საქართველოს ტექნიკური უნივერსიტეტი
GEORGIAN TECHNICAL UNIVERSITY

Approved by
Academic Board of GTU
05. September, 2012
Order № 740
Modified
Academic Board of GTU
02.04.2018
Order № 01-05-04/106

Master's Educational Program

Name of the program

Biomedical Engineering
ბიოსამედიცინო ინჟინერია

Faculty

Informatics and Control Systems
ინფორმატიკის და მართვის სისტემების

Program Supervisor

Professor Irine Gotsiridze

Qualification and program credits

ბიოსამედიცინო ინჟინერიის მაგისტრი მიენიჭება საგანმანათლებლო პროგრამის არა ნაკლებ 120 კრედიტის ათვისების შემთხვევაში **Master of Biomedical Engineering** Will be awarded in the case of passing not less than 120 credits of an educational program.

The language of teaching

English

Precondition for admission to the program

Applicant can apply to Master Degree Program if they have at least a Bachelor or equivalent degree. Applicants who are enrolled on the basis of the results of the Master's Exams, which is organized by National Assessment and Examinations Center (NAEC) through "Unified National Exams" and receive enough scores to be admitted to the by passing special exam defined by GTU. "Unified National Exams" provided through Computer Adaptive Testing (CAT) created by the experts of NAEC. Non resident applicant has the right to apply BME educational program, in accordance with Georgian legislation. Applicants are required to have English language knowledge at B2 level. The applicant must have the certificate confirming the knowledge of English on the level not less than B2 or must present international certificate TOEFEL (The Test of English as a Foreign Language) of II certification level. The applicant is free from the necessity of presenting a certificate confirming his/her

competence at having completed Bachelor course in the foreign language if educational language of the program was English. At not having appropriate certificate or other analogous document, the applicant will have an special test in English at the GTU- testing center.
Examinations / tests will be posted on the website of the GTU.
http://www.gtu.ge/study/index.php at least one month before the exams will start.

Description of the program

The program is drawn up with ECTS system, 1 credit is equal to 25 hours, which include the contact and independent working hours. The distribution of credits is presented in the curriculum. The program duration is 2 years (4 semesters) and includes 120 credits (ECTS). Learnning component - 75 credits and research component 45 credits.
The first year study process is as follows: 15 weeks is offered in each semester, the term of the midterm and final / additional exams at the beginning of each year is determined by the rector's order, based on instructional instruction management.
In the first semester of the first year of study, student will cover four 5 credits and one 10 credit courses. In the second year of the first year study, students cover four 5 credits and one 10 credit courses, as well as 5 credits for the master's research project / prospectus.
The second year study process is as follows:
In the first semester 15 weeks is dedicated to teaching, mid-term and final / additional examination dates are determined at the beginning of each year based on the instruction of the training process. In the first semester the student will pass two - 10 credit courses from one course to clinical practice and theoretical / experimental research / colloqium, estimated at 10 credits.
In the second semester of the second year of study, a Master's Degree qualification work is completes, completion and defence of master thesis includes 30 credits. The decree about Master's Degree Thesis defence is regulated according decision of the Faculty Board in accordance with Master's Personal Work Plan.
Master's personal work plan is available at the following email address:
http://gtu.ge/Study-Dep/Files/Pdf/mag_deb_danarTi_3_Sd.pdf

Research component

Masters study the research component according to the topic of the Master's Thesis, which is carried out in the Georgian Technical University and in the relevant organization defined by the Memorandum of Understanding.
Master Research Project - Prospectus
Master's Research Project - Prospectus is the outcome of review and analysis, the preliminary draft of the master's thesis that the graduate must complete in the second semester of study.
Theoretical / Experimental Study - Colloquium
The main objective of the theoretical / experimental study is to develop independent work skills, to create a clear presentation of the task of solving the main professional tasks, to acquire the modern methods of research, to establish and solve the issues raised during the work.
Completion and protection of qualification work
The qualification work is a major part of the research component. The completed qualification work should be the result of independent research work. The qualification work should reflect the results obtained from the theoretical / experimental research.
For the master's students, one of the semester exams are conducted in the research components: maximum score of 30 points, the maximum score of the final / additional exam is 40 points; The graduate who has 30 or more points in interim assessment (tested) has the right to pass the final exam / qualification work, at the same time and delivered the minimum amount of work (report text, qualification work) specified in the program.
For detailed information about the evaluation procedure of the Master's Education Program Research Component, see the following e-mail address:
http://gtu.ge/Study-Dep/Files/Pdf/mag_debul_kvl_komp_Sefa__SDwesi.pdf

Instruction for submitting a Master's Degree for Master's Degree is available at the following e-mail address:
http://gtu.ge/Study-Dep/Files/Pdf/mag_deb_danarTi%20_5_Sd.pdf

To get detailed information, get acquainted with Georgian Technical University's Regulations on Master's Degree:
http://gtu.ge/pdf/kvleviTi_kompon_Sefaseba.pdf

Program Analogues

https://liu.se/en/education/program/6mbme
http://www.chalmers.se/en/education/programmes/masters-info/Pages/Biomedical-engineering.aspx
https://sisweb.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=PROG&MAJR=T160

Educational Program Website;
http://biomedeng.gtu.ge/programebi.html

https://bmegtu.wordpress.com

In development and carrying out monitoring of the program is included " Committee of Support for Developing of BME Study", which is founded at the "Biomedical and Clinical Society of Georgia", Committee is comprised with 5 permanent members.

The purpose of the program

The program educational objectives of biomedical engineering program is to integrate engineering and life science principles into a comprehensive curriculum, that prepares students for entry into the doctoral program, biomedical industry, or professional school. Primary research areas are biomedical imaging, biomedical implants and devices, cardiac electrophysiology, multiscale computational modeling, tissue engineering and regenerative medicine. Program provide graduates with a rigorous, broad-based advanced education in engineering coupled with applied biology that will prepare graduates for the many diverse career opportunities of biomedical engineering. Provide an empowering professional degree for students who intend to become practicing engineers

Outcomes/competences (general and sectoral)

– **Knowledge and understanding**: Deep knowledge of the field of Biomedical Engineering, critical understanding of theories and principles, understanding of field's complex issues; Develop understanding of advanced principles in Biomedical Engineering. Awareness of current and leading-edge topics in Biomedical Engineering. To understand the biological bases of the assessments routinely performed by Biomedical Engineers;
– **Applying Knowledge:** Using of the specific for the field of Biomedical Engineering problem-solving methods; Development of research or practical projects in the accordance; Develop critical review skills, in the area of Bio-Medical Engineering. To develop the ability to critically evaluate current advances in issues and controversies in the area of Biomedical Engineering. An ability to apply knowledge of mathematics, science, and engineering to biomedical engineering problems. An ability to design and conduct experiments, as well as to analyze and interpret data. An ability to design a system, component, or process to meet desired needs. An ability to identify, formulate, and solve engineering problems. An ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems. A knowledge of biology and physiology. Clear public presentation of opinions in accordance with corresponding knowledge and logic for professional and general audience. An ability to use the techniques, skills, and modern engineering and computing tools necessary for engineering practice. An ability to function on multi-disciplinary teams. The capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology. A recognition of the need for, and an ability to engage in life-long learning. A knowledge of contemporary issues
-**Making judgments**: The broad education necessary to understand the impact of engineering solutions in a global and societal context, also analysis of abstract data and/or situations analysis by the mean of standard and some distinctive methods and form of the reasoned conclusions on their basis;
– **Communication skills:** An ability to communicate effectively orally and in writing, preparing of detailed written reporting concerning Ideas, existing problems and their solutions; information pass orally to professionals and non proffessional, and foreign languages; Creative of modern engineering, information and communication technologies; Skill to communicate in native and foreign languages;
– **Learning skills:** multilateral and consistent assessment of own learning process; determining of necessity of

further studying; determining of directions of own learning with the goals of enrichment of professional knowledge and experience.
– **Values:** Participation in the process of values formation and aspirations to their sustainable implementation; Defense of professional values (accuracy, punctuality, objectivity, transparency, organization, etc.); An understanding of professional and ethical responsibility

Forms and Methods of achieving of the learning outcomes

☒ Lecture ☒ Seminar (working in the group) ☒ Practical classes ☒ Laboratory classes ☒ Practice

☐ Course Work/Project ☒ Consultation ☐ Independent Work ☒ Master Thesis

Appropriate activities of teaching and learning methods:
One particular issue cannot be studied in the teaching process only with one method and one activity. The teacher has to use different methods and activities. During the teaching process, and in most cases the activities are merged. The activities in the teaching process complement each other. We offer you the most common activities and their definitions. The teacher will select the required activity from the specific goal and objective.
1. **Discussion / debate** are one of the most common activities of interactive teaching. Discussion process increases the quality and activity of students' engagement. Discussion can be turned into arguments and this process is not limited to the questions asked by the teacher. It develops the ability of the student to reason and justify their opinion.
2. **Cooperative learning** is a learning strategy when each member of the group is obliged not only to examine himself but also to help his/her team-mate to study the subject better. Each member of the group works on the problem, until all of them master the issue.
3. **Collaborative work** – By using this activity, teaching implies division of the students' group and assignment of teaching tasks to them. The group members individually work on the issue and in parallel share their opinions with other members of the group. Due to the set objective, it is possible to divide the functions among the members during the group's working process. This strategy provides all students maximum engagement in the learning process.
4. **Problem based learning** is an activity which uses a specific problem as the initial stages of obtaining new knowledge and integration process.
5. **Case study** - the teacher will discuss concrete cases with the students, and study the issue thoroughly. For example, in the safety of engineering, it can be a case of a particular accident or disaster, in the political science - concrete, for example, the Karabakh problem (Armenia-Azerbaijan conflict) analysis and etc.
6. **Brain storming** – this activity implies to form and promote radically different opinion, idea on concrete issue/problem. This activity contributes to the development of a creative approach to the problem. Its application is effective in case of a large number of students and consists of several main stages:

- Problem / issue determination in a creative perspective;
- In a certain period of time, without criticism, note the ideas expressed by the
- listeners (mainly on the board);
- Determination of assessment criteria to determine the establish the conformity of
- the idea with the aim of the research;
- Assessment of selected ideas with predetermined criteria;
- By process of elimination, distinguish those ideas that are most relevant to the
- issue.
- Demonstration of the highest evaluation idea as the best way to solve the set
- problem.

7. **Implication**. It is quite effective in terms of achieving the result. In many cases, it is better to provide the students with audio and visual materials simultaneously. The study material can be demonstrated by both the teacher and the student. This activity helps us to demonstrate different levels of learning material, to specify what
students will have to do independently; at the same time, this strategy visually reflects the essence of the topic/ problem. Demonstration may be simple.
8. **Induction** is such a form of transmitting any knowledge when the process of thinking in the course of the

study is directed towards generalization, in other words when delivering the material the process is going from concrete to general.
9. **Deduction** is such a form of transmitting any knowledge, which based on general knowledge represents logical process of discovering new knowledge in other words, the process is going from general to concrete.
10. **Analysis** helps us to divide the study material into constituent parts. This will simplify the detailed coverage of individual issues within a difficult problem.
11. **The synthesis implies** the composition of one whole by grouping individual issues. This activity contributes to the development of the problem to be seen as a whole.
12. **Verbal or orally transmitted**. Narration, talking and so forth belong to this activity. In this process the teacher orally transmittes and explaines study material and the students actively perceive and learn it through listening, remembering and thinking.
13. **The script** implies the following activities: making extracts, records, notes, theses, abstract or essay and other.
14. **Explanation** is based on the discussion on the issue. The teacher gives a concrete example from the material, which is discussed in detail within the given topic.
15. **Action-oriented training** requires active involvement of the teacher and student in the teaching process, where the practical interpretation of theoretical material is of special significance.
16. **Project planning and presentation.** When working on the project, the student uses the acquired knowledge and skills to solve the real problem. This increases students' motivation and responsibility. Working on the project includes planning, surveying, practical activity and the performance of the results in accordance with the selected issue. The project will be deemed implemented if its results are presented in a clear and convincing way. It can be performed individually, in couples or in groups; also within a subject or within a few subjects (integration of the subjects); after completion, the project can be presented to a big audience.

Student knowledge assessment system

Grading system is based on a 100-point scale.

Positive grades:

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

Negative grades:

- **(FX)** - Did not pass - 41-50 points of rating, which means that the student needs more work to pass and is given the right to take the exam once more with independent work;
- **(F)** – Failed - 40 points and less, which means that the work carried out by the student is not enough and he/she has to learn the subject from the beginning.

The criteria of the assessment of syllabuses are the conformity of the content of studying course with the aims of the course and with the results of teaching; perfect presentation of the results of study; the conformity between the aims of the course and the results of studying; the conformity between the results of studying and the methods of assessment. Each form and component of the evaluation from the general score of the assessment (100 points) is defined in the final assessment. In particular, the maximum score is 60, and the maximum score of the final exam ¬ 40. The minimum level of competence is defined in each form of assessment. Minimum positive score for final assessment is 20, maximum score of midterm test 30. Minimum positive assessment is 15 points, maximum score of current 30, minimum positive assessment - 15 points.

The forms of assessment:

- Intermediate assessments
- Final/extra exam

Components of Intermediate assessment:

- Intermediate Exam
- Current Activity
  - Testing with open or closed questions;
  - Performing practical / theoretical homework;
  - thematic project;
  - Course work / course project;
  - Written and / or oral inquiry;
  - Laboratory activity;
  - Workshop activity;
  - Participation in the discussion;

One semester exam is conducted during the semester. It is a necessary component of interim assessment.
Evaluation Methods:
· Testing with closed questions;
· Testing with open questions;
· Written survey issues;
· Description / conduct of laboratory work;
· Examination with open question questions or issues;
· Test with closed questions or questions;
· Ability to implement and protect the project.
The Syllabus provides the relevant forms and methods of assessing the student's knowledge. Appropriate methods of evaluation forms, criteria and scales.

For assessment methods, criteria and scales please refer to the following link:
http://gtu.ge/quality/new/Evaluating%20students.pdf

Field of employment

Biomedical engineers are employed in industry, in hospitals, in research facilities of educational and medical institutions, in teaching, and in government regulatory agencies. They often serve a coordinating or interfacing function, using their background in both the engineering and medical fields. In industry, they may create designs where an in depth understanding of living systems and of technology is essential. They may be involved in performance testing of new or proposed products. Government positions often involve product testing and safety, as well as establishing safety standards for devices. In the hospital, the biomedical engineer may provide advice on the selection and use of medical equipment, as well as supervising its performance testing and maintenance. They may also build customized devices for special health care or research needs. In research institutions, biomedical engineers supervise laboratories and equipment, and participate in or direct research activities in collaboration with other researchers with such backgrounds as medicine, physiology, and nursing. Some biomedical engineers are technical advisors for marketing departments of companies and some are in management positions
In representative firms of vendors of medical devices,for carrying out of markteting and service. Also as Health Information Technology (HIT) specialists of information technologies for processing of medical information.
Biomedical engineers can also employ themselves in research activities by working harmoniously with doctors in the field of computational mechanics, physiology, medicine and invent cutting - edge technology.

Opportunity to continue learning

Doctoral educational programs.

Human and material resources necessary for the implementation of the program

The program provides the appropriate human and material resources. In the program implementation, there are involved professors from West Pomeranian University of Technology according the Co-Operation Agreement between Georgian Technical University and West Pomeranian University of Technology. For more information see the attached syllabi and other attachment documentation,

Number of attached syllabus: 12

Program subject load

№	Course code	Course	Prerequisite	ECTS Credits			
				I Year		II Year	
				Semester			
				I	II	III	IV
1	EET34608E1-LP	Bioinstrumentation	Don't have	10			
2	BRS10808E1-LB	Physiology for Engineers	Don't have	5			
3	EET34708E1-LP	Biomaterials	Don't have	5			
4	EET34808E1-LP	Biomechanics	Don't have	5			
5	EET34908E1-LP	Biosensors	Don't have	5			
6.1	EET35008E1-LP	Tissue Engineering	Biomaterials		5		
6.2	EET31208E2-LS	Rehabilitation Engineering	Biomaterials				
7	EET38108E1-LP	Medical Informatics	Don't have		5		
8	EET38208E1-LS	Health Care Management and Economics	Don't have		5		
9	EET35108E1-LR	Medical Imaging and Image Analysis	Physiology for Engineers		10		
10	EET38208E1-LS	Mathematical Models in Biology and Medicine	Medical Informatics			10	
11	EET35208E1-LR	Clinical Engineering	Bioinstrumentation			10	
		Research Component:					
		Master Project Thesis /Prospectuse			5		
		Theoretical Practical Research/Coolloguim	Master Project Thesis /Prospectuse			10	
		Master Thesis	All subjects and research components				30
In year				60		60	
Total				120			

Map of learning outcomes

		Knowledge and understanding	Ability to use knowledge in practice:	Making judgments	Communication skills	Learning skills	Valuels
1	Bioinstrumentation	X	X	X			
2	Physiology for Engineers	X	X	X		X	X
3	Biomaterials	X	X		X	X	
4	Biomechanics	X	X	X			
5	Biosensors	X	X	X	X		X
6.1	Tissue Engineering	X	X	X			X
6.2	Rehabilitation Engineering	X	X	X			
7	Medical Informatics	X	X	X	X		
8	Health Care Management and Economics	X	X	X	X	X	
9	Medical Imaging and Image Analysis	X	X	X		X	
10	Mathematical Models in Biology and Medicine	X	X	X		X	
11	Clinical Engineering	X	X	X	X	X	X
	Research Component:						
	Master Project Thesis /Prospectuse	X	X	X	X	X	X
	Theoretical Practical Research/Coolloguim	X	X	X	X	X	X
	Master Thesis	X	X	X	X	X	X

Program Curriculum

№	Subject code	Subject	ECTS Credit\ Hour	Lecture	Seminar (group work)	Practical Work	Laboratory Work	Practice	Course Work/Project	Mid-semster Exams	fFnal exam	Independent Work
1	EET34608E1-LP	Bioinstrumentation	10/250	30		45				1	2	172
2	BRS10808E1-LB	Physiology for Engineers	5/125	15			30			1	2	77
3	EET34708E1-LP	Biomaterials	5/125	15		30				1	2	77
4	EET34808E1-LP	Biomechanics	5/125	15		30				1	2	77
5	EET34908E1-LP	Biosensors	5/125	15		30				1	2	77
6.1	EET35008E1-LP	Tissue Engineering	5/125	15		30				1	2	77
6.2	EET31208E2-LS	Rehabilitation Engineering	5/125	15	30					1	2	77
7	EET38108E1-LP	Medical Informatics	5/125	15		30				1	2	77
8	EET38208E1-LS	Health Care Management and Economics	5/125	15	30					1	2	87
9	EET35108E1-LR	Medical Imaging and Image Analysis	10/250	30		45				1	2	172
10	EET38208E1-LS	Mathematical Models in Biology and Medicine	10/250	30		45				1	2	172
11	EET35208E1-LR	Clinical Engineering	10/250	15				100		1	2	132

Program Supervisor — Irine Gotsiridze
Informatics and Control Systems Faculty
Head of Quality Assurance Service — Zurab Baiashvili
Dean of the Faculty — Zurab Tsveraidze

Aproved by
Informatics and Control Systems Faculty
At the meeting of Faculty Board
03.09 2012 Protocol № 6
Chairman of the Faculty Board — Zurab Tsveraidze

Agreed with

Quality Assurance Service of GTU — Irma Inashvili

Modified by
Informatics and Control Systems Faculty
At the meeting of Faculty Board Protocol № 5

02.04..2018

Chairman of the Faculty Board — Zurab Tsveraidze