საქართველოს ტექნიკური უნივერსიტეტი
GEORGIAN TECHNICAL UNIVERSITY

Approved by
Academic Board of GTU
on 23.09.2019
by Decree 01-05-04/263

Master's Educational Program

Program Title

ინფორმაციული ტექნოლოგიები ბირთვულ ინჟინერიაში

Information Technology of Nuclear Engineering

Faculty

ინფორმატიკისა და მართვის სისტემების ფაკულტეტი

Faculty of Informatics and Control Systems

Program Supervisor

Professor Alexander Sharmazanashvili

Qualification to be Awarded

მეცნიერების მაგისტრი ინფორმატიკაში
Master of Science (MSc) in Informatics

The Language of Teaching

English

Admission Prerequisites to the Program

Applicants must have at least a bachelor's or an equivalent degree and should be enrolled based on the results of the general master's examinations - general masters exams and exams / tests defined by Georgian Technical University. University internal exam / test questions will be posted on Faculty of Informatics and Management Systems according to educational http://gtu.ge/Ims/ and the Teaching Department website at http://www.gtu.ge/study/index.php at least one month before the exams. Admission to the program without passing the master's exams is possible in accordance with the legislation of Georgia. Applicants must have B2 English language certificate. Persons who have completed a course / program whose language was considered English are exempted from necessity to submit the certificate.

Program Description

Educational program built on the base of ECTS system and contains 120 overall credits. 1 credit consists of 25 hours, which includes both, student contact hours and hours for independent work.

Program consists of educational and research components.

Educational component has 75 credits and includes 12 educational courses defined for students together with educational practice on the 2nd year of education. **Research component** has 45 credits. It consists of one project/prospectus- 5 credits, one theoretical/experimental research/colloquium- 10 credits and preparation / defend of dissertation work - 30 credits.

Duration of educational program is 2 years (four semesters).

In the **first semester of the first year** student has to learn 3 mandatory courses with 10 credits each. First semester of the first year consists of 19 weeks. Where 1-8 and 10-17 weeks are education period. 9th week is for midterm exams and 17th - 18th weeks are for final exam. Additional exam is held on 19th week if necessary.

In the **second semester of the first year** student has to learn 2 mandatory and 1 optional courses. Among of mandatory one has 10 credits and another 5 credits. Optional course has 10 credits. In addition, student has to pass research component, project/prospectus with 5 credits. Second semester of the first year consists of 19 weeks. Where 1-8 and 10-16 weeks are education period. 9th week is for midterm exams and 17th - 18th weeks are for final exam. Additional exam is held on 19th week if necessary.

In the **first semester of the second year** student has to complete 1 mandatory course with 5 credits and 2 optional courses. Among the optional courses, one is with 5 credits and another is with 10 credits. In addition, student has one theoretical/experimental research/colloquium with 10 credits. First semester of the second year consists of 19 weeks. Where 1-8 and 10-16 weeks are education period. 9th week is for midterm exams and 17th - 18th weeks are for final exam. Additional exam is held on 19th week if necessary.

In the **second semester of the second year** student has to complete dissertation thesis. This work contains 30 credits. Second semester of the second year consists of 19 weeks. Where, 1-17th weeks are for completing the master's thesis. 18-19th weeks are for the master's thesis defense.

Evaluation of knowledge carrying out according to **Current activity** (maximum score 30, minimal positive evaluation 15), **Mid-semester exam** (maximum score 30, minimal positive evaluation 15) and **Final exam** (maximum score 40, minimal positive evaluation 20).

Research Components:

- **Research Project/Prospectus** is result of research and analyses survey;
- **Theoretical/Experimental research (colloquium);**
- **Preparation of Dissertation thesis and Defense.**

Detailed information about "The evaluation of research component of educational program" and „Publication instructions of dissertation work" can be found here:

https://gtu.ge/Learning/debuleba_magistraturis_sesaxeb.php

For study course purposes we have used examples of various Master programs of universities around the world. Please see below links to those programs:

1) Master's Programme in Computational Science and Engineering. **Umeå University**. Umeo, Sweden
https://www.umu.se/en/education/master/masters-programme-in-computational-science-and-engineering/

2) Nuclear Engineering Master's program. **The University of Ontario Institute of Technology**
Ontario, Canada
https://uoit.ca/programs/energy-systems-and-nuclear-science/nuclear-engineering-masters-program.php#tab_program_curriculum

3) Product Design in Mechanical Engineering. **University of Applied Sciences Ravensburg-Weingart**
Weingarten, Germany
https://www.hs-weingarten.de/web/masterstudiengang-produktentwicklung-im-maschinenbau/hauptstudium

4) Software Design and Programming. **University of Denver**. Denver, USA
https://universitycollege.du.edu/ict/degree/masters/software-design-and-programming-online/degreeid/396#curriculum

Program Objective

Objective of the program is: Learning information technologies tasks and methods for design, construction and maintenance of nuclear physics experimental facilities; Learning of computer aided design based geometry modelling methods of experimental facilities; Learning of data acquisition methods in complex systems on the example of nuclear detectors; Learning of data transferring and distributed computing methods for the physical processes simulation and reconstruction tasks in nuclear detector; Learning of object-oriented programming and software packages customization methods for the nuclear engineering tasks.

The Learning Outcomes/Competence (general and field-specific)

- The student will be able to connect engineering program packages with nuclear engineering tasks;
- The student will be able to analyze engineering geometry models of physical experimental devices;
- The student will be able to analyze efficiency of modeling tasks, process reconstruction tasks, data transmission and distributed computing tasks for ongoing experiments on nuclear detector.
- The student will be able to design and create 2D and 3D geometric models of physical experimental devices based on computer-aided design;
- The student will be able to receive and process data from complex systems;
- The student will be able to process engineering-project databases of physical experimental devices;
- The student will be able to program geometrical descriptions of physical experimental devices for

process simulations;

- The student will be able to client/server applications for nuclear engineering tasks.
- The student will be able to make presentation both for scientist of nuclear physics and wide audience;
- The student will be able to demonstrate his/her readiness for efficient communication with collaborative groups.

Methods (teaching - learning) of Achieving Learning Outcomes

☒ Lecture ☒ Seminar (working in groups) ☐ Practical class ☒ Laboratory ☒ Practice
☒ Course work/project ☒ Consultation ☒ Independent work

The following teaching-learning activities apply to the learning process, depending on the specific curriculum specification, which is reflected in the relevant curriculum (syllabi): Problem based learning; Case study; Implication; Analysis; The synthesis; Verbal or orally transmitted; Explanation; Action-oriented training; Project planning and presentation. Detailed information is provided on the GTU website:
https://gtu.ge/quality/Forms-And-Recomendations/Recomendations.php

Student Knowledge Assessment System

Grading system is based on a 100-point scale.

Positive grades:

- **(A)** - Excellent - grades between 91-100 points;
- **(B)** – Very good - grades between 81-90 points
- **(C)** - Good - grades between 71-80 points
- **(D)** - Satisfactory - grades between 61-70 points
- **(E)** - Pass - the rating of 51-60 points

Negative grades:

- **(FX)** - Did not pass - grades between 41-50 points, which means that the student is required to work more to pass and is given the right, after independent work, to take one extra exam;
- **(F)** – Failed - 40 points and less, which means that the work carried out by the student did not bring any results and he/she has to learn the subject from the beginning.

Each form and component of the assessment of the total assessment score (100 points) have a certain share in the final assessment. In particular, the maximum score of the medium-term rating is 60, and the maximum score of the final exam is 40. In each form of assessment, the minimum limit of competence is determined. The minimum positive score for the final grade is 20. The minimum positive score for the mid-exam exam is 15 points, and the maximum is 30 points. The minimum total positive assessment of the current activity is 15 points, and the maximum 30 points.

Evaluation Forms:

- Current activity - 30 points
- semester exam - 30 points
- final / additional exam - 40 points

Evaluation methods:

- homework
- description / carrying out laboratory work
- written and / or oral request
- events at the workshop
- Practice of reading case studies
- Testing with closed questions
- examination with open and closed questions
- Practice Report

The program provides relevant forms and methods for assessing student knowledge.

Sphere of Employment

Research organizations that develop new IT technologies perform data acquisition, processing and analysis. Also, computer support for experimental devices; Organizations that need computer-aided design technologies and engineering solutions. such employment areas include: mechanical engineering, energetics, military, metallurgy, construction and other industrial facilities; Companies involved in the development of computer applications and provide secure information systems development, integration and implementation. Such areas are: communications, economics, medicine, banking, advertising, insurance and more. Also, higher education intuitions.

Potential for Further Education

Doctoral Educational Programs

Human and Material Resources Required to Implement the Program

The program is provided with relevant human and material resources. Additional information is given in the Appendix, which describes:

a) The specific material resource of the program (laboratories, computer equipment, equipment for the visualization of educational materials and tools, etc.)

b) Data about the academic staff Implementing the program: copy of diplomas, certificates, CVs and list of articles.

The Number of Syllabi Attached: 12

Courses in the Program

№	Course	Admission prerequisites	ECTS Credits			
			I Year		II Year	
			Semester			
			I	II	III	IV
1	Computer Modelling of Parts and Assemblies	Don't have	10			
2	Programming and Computing Technologies in HEP Experiments	Don't have	10			
3	Programming of Geometry Descriptions in Simulation Software Packages	Don't have	10			
4	Computer Technologies of Integration and Installation of Facilities for Experiments	Computer Modelling of Parts and Assemblies		10		
5	Numerical Methods and Optimization	Don't have		5		
6	Engineering Data Management Systems in HEP Experiments	Computer Modelling of Parts and Assemblies			5	
	Optional block 1					
7	Computer modelling of Profiles and Parts of Facilities for Experiments	Computer Modelling of Parts and Assemblies		10		
8	Engineering Analysis of facilities for Experiments	Computer Technologies of Integration and Installation of Facilities for Experiments			10	
9	Practice: Geometry Modelling and Integration of Facilities for Experiments	Computer Modelling of Parts and Assemblies; Computer modelling of Profiles and Parts of Facilities for Experiments			5	
	Optional block 2					
10	Software Packages Programming on the base of ObjectARX	Don't have		10		
11	Java, PHP, Python Programming of Network Application in HEP	Don't have			10	
12	Practice: Development of Software Application for	Software Packages Programming			5	

	Parametrical Description of Geometry	on the base of ObjectARX; Numerical Methods and Optimization				
		Per semester	**30**	**25**	**20**	
		Total:		**75**		
Research Component:						
	Master Research Project / Prospectus	Computer Modelling of Parts and Assemblies Programming and Computing Technologies in HEP Experiments Programming of Geometry Descriptions in Simulation Software Packages		5		
	Theoretical / experimental research / colloquium	Research Project/Prospectus			10	
	Accomplishment and Defense of Master's Thesis	Theoretical/Experimental research/ colloquium				30
		Total per semester:	**30**	**30**	**30**	**30**
		Total per year:	**60**		**60**	
		Total:		**120**		

Program Curriculum

№	Subject code	Subject	ECTS Credit/Hours	Hours								
				Lecture	Seminar (work in the group)	Practical classes	Laboratory	Practice	Course work/project	Mid-semester exam	Final exam	Independent work
1	**ICT35608E2-LB**	Computer Modelling of Parts and Assemblies	10/250	30			45			2	3	170
2	**ICT35708E2-LB**	Programming and Computing Technologies in HEP Experiments	10/250	30			45			2	3	170
3	ICT12101E3-LB	Programming of Geometry Descriptions in Simulation Software Packages	10/250	45			30			2	3	170
4	**ICT35808E2-LB**	Computer Technologies of Integration and Installation of Facilities for Experiments	10/250	30			45			2	3	170

5	MAS14208E2-LSB	Numerical Methods and Optimization	5/125	15	15		15			1	2	77
6	ICT35908E2-LB	Engineering Data Management Systems in HEP Experiments	5/125	15			30			2	3	75
7	ICT36008E2-LB	Engineering Analysis of facilities for Experiments	10/250	30			45			2	3	170
8	ICT36108E2-LB	Computer modelling of Profiles and Parts of Facilities for Experiments	10/250	30			45			2	3	170
9	ICT36208E2-R	Practice: Geometry Modelling and Integration of Facilities for Experiments	5/125					45		2	3	75
10	ICT36408E2-LB	Software Packages Programming on the base of ObjectARX	10/250	45			30			2	2	171
11	ICT36308E2-LB	Java, PHP, Python Programming of Network Application in HEP	10/250	30			45			2	3	170
12	ICT36505E2-R	Practice: Development of Software Application for Parametrical Description of Geometry	5/125					45		2	3	75

Program Supervisor Alexander Sharmazanashvili

Faculty of Informatics and Control Systems
Head of Quality Assurance Service

Head of the Department of
Computer Engineering Zurab Tsveraidze

Agreed with

Quality Assurance Service of GTU Irma Inashvili

Approved

The Council of the Faculty of
Informatics and Control Systems
23.09.2019 prot.N8
The Head of the Faculty Council Zurab Tsveraidze

Attachment 1

Learning Outcomes[1]

Course	The student will be able to connect engineering program packages with nuclear engineering tasks	The student will be able to analyze engineering geometry models of physical experimental devices	The student will be able to analyze efficiency of modeling tasks, process reconstruction tasks, data transmission and distributed computing tasks for ongoing experiments on nuclear detector	The student will be able to design and create 2D and 3D geometric models of physical experimental devices based on computer-aided design	The student will be able to receive and process data from complex systems	The student will be able to process engineering-project databases of physical experimental devices	The student will be able to program geometrical descriptions of physical experimental devices for process simulations	The student will be able to client/server applications for nuclear engineering tasks	The student will be able to make presentation both for scientist of nuclear physics and wide audience	The student will be able to demonstrate his/her readiness for efficient communication with collaborative groups
Computer Modelling of Parts and Assemblies	1	1		1		1				1
Programming and Computing Technologies in HEP Experiments	2		2		1	2		1	1	
Programming of Geometry Descriptions in Simulation Software Packages	1	2	1	1			2			2
Computer Technologies of Integration and Installation of Facilities for Experiments		2	2			2	2		3	
Numerical Methods and Optimization			2		2	2				
Engineering Data Management Systems in	3	2	3		3	3		2		

[1] Following numbers should be used in program learning outcomes: introduction -1; knowledge acquisition - 2; Strengthen knowledge - 3

HEP Experiments										
Engineering Analysis of facilities for Experiments			3	2					3	2
Computer modelling of Profiles and Parts of Facilities for Experiments	3			3	3	2			3	
Practice: Geometry Modelling and Integration of Facilities for Experiments	3		3	3		3	3		3	3
Software Packages Programming on the base of ObjectARX	3					2	2	3	2	
Java, PHP, Python Programming of Network Application in HEP	2					2	2	3		3
Practice: Development of Software Application for Parametrical Description of Geometry	3	3	2		3			3	3	3

Map of Program objectives and learning outcomes [2]

Attachment 2

Program objectives	The student will be able to connect engineering program packages with nuclear engineering tasks	The student will be able to analyze engineering geometry models of physical experimental devices	The student will be able to analyze efficiency of modeling tasks, process reconstruction tasks, data transmission and distributed computing tasks for ongoing experiments on nuclear detector	The student will be able to design and create 2D and 3D geometric models of physical experimental devices based on computer-aided design	The student will be able to receive and process data from complex systems	The student will be able to process engineering-project databases of physical experimental devices	The student will be able to program geometrical descriptions of physical experimental devices for process simulations	The student will be able to client/server applications for nuclear engineering tasks	The student will be able to make presentation both for scientist of nuclear physics and wide audience	The student will be able to demonstrate his/her readiness for efficient communication with collaborative groups
Learning information technologies tasks and methods for design, construction and maintenance of facilities of HEP Experimental	√	√	√	√	√	√				
Learning of computer aided design based geometry modelling methods of experimental facilities	√	√	√	√			√			√
Learning of data acquisition methods in complex systems on the example of nuclear detectors	√		√		√	√		√		√
Learning of data transferring and distributed computing			√		√		√	√	√	√

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[2] Program learning outcomes should be marked by "√" symbol

methods for the physical processes simulation and reconstruction tasks in nuclear detector											
Learning of object-oriented programming and software packages customization methods for the nuclear engineering tasks		√		√			√	√	√	√	

[2] Program learning outcomes should be marked by "√" symbol