to • apply variety of methods in their field of specialization • independent study on the basis of research literature	
Prerequisites:	n/a	
Examination:	Approximately 75 minutes presentation	
Examination requirements:	Proof of overview on literature in the field of specialization	
Additional notes and regulations:	n/a	

Math.8302	Accompanying seminars: Scientific analysis of research questions	4 ECTS, 2WLH
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • overview on methods relevant to solving problems	
Core skills:	After having successfully completed the module students will be able to • formulate mathematical problems; • describe solution strategies; • communicate solution ideas and obstacles.	
Prerequisites:	n/a	
Examination:	Approximately 75 minutes presentation	
Examination requirements:	Proof of overview on methods in the field of specialization	
Additional notes and regulations:	n/a	

Math.8303	Accompanying seminars: Documentation of mathematical issues	4 ECTS, 2WLH
Learning outcomes:	In this module students learn methods, concepts, theories and applications in mathematical research with particular focus on • development on personalized style of writing following guidelines of good scientific practice in mathematics	
Core skills:	After having successfully completed the module students will be able to • formulate mathematical problems; • describe solution strategies; • communicate solution ideas and obstacles; • master the established rules of good scientific practice.	
Prerequisites:	n/a	
Examination:	Approximately 75 minutes presentation	
Examination requirements:	Ability of documentation of mathematical issues	
Additional notes and regulations:	n/a	

Math.8304	Key competences in university teaching	4 ECTS, 2WLH
Learning outcomes:	In this module students acquire skills in university teaching: • ability to communicate mathematical content to students; • ability to deal with exercise classes; • use of appropriate teaching methods and visualization techniques; • confident appearance.	
Core skills:	After having successfully completed the module students will have acquired: • rhetoric and presentation skills; • capabilities of dealing with conflicts and to motivate; • time management skills.	
Prerequisites:	n/a	
Examination:	Giving a lesson in an exercise class (approximately 100 minutes)	
Examination requirements:	Ability of applying basic key competences in university teaching	
Additional notes and regulations:	n/a	

Study methods
Seminars,
Colloquiums,
Seminars with external audience,
Colloquiums with external audience,
Lectures,
Symposiums,
Seasonal schools

The evaluation scheme of the doctorate candidates

The evaluation scheme of the study components of the doctorate candidates:
a) Five types of positive evaluation:
a.a) (A) Excellent – 91-100 grades;
a.b) (B) Very good – 81-90 grades of maximal evaluation;
a.c) (C) Good – 71-80 grades of maximal evaluation;
a.d) (D) Satisfactory – 61-70 grades of maximal evaluation;
a.e) (E) Sufficient - 51-60 grades of maximal evaluation;
b) Two types of negative evaluation:
b.a) (FX) Referred - 41-50 grades of maximal evaluation, which means that the student needs to study harder and bears the right to hold the additional examination having worked independently one more time.
b.b) (F) Failed – 40 grades of maximal evaluation or less, which means that the work implemented by the student is not sufficient and he/she needs to study the subject from the very beginning.

Evaluation scheme of the scientific-research component (PhD thesis) of the doctorate candidate:
a) Excellent (summa cum laude) – excellent thesis;
b) Very good (magna cum laude) – the result which exceeds all the set requirements from any point of view;
c) Good (cum laude) – the result which exceeds all the set requirements;
d) Average (bene) – the result which satisfies all the set requirements from any point of view;
e) Satisfactory (rite) – the result which still satisfies all the set requirements notwithstanding the faults;
f) Insufficient (insufficienter) – the result which does not satisfy the set requirements due to the significant faults;
g) Completely insufficient (sub omni canone) – the result which does not satisfy the set requirements at all.

Referee of PhD thesis:
The thesis must be evaluated by at least one international referee, that is, one that does not have employment relationship with a Georgian Higher Educational Institution.

Space and technical basis needed
For implementing the program there are no specific technical equipment needed. Space requirements are satisfied by resources of Faculty of Exact and Natural Sciences and by Vekua Institute of Applied Mathematics.

Cotutelle agreement
In case of cotutelle agreement specific regulations may apply that will be detailed in the cotutelle agreement.

Maximum number of students: 25

Financing: TSU