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**Curriculum**

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| **Program** | Bachelor degree program – **Physics**  |
| **Degree awarded** | **Bachelor of Science (BSc) in Physics** |
| **Faculty**  | **Faculty of Exact and Natural Sciences** |
| **Program coordinator/coordinators** | **Demur Tedoradze - Associated Professor** **Gogisa Tomaradze - Associated Professor**  |
| **Length of the program (semester, ECTS)** | **4 years / 8 semesters / 240 credits**Basic (Major) Programme – 180 cr.Minor Program/Free credits – 60 cr. |
| **Language of the Program**  | **Georgian** |
| **Program development and renewal date of issue** | The Accreditation Decision #67, 23.09.2011Faculty of Exact and Natural Sciences Board protocol №7; 25.04.2011Academic Board protocol №1 (11/12) 31.08.2011; Faculty Board Protocol #8, 24.05.2012Academic Board protocol #17, 25.05.2012 Department of Physics Meeting Protocol #5, 22.01.2014Department of Physics Meeting Protocol #7, 16.05.2014Faculty Board Protocol #3, 16.05.2014Faculty Board Protocol #12, 15.06.2016Academic Board protocol #2, (15/16) 22.09.2016Faculty Board Protocol #1, 11.09.2017Academic Board protocol #1 (17/18) 15.09.2017 |
| **Program prerequisites** |
| **-** Certificate of general education;**-**  Certificate of confirmation of passing the unified national exams;Note: For International Students/ non-citizens of Georgia – secondary or equivalent education in a foreign country certificate recognized under inter-country agreement |
| **Aim of the Program** |
| * Provide knowledge for the first of higher education in the field;
* Assist to develop computer skills to deal with theoretical and practical issues;
* Assist to develop deep knowledge of general Physics, relevant mathematical apparatus and theoretical physics;
* Assist to develop skills for conducting experiments in physics;
* Assist to develop computer skills;
* Provide with minor and elective programs in addition to majors.
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| **Learning outcomes (the map of competences):** |
| **Knowledge and understanding** | * Deep knowledge of mathematical apparatus (differential and integral calculus; vector and tensor Analysis);
* Deep knowledge of essential theories of general physics (Mechanics, thermodynamics, electromagnetism and optics)
* Knowledge of the basics (classical mechanics, relativity, quantum mechanics and stat physics) of theoretical physics;
* Knowledge of the elements (atom and nucleus, solid bodies and astronomy) of contemporary physics;
* Knowledge of the essential spheres and approaches of physics use in different spheres of physics;
* Ability to explain natural phenomena and knowledge of the principles of physical studies;
* Foreign language competence to refer to the literature in Computer Technologies.
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| **Applying knowledge** | * Ability to use mathematical apparatus;
* Ability of computer calculation and computer modelling;
* Ability of proper evaluation of physics problems, indication of analogues and the use of common methods of problem solving in different situations;
* Ability to conduct independent experiment, describe experimental data, analyze and critically evaluate;
* Ability to understand natural phenomenon, make relevant approaches and create its working model;
* Ability of applying physical research principles in different spheres other than physics.
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| **Making judgement** | After the completion of the program, the graduate will have: * Ability of conducting discussions and analysis on theories, concepts and practical issues of physics;
* Ability of approaching argumentative conclusions on physics problems through diverse approach and analysis;
* Ability of understanding social value of the problem and is responsible for the environmental safety and healthcare;
* Ability of situational analysis with the use of physical theories.
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| **Communication skills** | A student will be* Communicating effectively orally and in written form;
* Adapting, observing, listening, asking questions and working in a group;
* Creatively applying information and communication technologies;
* Properly managing time;
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| **Learning skills** | A student will have:* Ability to research and work on resources in physics and other theoretical fields;
* Ability to update on physical sciences on regular basis;
* Desire of professional development and independent work;
* Ability of professional self-assessment and identification of future study perspectives.
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| **Values** | A student will have:* Ability to share and practically realize professional values on local and national levels;
* Ability of critical thinking and self-criticism;
* Ability to stand for professional values in different situations;
* Ability to be responsible for the safety of the environment.
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| **Teaching methods** |
| From traditional teaching methodology we offer: Induction, deduction, analysis, and synthesis; verbal and explanatory, writing, heuristic and demonstrative; Also:**Discussion/debates** – one of the widely spread method of interactive studying. The process of discussion raises the quality of participation and activity of students. This process isn’t limited only to questions asked by professor. This method develops the ability of conformation ones’ own idea and discussion.**Collaborative work** – studying by this method means dividing groups and giving tasks to them, the members of the group individually think about issue and share information with other members. Due to the goal set there is possibility to share functions among the members during the process of study that provides maximum attendance of all students in the process of study.**Problem Based Learning** – a method that uses a problem as a starting point for new study and integration process;**Cooperative teaching** – is a teaching strategy in which every group member in not only responsible to learn but also to assist his/her group members perform better. Each group member works on the problem until everybody understands the issue.**Huristic Method**  – is a step-by-step problem solution. It is implemented through independently adressing facts and identifying links between them in the learning process.  **Case study** -  a professor discusses certain cases with students who study them in all aspects and details e.g. it can be a discussion of the case history of a patient in the sphere of medicine; a conflict (e.g. Azerbaijan vs. Armenia) analysis in the sphere of political science and etc.**Brainstorming** – encourages to state and express completely diferent idea and view on a certain isse within the frames of a certain topic. It also encourages the enhancement of the creative approach to a problem and is effective with big groups of students, and it covers several basic phases: * + Creative definition af an issue/problem.
	+ Taking down (usually on the board) ideas around the issue without criticism within certain period of time.
	+ Selecting most relevant ideas through elimination.
	+ Formulating assessment criteria to establish compliance with the research objective.
	+ Evaluating selected ideas according to the criteria set in advance.
	+ Identifying the idea with the highest score as the best solution.

**Role Playing and Situations** –role playing scenarios allow students to view the issue from different angles and help them form alternative views. Like discussion role playing provide a student with the skills of independently expressing his/her own position and defending it in a debate.  **Demonstrative method** – this method means visual presentation of information. From the standpoint of reaching result, it is quite effective, demonstration of material to be studied is possible by teacher and student as well. This method helps us to make the perception of different stage of educational material more significant. Say concretely, what student should do all alone. Demonstration may carry simple image or take such difficult face as carrying out multistep experiment.**Induction, Deduction, Analysis and Synthesis*** + **Induction Method**  implies the form of any subject knowledge in which the flow of ideas in the learning process is directed from private to the specific, from facts to the generalization i.e. the process of presenting material is directed from specific to general.
	+ **Deduction Method** implies the form of any subject knowledge sharing which is a logical process of discovering new competency on the bases of common knowledge, i.e. the process is directed from general to specific.
	+ **Method of Analysis** helps to split one whole of teaching material into components; this makes it easier to adress details of certain issues within a complex problem;
	+ **Method of Synthesis** implies the reverse procedure as it is used to group certain issue in one whole. It develops the skill of viewing a problem as a whole.

**Method of explaining** – is based on discussion around the given issue, while reporting the material, professor is giving a specific example that is discussed in details in the frame of the given theme. **Action oriented learning** – demands active participation of a student and a professor in the process of study, where practical interpretation of theoretical material takes special loadings.There is an array of teaching methods complying with a specific problem that can be applied by a teacher.  |
| **Structure of the Program** |
| The program covers 180 credits of major and 60 credits of minor courses equaling a total of 240 credit hours. Major course combines: compulsory university courses (15 credits), compulsory faculty courses (20 credits), elective compulsory faculty modes (20 credits), compulsory courses of specialization (120 credits) and two elective specialization courses (5 credits). **See Appendix 1.** |
| **Assessment System** |
| Final assessment of a student is obtained from the add-up of mid-term and final exams throughout the semester. The educational course has a grading scale of 100 points. The student has the right to take the final exam, if his/her minimum competency equals 18 points.Minimum margin of assessment received by the student on the final exam is 15 points. Below than this, is assessed with FX (fail).Evaluation System includes: A. Five Forms of Positive Assessment:  (A) Excellent – 91 – 100 points  (B) very good – 81-90 points  (C) good – 71-80 points (D) satisfactory – 61-70 points (E) sufficient – 51-60 pointsB. Two Forms of Negative Assessment: (FX) (Administrative Fail in Course for Grade/could not pass) – A student gets 41-50 points from maximum evaluation which means that s/he is required to work more for passing the exam, and that s/he is entitled to take a make-up exam only once through personal study(F) (Academic Fail) – A student gets 0 – 40 points from maximum evaluation; it means that the work done by him/her is not sufficient and she/he has to retake the course. According to educational component of educational program, in case of adoption of FX, a makeup exam will be appointed no less than 5 calendar days after the conclusion of the final exam results.The number of points received in the make-up final exam, is not added to the final assessment received by the student.According to the assessment 0-50 points received from the make-up final exam, in the final evaluation of the educational component, the student will receive a grade of F-0.(Midterm and final exams take place in exam center of ATSU)Specific assessment criteria are outlined in the syllabus of any academic course. |
| **Employment opportunities** |
| Scientific research and scientific entrepreneurial organizations where the knowledge of physics, mathematics and informatics is applied at different stages;Insurance companies and banks; State and private enterprises and offices with technical profiles (communications, power system and etc.); A graduate can continue graduate studies in physics and its neighboring professions at any university. |
| **Supportive resources**  |
| Students use* rooms # 4404,4407 and labs #4501, 4504, 4505, 4601 in the building 2 of ATSU and the laboratories in the building located in Akhalgazrdoba avenue.
* ATSU library and reference literature kept in the libraries of the Faculty of Exact and Natural Sciences and the Department of Physics.
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 **დანართი 1**

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**Curriculum 2017-2021**

**Programme: Physics**

**Qualification: Bachelor of Science in Physics (BSc in Physics)**

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| № | Course | Contact hrs. per week | Credit Number | The number of hours | Lectures/practical/group work/laboratory | Semester | Precondition |
| Total | Contact | Independent | I | II | III | IV | V | VI | VII | VIII |
| Auditory | Midterm and final exam |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 1 | **University Compulsory (15 ECTS)** |
| 1.1 | Foreign Language-1  | 4 | 5 | 125 | 60 | 3 | 62 | 0/3/0/ | 5 |  |  |  |  |  |  |  |  |
| 1.2 | Foreign Language -2 | 4 | 5 | 125 | 60 | 3 | 62 | 0/3/0/ |  | 5 |  |  |  |  |  |  | 1.1 |
| 1.3 | Foreign Language -3 | 4 | 5 | 125 | 60 | 3 | 62 | 0/3/0 |  |  | 5 |  |  |  |  |  | 1.2 |
| **სულ:** | **12** | **15** | **375** | **180** | **9** | **186** | **-** |  |  |  |  |  |  |  |  |  |
| 2 | **Faculty Elective Courses (20 ECTS – 4 courses)** |
| 2.1 | Math Analysis -1 | 4 | 5 | 125 | 60 | 3 | 62 | 2/2/0/0 | 5 |  |  |  |  |  |  |  | - |
| 2.2 | Introduction to Physics | 3 | 5 | 125 | 45 | 3 | 62 | 2/1/0/0 | 5 |  |  |  |  |  |  |  | - |
| 2.3 | Introduction to Chemistry | 3 | 5 | 125 | 45 | 3 | 77 | 2/0/1/0 | 5 |  |  |  |  |  |  |  | - |
| 2.4 | Introduction to Biology | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0 | 5 |  |  |  |  |  |  |  | - |
| 2.5 | Introduction to Geography | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0 | 5 |  |  |  |  |  |  |  | - |
| 2.6 | Linear Algebra and Analytical Geometry | 3 | 5 | 125 | 45 | 3 | 77 | 1/2/0/0 | 5 |  |  |  |  |  |  |  | - |
| 2.7 | Programming Basics | 3 | 5 | 125 | 45 | 3 | 77 | 1/0/2/0 | 5 |  |  |  |  |  |  |  | - |
| **Total:** | **13** | **20** | **500** | **180** | **12** | **308** | **-** |  |  |  |  |  |  |  |  |  |
| 3 | **Specialization Compulsory Courses (120 ECTS)** |
| 3.1 | Computer Skills | 4 | 5 | 125 | 60 | 3 | 62  | 1/0/3/0 | **5** |  |  |  |  |  |  |  | - |
| **General Physics** |  |  |  |
| 3.2 | Mechanics | 6 | 10 | 250 | 90 | 3 | 157 | 2/2/2/0 |  | **10** |  |  |  |  |  |  | 2.2 |
| 3.3 | Molecular Physics and Thermodynamics | 5 | 7 | 175 | 75 | 3 | 97 | 2/2/1/0 |  |  | **7** |  |  |  |  |  | - |
| 3.4 | Electricity and Magnetism | 6 | 10 | 250 | 90 | 3 | 157 | 2/2/2/0 |  |  |  | **10** |  |  |  |  |  |
| 3.5 | Optics | 6 | 10 | 250 | 90 | 3 | 157 | 2/2/2/0 |  |  |  |  | **10** |  |  |  | 3.4 |
| 3.6 | Atomic and Nuclear Physics | 6 | 10 | 250 | 90 | 3 | 157 | 2/2/2/0 |  |  |  |  |  | **10** |  |  | 3.5 |
| **Mathematics** |  |  |  |
| 3.7 | Analytical Geometry and Higher Algebra | 5 | 8 | 200 | 75 | 3 | 122 | 3/2/0/0 |  | **8** |  |  |  |  |  |  | 2.6 |
| 3.8 | Math Analysis 2 | 4 | 7 | 175 | 60 | 3 | 112 | 2/2/0/0 |  | **7** |  |  |  |  |  |  | 2.1 |
| 3.9 | Math Analysis 3 | 2 | 4 | 100 | 30 | 3 | 67 | 1/1/0/0 |  |  | **4** |  |  |  |  |  | 3.8 |
| 3.10 | Differential Equations | 2 | 4 | 100 | 30 | 3 | 67 | 1/1/0/0 |  |  | **4** |  |  |  |  |  | 3.8 |
| 3.11 | Complex Variables Functions Theory | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0 |  |  |  | **5** |  |  |  |  | 3.8 |
| **Theoretical Physics** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3.12 | Elements of Tensor Calculus | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0/ |  |  |  | **5** |  |  |  |  | 2.6 |
| 3.13 | Classical Mechanics | 4 | 5 | 125 | 60 | 3 | 62 | 2/2/0/0 |  |  |  |  | **5** |  |  |  | 3.2 |
| 3.14 | Field Theory | 4 | 5 | 125 | 60 | 3 | 62 | 2/2/0/0 |  |  |  |  |  | **5** |  |  | 3.13 |
| 3.15 | Quantum Mechanics -1 | 6 | 10 | 250 | 90 | 3 | 157 | 3/3/0/0 |  |  |  |  |  |  | **10** |  | 3.14 |
| 3.16 | Quantum Mechanics -2 | 4 | 6 | 150 | 60 | 3 | 87 | 2/2/0/0 |  |  |  |  |  |  |  | **6** | 3.15 |
| 3.17 | Statistical Physics | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0 |  |  |  |  |  |  | **5** |  | 3.3 |
| 3.18 | Astronomy | 3 | 4 | 100 | 45 | 3 | 52 | 2/1/0/0 |  |  |  |  |  |  |  | **4** | - |
| **Total:** | **76** | **120** | **3000** | **1140** | **54** | **1806** | **-** |  |
| 4-5 | **Specialization Elective Course (20 ECTS)** |
|  | **Elective Course - 1** |  | **10** |  |  |  |  |  |  |  |  |  | **5** | **5** |  |  |  |
| 4.1 | Electrical Engineering | 3 | 5 | 125 | 45 | 3 | 77 | 2/0/1/0 |  |  |  |  | 5 |  |  |  | 3.4 |
| 4.2 | Radio Engineering | 3 | 5 | 125 | 45 | 3 | 77 | 2/0/1/0 |  |  |  |  |  | 5 |  |  | 3.4 |
| 4.3 | Solid State Physics | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0 |  |  |  |  | 5 |  |  |  | 3.3 |
| 4.4 | Plasma Physics | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0 |  |  |  |  |  | 5 |  |  | 3.14 |
| 4.5 | Foreign Language | 3 | 5 | 125 | 45 | 3 | 77 | 0/3/0/0 |  |  |  |  |  | 5 |  |  | - |
|  |  |
|  | **Elective Course – 2** |  | **10** |  |  |  |  |  |  |  |  |  |  |  | **5** | **5** |  |
| 5.1 | Methods of Teaching Physics | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0 |  |  |  |  |  |  | 5 |  | - |
| 5.2 | Physics History | 3 | 5 | 125 | 45 | 3 | 77 | 2/0/0/1 |  |  |  |  |  |  | 5 |  | - |
| 5.3 | Theoretical Basics of Biophysics | 3 | 5 | 125 | 45 | 3 | 77 | 2/1/0/0 |  |  |  |  |  |  |  | 5 | - |
| 5.4 | Physical Practice | 3 | 5 | 125 | 45 | 3 | 77 | 0/3/0/0 |  |  |  |  |  |  |  | 5 | - |
| 5.5 | Foreign Language | 3 | 5 | 125 | 45 | 3 | 77 | 0/3/0/0 |  |  |  |  |  |  | 5 |  |  |
| **Total:** | **12** | **20** | **500** | **180** | **12** | **308** |  |  |  |  |  |  |  |  |  |  |
| 6. | **Free Credits** | 3 | 5 | 125 | 45 | 3 | 77 |  |  |  |  |  |  |  |  | 5 |  |
|  |  |  |  |  |  |  |  |  |
|  | **Overall Total:** | **116** | **180** | **4500** | **225** | **90** | **2685** |  |  |
|  | **Minor Modules** |  | **60** |  |  |  |  |  |  |  | **10** | **10** | **10** | **10** | **10** | **10** |  |

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|  | **Program Components** |  |  |  |  |  |  |  |  |  |  |  |  |
| University Compulsory Course (Foreign Language) | 5 | 5 | 5 |   |   |   |   |   | 15 |
| Faculty Courses | Free Credits |  |   |   |   |   |   |   |  5 | 5 |
| Elective  | 20 |   |   |   |   |   |   |   | 20 |
| Specialization Courses | Compulsory |  | 25 | 15 | 20 | 20 | 10 | 15 | 15 | 120 |
| Elective |   |   |   |   |  5 | 5 | 5 | 5 | 20 |
| ***Note:*** *Academic degree is awarded to a student after passing Minor or Teacher training education Program together with Major Program. Students of the Faculty of Exact and Natural Sciences are offered Minor programs in Mathematics, Chemistry, Biology, Ecology, Applied Biosciences, Geography, Business Management, Economics, and Tourism. These programs are introduced in 3 – 8 semesters with 10 credit scale each.*  |
| Minor Credits |   |   | 10 | 10 | 10 | 10 | 10 | 10 | 60 |
| Total | 25 | 30 | 30 | 30 | 35 | 25 | 30 | 35 | 240 |
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|  | **Program Components** |  |  |  |  |  |  |  |  |  |  |  |  |
| University Compulsory Course (Foreign Language) | 5 | 5 | 5 |   |   |   |   |   | 15 |
| Faculty Courses | Compulsory | 20 |   |   |   |   |   |   |   | 20 |
| Elective  | 5 |   |   |   |   |   |   |   | 5 |
| Specialization Courses | Compulsory |  | 25 | 15 | 20 | 20 | 10 | 15 | 15 | 115 |
| Elective |   |   |   |   |  5 | 10 | 5 | 5 | 25 |
| ***Note:*** *Academic degree is awarded to a student after passing Minor or Teacher training education Program together with Major Program. Students of the Faculty of Exact and Natural Sciences are offered Minor programs in Mathematics, Physics, Chemistry, Biology, Ecology, Applied Biosciences, Geography, Business Management, Economics, and Tourism. These programs are introduced in 3 – 8 semesters with 10 credit scale each.*  |
| Minor Credits |   |   | 10 | 10 | 10 | 10 | 10 | 10 | 60 |
| Total | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 240 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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