

Approved

Chairman of the Advisory Council

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REPORT
**on the Results of External Assessment of the Programme "Applied
Physics and Mathematics" (Bachelor's Degree)**
Saint Petersburg State University

Experts

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SUMMARY OF THE PROGRAMME

The programme "Applied Physics and Mathematics" (Bachelor's degree) is implemented within the field "Applied Mathematics and Physics" under the SPBU Educational Standard and leads to Bachelor's degree. The programme is managed by Associate Professor Andrei Komolkin, Associate Professor, Chair of Nuclear-Physics Research Methods.

AKKORK experts visited the university within the external programme assessment procedure from the 6th to the 7th of March, 2018.

Strong points of the programme under analysis

The quality of graduates learning outcomes of the programme "Applied Physics and Mathematics" (Bachelor's degree) implemented at the SPBU was estimated as high, while quality assurance of education provided by the educational institution in programme implementation was found to be sufficient. Strong points of the programme include the following.

- Saint Petersburg State University, where the programme is implemented, is the oldest and one of the most influential Russian universities. It enjoys a special status along with Lomonosov Moscow State University. An SPBU diploma is a guarantee of competitive advantage that graduates in this programme have in the regional, national, and global labor markets.
- The content of the programme and the competency-oriented graduate model are in accordance with a series of professional standards: 01.001 "Teacher (Teaching in Pre-School, Primary Comprehensive, Basic Comprehensive, and Secondary Comprehensive Education) (Preschool Teacher and School Teacher)"; 01.004 "Teacher for Vocational Training, Professional Education, and Continuing Professional Education"; 06.001 "Programmer"; 40.011 "Expert in Research and Development".
- The subjects in computer simulation that the programme includes are highly topical and offer quality education. This is especially important in the context of international research.
- The programme was developed and is implemented in tight cooperation with leading research institutions and companies in the respective field both in Saint Petersburg and across Russia: The A. Ioffe Physical Technical Institute of the Russian Academy of Sciences, B. Konstantinov St. Petersburg Nuclear Physics Institute, National Research Center "Kurchatov Institute", GK Tavrida Elektrik JSC, and more (a total of over 50 institutions and companies).
- Employers are involved in each stage of programme implementation, which includes: membership in the Teaching Commission and Programme Council to determine the purposes and content of the programme, participating in the State Final Examination, agreeing graduate qualification work subjects, hosting student practice and internship, etc.
- Students' research work is largely practice-oriented and related to their occupation.

- The educational process within the programme is ensured by a highly-skilled teaching staff. About 30% of the lecturers are Doctors of Science and about 60% PhDs. All the lecturers are active researchers, producing a total of 465 articles in RSCI, Web of Science, and Scopus-indexed journals over the past 2 years. About 10% of teachers in the programmes have carried out research and teaching work abroad in the recent years. The subjects of graduate qualification works are determined by teaching staff and employers whose scientific interests and research areas lie within the field of Applied Mathematics and Physics.

- Students are offered support for research and reporting at international conferences.

- 9 SPBU chairs are responsible for implementing the learning process within the programme. The set of subjects ensures fundamental basic training in Physics and Mathematics while extending students' scientific scope to include from biophysics to atmospheric physics as branches of physics, from numerical computation of partial differential equations to object-oriented programming as specific areas of applied mathematics and computer science.

- The university offers excellent scientific equipment, in particular for physical research. The resources are referred to as the SPBU Research Park, which consists of 26 resource centers. Essential facilities for the programme include the laboratories, the Computing Center, and the resource centers located in V. Fock Physical Research Institute Near the main teaching building for Applied Physics and Mathematics. Teachers and students of the programme "Applied Physics and Mathematics" have regular access to scientific equipment, materials, and computing tools that enable cutting-edge research in science and technology. Laboratory and practical classes enable students in the Bachelor's programme to acquire experience of working in scientific laboratories, which is extremely important to their further employment in the field.

The equipment is modern and used for global-scale research.

- SPBU possesses one of the best university libraries across Russia. The Library has subscriptions to all influential physical journals and electronic abstract databases. It provides lecturers and students of the programme with up-to-date professional literature in a quick and efficient manner.

- The experts found students to show great interest in their studies, which is indicative of the programme's success and orientation to a specific consumer, which ensures easy employment in the respective field with decent salaries.

- Student-teacher interactions are regular and efficient.

- Students have good English skills.

Weak points of the programme under analysis

The experts found a number of shortcomings and areas of potential improvement for the Bachelor's programme "Applied Physics and Mathematics".

- Some employer and student representatives reported students in the 3rd and 4th year of the Bachelor's programme to have too little time for research work. This is due to the busy curriculum and broad yearly sets of subjects.

- Some graduates referred to their work experience in expressing the opinion that Chemistry should be covered in more detail. The experts also believe that a concise course in Physical Chemistry would be more relevant for Physics students.

- A narrow, highly formalized approach to physics as a major showed in the course of direct assessment of competencies. Students often failed to relate their knowledge to simple physical phenomena, which indicated poor analytical skills and inability to use the existing knowledge. This problem is largely due to students' inability to use information from related branches of science to get a broader picture of the objects or phenomena described in their research works.

- A number of teachers of the programme admitted the university to have advanced scientific equipment but reported its efficient use within the learning process to be prevented at times. Students cannot use certain equipment of their own because it is too complex and expensive, so they have to watch experts carry out the experiments. The University has a lack of high-quality modern *training* equipment.

- Even though the SPBU administration has taken a number of measures to ensure student feedback (the Student Council, On-Line Reception, etc.), the experts' meeting with students showed student awareness and use of the tools to be poor. Student surveys appear to be occasional and not a regular work practice. Students have to display initiative if they want programme managers or the University's administration to know their opinion on the content of the programme, form of instruction, social and household problems (accommodation, transport, meals, etc.).

- Students reported the following social and household problems to prevent full-fledged programme implementations.

- 1) Students residing in Saint Petersburg can only get dormitory accommodation after non-resident students have been provided with accommodation. The way from the main part of the city to the main academic building takes sixty to ninety minutes.

- 2) Some classes within the programme take place in the city center. This causes a similar conveyance problem for students who live in dormitories, especially if they have to arrive for the first class.

- 3) None of campus student canteens work on Sundays.

- 4) Some classrooms are unacceptably cold during the cold season. The experts also found some rooms in the main academic building to need renovation.

Key expert recommendations on the programme

- Managers of the programme should improve the curriculum so that senior students have more time for independent work, primarily research, and work experience internship. This should probably include introducing additional elective

courses to the curriculum. This will enable students who are more or less certain that they want a scientific career to carry out more research and those who prefer industrial employment to take further work experience internship or practice.

- The SPBU administration should pay special attention to training devices and equipment in training laboratories for Applied Mathematics and Physics. Funds should be allocated to purchase any necessary equipment as well as to ensure its regular repair, maintenance and upgrading. Quality training equipment is absolutely necessary as a bridge to lead students to the high-grade equipment offered by the SPBU Research Park.

- The University's administration as well as the programme management should improve the student feedback scheme. Students view the initiative to file a suggestion or complaint on any issue related to programme implementation as having the potential to cause a conflict and thus tend to avoid it. It is thus essential that student surveys, both anonymous written or electronic ones and joint meetings of students and programme managers should be a regular work practice normally initialized by programme managers.

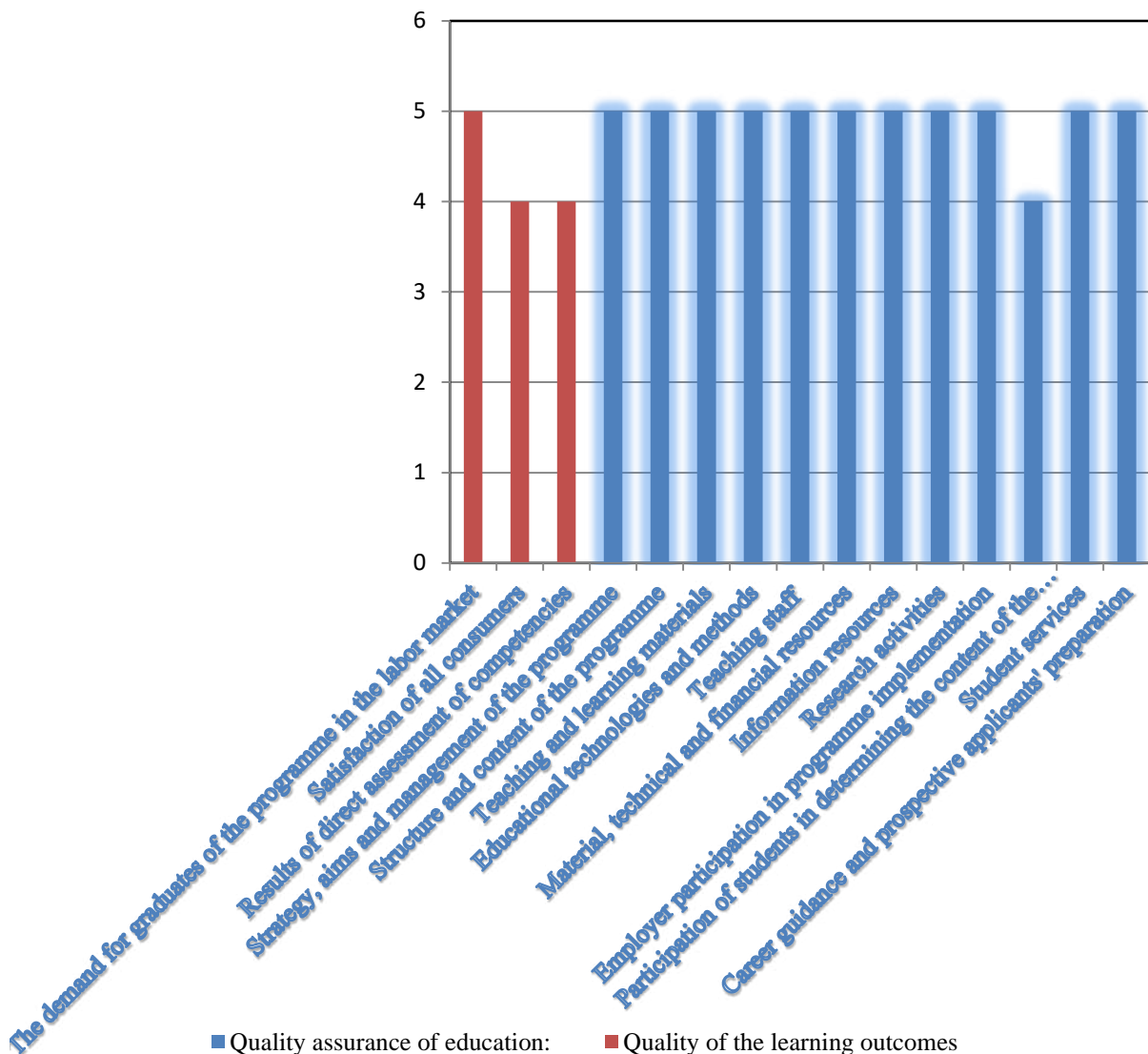
- The University's administration should pay due regard to the above students' suggestions regarding the studying conditions of the programme and campus life. First and foremost, effort should be made to provide dormitory accommodation to all students of the programme as the campus is located far from the main part of the city. Inspections should be carried out to make sure that sanitary requirements (room temperature) are met in all classrooms of the main academic building. Any repairs necessary should be done.

Assessment profile of the learning outcomes and quality assurance of education

No.	Criterion		Assess ment
<i>I</i>	<i>Quality of the learning outcomes</i>		
	1.	The demand for graduates of the programme in the labor market	5
	2.	Satisfaction of all consumers	4
	3.	Results of direct assessment of competencies	4
<i>II</i>	<i>Quality assurance of education:</i>		
	1.	Strategy, aims and management of the programme	5
	2.	Structure and content of the programme	5
	3.	Teaching and learning materials	5
	4.	Educational technologies and methods	5
	5.	Teaching staff	5
	6.	Material, technical and financial resources	5

7.	Information resources	5
8.	Research activities	5
9.	Employer participation in programme implementation	5
10.	Participation of students in determining the content of the programme	4
11.	Student services	5
12.	Career guidance and prospective applicants' preparation	5

Assessment profile of the learning outcomes and quality assurance of education



QUALITY OF THE LEARNING OUTCOMES

1. Demand for the graduates of the programme on the federal and regional labor market

Criterion assessment: excellent

Analysis of the role and place of the programme

The programme "Applied Physics and Mathematics" characteristically combines fundamental basic training in physics and mathematics with extensive training in modern information technology. The content of the programme thus corresponds to the current trends in the labor market since computer simulation of technical processes as well as natural phenomena, using computers to calculate various devices and structures, and software development is an essential, or even primary part of a modern researcher's or engineer's work.

The city of Saint Petersburg has always been one of Russia's biggest centers concentrating research and educational institutions as well as representatives of knowledge-intensive industries. The Saint Petersburg Employment Office reports the demand for specialists who are knowledgeable in physics and mathematics to grow continuously, while that for software engineers has more than doubled over the past 3 years. The Labor Committee of Saint Petersburg and Leningrad Region reports the demand for design engineers to have doubled from 2015 and 2017 and expects more jobs in this and similar fields in the nearest future. Even though the above reports do not specify the share of jobs that applied mathematics and physics account for, the assumption appears sound that the demand for graduates in the programme grows along with the total figures. According to the Saint Petersburg Statistics Agency, the number of employees in the industries targeted by the programme has increased by about 6.5 thousand over the past year, which is more than the total graduate count of all educational institutions in Saint Petersburg that offer training in Applied Mathematics and Physics. This and other data that the educational institution has included in the self-evaluation report as well as the information that the experts found out during their visit to SPBU suggest that nearly all graduates in the programme find employment in the labor market of Saint Petersburg and Leningrad Oblast.

Saint Petersburg universities that offer Bachelor's programmes in Applied Mathematics and Physics apart from SPBU are Peter the Great St. Petersburg Polytechnic University and the St Petersburg National Research Academic University of the Russian Academy of Sciences. SPBU accounts for over 30% of the total graduates in the field. As the labor market grows continuously, SPBU graduates seldom have to compete directly from graduates of other higher education establishments. It should be taken into account that despite the more or less standard basic training in General Physics, Laboratory Practicum in Physics,

and a course of Higher Mathematics (Mathematical Analysis, Linear Algebra, and Differential Equations), the field "Applied Mathematics and Physics" includes a broad range of specializations that are characteristic of certain higher education establishments. Those of SPBU are Nanobiophysics, Computational, Information, and Tomographic Technology, Spectroscopy, Modern Information Technology in Electrical and Plasma Physics, and Physical Principles of Functional Matter Diagnosis. SPBU cooperates with a number of companies to ensure further employment guarantees for its graduates. Those include the industrial group Tavrida Elektrik, a producer of electrical equipment with offices in Petersburg, Moscow, and Sevastopol.

Analysis of information indicators submitted by the higher education institution (conclusions)

- *The percentage of students combining study at the higher education institution with work in their specialization field: 10%*
- *The percentage of graduates who found employment within one year after the graduation from the educational institution in the field of training (specialization) within the programme: the educational institution did not provide any data for the recent year; 41% over the past 3 years*
- *The percentage of graduates employed on request of corporate employers: n/a; the share of graduates who were employed following internship: 10 to 20%*
- *The percentage of students trained on request of employers, for example, under tripartite (target) agreements: 8%*
- *The percentage of graduates working in their specialization fields within the region: 41%*
- *The percentage of graduates working in their specialization fields outside of the region: 0%*
- *Number of complaints about graduates: 0*
- *Number of positive feedbacks on graduates from organizations: 8*
- *The percentage of students in the programme admitted for Master's programmes who have completed training under Bachelor's programmes: over 50%*
- *The percentage of graduates of the educational institution in the programme as related to that of graduates of all other regional higher education institutions in the programme: 30%*

2. *Satisfaction of consumers with the learning outcomes*

Criterion assessment: good

- *The percentage of employers who believe that the competencies of graduates of the programme:*

- *fully comply with the requirements to modern experts in the industry: 46%*
- *essentially comply with the present-day requirements to experts in the industry with minor reservations: 54%*
- *there are few graduates whose competencies comply with the present-day requirements to experts in the industry: 0%*
- *do not comply with the present-day requirements to experts in the industry: 0%*
- *The percentage of graduates satisfied with the learning outcomes: 83%*

3. Direct assessment of competencies by an experts

Criterion assessment:

During the visit, a direct assessment of the competencies of graduate students was conducted. 7 4th year students took part in the direct evaluation, which is 23% of the graduate course.

Students were offered to prepare a short presentation on their future graduate qualification work and answer a series of questions asked by the experts within the direct assessment.

To analyze the formation of competencies, an experts selected the following:

- Assessment of competencies characterizing the individual's personal qualities as an integral part of their professional competence:

OKB-3 "Has a high cognitive culture and capable of perceiving, generalizing, and analyzing information, setting goals and choosing solutions, capable of analyzing philosophical, outlook-related problems as well as problems of social and personal importance."

- Assessment of competencies aimed at the development, maintenance and improvement of communications:

OKB-1 "Can produce oral and written speech in Russian in a well-argued, logically correct, and meaningful manner; can use public speaking, discussing, and polemic skills."

- Assessment of professional competencies ("competence core"), including the competencies reflecting the need (requirements) of the regional and/or federal labor market, depending on the main consumers of the graduates of the programme:

PK-1 "Should be able to use in professional activities knowledge in physical and mathematical disciplines as well as computer science, including the following: mechanics, molecular physics and thermodynamics, electrodynamics, optics, introduction to quantum microphysics, quantum physics, solid state physics, subatomic physics, statistical physics, linear algebra and geometry, mathematical analysis, higher mathematics, equations of mathematical physics, computer science, programming and numerical methods; physical principles of retrieving, storing, processing, and transferring information, and computer modeling";

PK-3 "Should understand the meaning of problems set in the context of professional activities and use appropriate physical and mathematical instruments and modeling techniques to describe and solve them";

PK-6 "Should be able to present results of his/her activities using modern instruments with due regard to the audience's demands, in particular in the form of reports and presentations."

Experts asked students the following questions during the direct assessment of competencies:

1) Please describe the area of your research and the specific issue that your graduate qualification work deals with.

2) Please describe the research methods you use, in particular any experiments carried out for your graduate qualification work, the mathematical tools used to model the phenomena studied, analytical and numerical simulation methods.

3) Please describe your key findings at present.

4) Please outline your further research and share your future work/study plans after you complete the Bachelor's programme.

5) A number of clarifying questions were asked, e.g. to name the types of equations used, explain the physical and mathematical meaning of their parameters, explain any symbols and abbreviations, etc.

The direct assessment of competencies revealed the vast majority of students to have mastered the competencies sufficiently.

Level Percentage of students	Sufficient level (students coped with 80 % of the proposed tasks)	Acceptable level (percentage of tasks solved: 50 to 79 % of the tasks were completed)	Low level (percentage of tasks solved: less than or equal to 49 %)
Results of direct assessment of competencies characterizing the individual's personal qualities as an integral part of their professional competence			
90%	+		
10%		+	
The results of direct assessment of competencies aimed at the development, maintenance and improvement of communications			
80%	+		
20%		+	
The results of direct assessment of professional competencies ("competence core"), including the competencies reflecting the need (requirements) of the regional			

and/or federal labor market, depending on the main consumers of the graduates of the programme			
50%	+		
50%		+	

When conducting the quality assessment of education, the experts analyzed 7 (enter the number) graduate qualification works, which amounted to 23% of the graduate works of the current year in this field. The expert concluded that the analyzed graduate qualification works fully complied with all the requirements stated below.

GRADUATE QUALIFICATION WORKS

N o.	Objects of assessment	Expert commentaries
1.	Topics of graduate qualification works correspond to the field of study and current level of scientific and/or technological development in the programme field.	Complies
2.	The tasks and contents of graduate qualification works are aimed at demonstrating competency formation in the graduate.	Complies
3.	The degree to which data collected or received during the predegree practice and the implementation of course projects was incorporated in the independent research part of the graduate qualification works.	Complies
4.	Graduate thesis topics are defined by the needs of manufacturers as well as the experimental purposes of teachers of the educational institution.	Complies
5.	The findings of graduate qualification works can be applied in industry.	Complies
6.	The degree to which research findings of the chair, faculty and outside research and production and/or research organizations was incorporated in the independent research part of the graduate qualification works.	Complies

Conclusions and recommendations of experts

Conclusions

The experts assessed the quality of the learning outcomes of the programme "Applied Physics and Mathematics" (Bachelor's degree) as high based on the information provided by the educational institution and direct assessment of competencies. The experts believe the demand for graduates in the programme to be high and tend to grow. They assessed consumer satisfaction as good. The grade was decreased due to relatively low satisfaction with salaries among graduates. It should be noted, however, that the programme can hardly influence the indicator.

The experts also found students to have a positive outlook.

The students' works are practice-oriented and can be presented at international conferences. English and presentation skills are high.

Recommendations

The experts recommend the programme management to pay special attention to the financial conditions that employers can offer to graduates and enhance their cooperation with those employers who offer decent salaries where possible.

QUALITY ASSURANCE OF EDUCATION

1. Strategy, aims and management of the programme

Criterion assessment: excellent

Strong points of the programme

- The Development Strategy of this programme is part of the SPBU Development Strategy until 2020. Thus ensures stable development and high implementation quality for the programme.

- The programme aims at meeting the continuously growing demand of Petersburg companies for experts in applied mathematics and physics, which makes the programme topical and its development well-planned.

- The programme management system is well-considered and integrated in the SPBU management system. The Programme Council is responsible for analyzing the programme and its promotion strategy as well comparing it with similar programmes; the Teaching Committee reviews the curricula and subject set; the Graduate Office monitors the demand for graduates; the Programme Office maintains the teaching and learning documentation; and the Academic Unit organizes the learning process.

- Employers play a major role in programme management as they make over 50% of the Programme Council and attend meetings of the Teaching Committee.

Recommendations

The percentage of students who can only describe the purposes of the programme in a vague manner is as high as 71% according to the educational institution's self-evaluation report. This is probably due to poor involvement of students in programme management and bears the potential of decreasing study motivation in students. The managers of this programme should improve the student feedback mechanism (see the previous section for more details).

Subject-specific feedback as well as that for the entire programme can be arranged as follows:

1. Anonymous questionnaires to be filled out upon the completion of each subjects. Teachers can review them to obtain useful information.
2. Students can elect a course representative to attend meetings to discuss academic and general issues.

Additional material

In the process of self-evaluation of the educational institution, data on teachers' satisfaction with the personnel policy and applicable motivation system was presented. 27% of teaching staff implementing the Bachelor's programme "Applied Physics and Mathematics" were fully satisfied with the personnel policy, 34% were partly satisfied, and 7% were unsatisfied. The data on satisfaction with the motivation system was about the same (about 30% of teachers were not sure). The SPBU administration should carry out a survey among the teaching staff and develop the personnel policy and motivation system with more regard to teachers' opinion and suggestions.

2. Structure and content of the programme

Criterion assessment: excellent

Strong points of the programme

- The managers of this programme have developed a competency-oriented graduate model that fully corresponds to the programme's purposes and the demand of the labor market. The competency-oriented model contains general cultural competencies that characterize an individual's personal skills, those aimed at developing communication skills, and specific professional competencies.
- The scope of subjects on the programme's curriculum fits its purposes and aims at developing the necessary competencies.
- The set of subjects and their syllabi as well as all graduate qualification work topics have been agreed with employers through direct inquiries between employers and the Teaching Committee. Some subjects on the curricula were developed by external part-time employees.

- It is interesting that basic subjects such as Higher Mathematics are taught to three groups of 1st and 2nd year students depending on background training. This helps bring students with relatively poor background knowledge to the level that is necessary to master the programme curriculum.

Recommendations

- With due regard to the suggestion of certain employers and students, the programme management should increase the time for practice and research work in the 3rd and 4th year according to the curriculum. This should probably include introducing additional elective courses to the curriculum. This will enable students who are more or less certain that they want a scientific career to carry out more research and those who prefer industrial employment to take further work experience internship or practice.

- One of the graduates believed that Chemistry should be covered in more detail. The recommendation for the programme management is to introduce the subjects to the curriculum as elective courses.

Additional material

The educational institution's self-evaluation report provides the data of a student questionnaire survey to find out if the structure and content of the programme meet students' expectations. 96% of the students reported the programme to fully or essentially meet their expectations. Student interviews that took place during the expert visit to SPBU confirmed the figures. This indicates the content of the programme to largely meet students' expectations.

3. Teaching and learning materials

Criterion assessment: excellent

Strong points of the programme

- This programme has all the necessary teaching and learning materials: subject and practice study programmes, test and exam materials for formative and interim control, study literature, electronic information resources, etc.

- The SPBU Library is one of Russia's best libraries. It possesses nearly all educational literature, monographs and scientific periodicals, and subscriptions to scientific abstract databases that students and teachers in the programme use.

- Teachers participate in the all-round review of all teaching and learning materials through the Programme Council and the Teaching Committee. This ensures a high academic quality and topicality of the teaching and learning materials with due regard to the changing requirements of the labor market.

- The programme's curriculum contains a number of subjects within which students find out about the latest scientific developments and contemporary scientific literature.

Recommendations

- The procedure of all-round review and thorough documenting of subject programmes, test and exam materials, etc. are definitely helpful in terms of maintaining a high quality of the educational process. However, the formalization makes it less easy to find new development paths for the programme, like introducing new unparalleled subjects into the curriculum or modifying the content/instruction procedure of the existing ones. For instance, the requirement that each subject should have core study literature cannot be met for a subject that deals with a rapidly developing research area with no study literature available at the time. Yet, a number of textbooks were written based on the experience of teaching the subject. Thus, the SPBU administration and units that control the development of teaching and learning materials should develop a simplified procedure for introducing a small number of experimental subjects to curricula. The disciplines should be introduced on the initiative of teachers concerned who can develop a whole new course on their own or restructure an old one on agreement with the Programme Council, in which case the documentation procedure should be simplified. If the experiment turns out to be successful, the subject can become a standard element of the curriculum.

Additional material

In the course of the site-visit the experts studied some teaching and learning materials developed by the educational institution, in particular the study programme for Higher Mathematics. Firstly, the experts found the programme "Applied Physics and Mathematics" to offer excellent training in Mathematics in compliance with the goals and objectives of the programme. Secondly, the study programme was concise, which makes it stand out among those by other educational institutions.

4. Educational technologies and methods

Criterion assessment: excellent

Strong points of the programme

- The techniques and methods used in the programme "Applied Physics and Mathematics" fit the programme's goals and help develop the competencies provided for under the respective Educational Standard.

- Most classes have the well-established form of lecture, seminar, practical class, and laboratory class. It should be noted that all the above forms are naturally interactive since students can ask questions, suggest and discuss various solutions, consult the lecturer when completing a laboratory assignment, etc. It is hard to estimate the percentage of time for which such classes account as it largely depends on the teacher's individual style, students' activity, and other factors, but the estimate of 40% that the educational institution provided in its self-evaluation report appears realistic.

- SPBU actively develops e-learning methods and techniques. It is hard to predict at this stage what role electronic courses will play in the learning process. However, the benefits and advantages of electronic devices and information technology, including the Blackboard system developed by SPBU, namely choosing elective subjects, receiving individual assignments as well as electronic educational literature, and exchanging organizational information are beyond doubt.

- The practice of dividing students in the programme into 3 groups depending on their background training for a number of basic subjects is interesting.

- The experts found the two-stage interim control (e.g. during examination in Higher Mathematics) to be quite efficient. The first stage mostly assesses the ability to solve typical problems and basic theoretical knowledge. Passing the stage ensures a satisfactory mark. The second stage deals with more complex knowledge and skills like theorem proving and is taken by students who claim high grades. The examination system is very sparing in terms of students and teachers' time and energy.

Recommendations

- With due regard to the suggestion of certain employers and students, the programme management should increase the time for practice and research work according to the curriculum. This would improve graduate competencies such as cognitive culture, the ability to perceive, generalize, and analyze information, set goals and choose solutions, analyze philosophical, outlook-related problems as well as problems of social and personal importance; basic knowledge in research methodology, the ability to use the knowledge and skills required in solving practical problems both during training and in professional/social activities; the ability to use modern software, devices, and units in the sphere of focus, and more.

- The list of forms of student activities within the programme include the term "independent work under teachers' supervision". The experts found this expression to be rather unfortunate because any work that is supervised by a teacher cannot be referred to as independent. Independent work means that the student does the time management, prepares a work plan, and chooses the appropriate solution, while the teacher controls *the result* only. The term here

clearly refers to a certain type of practical activities carried out under teachers' supervision. This should not be presented as another form then.

During the visit, the experts attended a class, the analysis of which is presented below.

Teacher's full name Natalya Matveeva

Group/specialization

1. Subject/module Laboratory work (1st year)

2. Learning session type

lecture

seminar

laboratory work

practical classes

complex class _____

other _____

3. Subject of the learning session: Physics

4. Goal of the learning session: carrying out experiments to demonstrate physical phenomena

5. Objectives of the learning session: studying principles of physics

6. Material and technical support of the learning session: basic laboratory work equipment for the 1st year

7. Specify:

Item No.	Knowledge and skills planned to be developed at the lesson as well as the competencies affected by knowledge and skills (д.б. are announced by the lesson teacher)	Forms, means, methods and techniques that are planned to be used during the learning session for the formation of competence
1.	Carrying out several experiments	Laboratory equipment
2.	Studying experiments to understand physical phenomena	Laboratory equipment
3.		

ASSESSMENT OF THE TEACHER

N o.	Analysis criteria	Indicators	Rating (0, 1, 2)
1.	Compliance with the training schedule	Timely start and end of class, time-balanced sections.	2
2.	Organizing time	Greeting. Topic, goal messaging (connection of the goal with the competences formed).	2
3.	Motivation of	Indication of relevance, the formed	2

	listeners for upcoming activities	professional and / or social and personal competencies.	
4.	Psychological climate in the audience	The presence of positive emotional interaction between the professor and students; mutual benevolence and audience involvement.	2
5.	Quality of presentation	Structured material; the clarity of the definition of current tasks; systematic and accessible presentation; adaptability of presentation to the peculiarities of the audience; availability of examples, relevant facts.	2
6.	Conformity of the content to the course programme	Compare with working curriculum of the discipline (teaching and learning materials).	2
7.	Use of visual materials	A textbook, a workshop, handouts, tables, drawings, etc.	2
8.	Oratory	Audibility, intelligibility, euphony, literacy, speech tempo; facial expression, gestures, pantomime; emotional saturation of the performance.	2
9.	Feeling the audience	The ability to respond in time to changes in perceptions of the students.	2
10.	Civility in relation to students		2
11.	Methods of organizing attention and regulating students' behavior	Increase of interest among listeners (original examples, humor, rhetorical techniques, etc.); involving listeners in a dialog, into the process of performing tasks, etc. But not: open call for attention of listeners; demonstration of disapproval; psychological pressure, blackmail.	2
12.	Maintaining "feedback" with the audience during the class	Learning control	-
13.	Summarizing the learning session (<i>reflection organization</i>)	The organization of reflection, during which students actively discuss the outcomes	2
14.	Image	Compliance with corporate style, presentability, charisma	2

15.	Final grade		2
16.	Notes and suggestions of the expert		

Additional material

While performing the desktop analysis of the self-evaluation report, the analysis of the curriculum and the schedule of classes, the experts determined interactive classes to account for at least 40%. The teaching and learning materials of five subjects were studied in the course of the visit: Higher Mathematics (active and interactive classes: about 40%), Physical Practicum (about 100%), High Voltage Special Laboratory (about 100%), Introduction to Plasma Physics (about 40%), and Introduction to Materials Physics (about 60%). Based on the data, the experts believe the forms of instruction, educational techniques, and the percentage of active and interactive classes to fully fit the purposes of this programme as well as the competency-oriented graduate model.

5. Teaching staff

Criterion assessment: excellent

Strong points of the programme

- The educational process within the programme is ensured by a highly-skilled teaching staff. 30% of the them are Doctors of Science, and 63% are PhDs. All the lecturers are active researchers, producing a total of 465 articles in RSCI, Web of Science, and Scopus-indexed journals over the past 2 years.
- Nearly all (97%) the teachers have a working experience in the respective field; over 2/3 (71%) of the teachers combine teaching at the university with research work under internal and external grants.
- About 10% of teachers in the programmes have carried out research and teaching work abroad in the recent years.
- The publishing requirements to teachers for the competitive selection (at least 3 works published in RSCI, Web or Science and Scopus indexed journals in the past 3 years for associate professors and 4 for professors) and the other qualification requirements appear to be well-balanced.

Recommendations

- The findings of the teacher survey included in the educational institution's self-evaluation report indicate relatively low satisfaction with the university's personnel policy (27% fully satisfied, 34% partly satisfied, 7% unsatisfied, and the

rest not sure). The University's administration should pay more attention to teachers' interests.

- It is a well-known fact that scientometric parameters do not ensure a 100% accurate assessment of academic staff qualification. As has been mentioned above, the experts believe SPBU's established criteria to be generally reasonable. However, a detailed justification, e.g. why publication activity has to be this and that, is welcome. Therefore, the experts recommend the programme and University's management to thoroughly think out any formal requirements to teaching staff, in particular by referring to the average values of the previous years. Secondly, special cases should be provided for, such as employees who have been working on a very complex scientific problem for a long time, where formal parameters can turn out to be inapplicable.

- With due regard to the somewhat formal and compulsory approach to advanced training for teachers that is well-established in the Russian education system, the experts recommend the SPBU administration to use a broader interpretation of it, i.e. view articles published in high-rating journals and reports at international conferences as advanced training.

- The experts' interviews with students showed students to rarely use feedback instruments to contact programme managers, in particular for professional assessment of teachers. Even though a number of student surveys are carried out to study this aspects, the managers of the programme should take further action to improve the feedback mechanism. Firstly, student surveys should be a mandatory, systematic work procedure. Surveys to assess teachers' performance should be anonymous. Secondly, survey results should be reported to teachers, in which the programme management should take measures to implement the main suggestions of students.

- The self-evaluation report and interviews with representatives of the educational institution's administration showed actual competition for teaching positions with 2 or more candidates competing for a position to be rather rare. The position mostly goes to the teacher who has occupied it before. Thus, the procedure should be referred to as employee assessment for the purpose of contract renewal rather than competitive selection. Competition is more appropriate to employ a new worker where a new position has emerged due to a staff increase or when a teacher has been dismissed, retired, etc.

6. Material, technical and financial resources of the programme

Criterion assessment: excellent

Strong points of the programme

- The experts found the scientific equipment offered by the SPBU Research Park to be very impressive. The University's material resources generally cover the needs of the programme and enable teachers as well as students to carry out

cutting-edge physical and interdisciplinary research in science and technology. Essential facilities for the programme include the laboratories, the Computing Center, and the resource centers located in V. Fock Physical Research Institute Near the main teaching building for Applied Physics and Mathematics. Laboratory and practical classes enable students in the Bachelor's programme to acquire experience of working in scientific laboratories, which is extremely important to their further employment in the field.

- The University has enough buildings and facilities to host classes as well as students' and teachers' research within the programme.

Recommendations

- Based on teacher interview data, the experts recommend the programme management and the SPBU administration to address the issue of providing necessary equipment to training laboratories in Applied Mathematics and Physics. Students need training equipment to develop basic physical experiment skills as a prerequisite for being permitted to use the complex and expensive equipment that the SPBU Research Park offers.

- Necessary funds should be allotted to ensure maintenance of modern equipment.

- The expert recommend the University's administration to carry out regular sanitary inspections in academic buildings and classrooms and do any repairs necessary.

Additional material

During their visit, the experts interviewed students and teachers participating in programme implementation to find out how satisfied they were with the quality of classrooms. The information obtained suggests that the number and area of rooms used to implement the programme are sufficient. However, complaints were received regarding low temperature in certain classrooms. The experts recommend the managers of the programme and the University's administration to check the information and carry out any necessary renovation if necessary.

7. Information resources of the programme

Criterion assessment: excellent

Strong points of the programme

- SPBU possesses one of the best university libraries across Russia. The Library has subscriptions to all influential physical journals and electronic abstract databases. It provides teachers and students of the programme with up-to-date professional literature in a quick and efficient manner.

- The University offers convenient electronic services like Blackboard, student accounts, etc., which enable all parties to the programme to exchange information, make up individual curricula, control performance, handle electronic documentation, etc. All processes involved in the implementation of the programme use information and communication technology.

8. *Research activities*

Criterion assessment: excellent

Strong points of the programme

- All lecturers implementing the programme "Applied Mathematics and Physics" carry out large-scale research activities. The vast majority of them head or participate in internal and/or external funding grants. Teachers in the programme (Bachelor's degree) have carried out a total of 152 research works over the past 3 years.

- To prove the academic activity and high qualification of the teachers, they have authored a total of 465 articles in leading Russian and international journals.

- Students are involved in research work on a regular basis. Bachelors' involvement mainly consists of graduate qualification work. Over 50% of graduate qualification work subjects were suggested by employers and are definitely novel, which favors the development of research competencies in graduates.

Recommendations

- As has been mentioned above, the programme management should increase the time for practice and research work in the 3rd and 4th year according to the curriculum with due regard to the suggestion of certain employers and students. This should probably include introducing additional elective courses to the curriculum.

Additional material

Students are involved in scientific seminars and a youth scientific conference. The experts believe the programme to ensure adequate involvement of students in scientific work.

9. *Employer participation in programme implementation*

Criterion assessment: excellent

Strong points of the programme

- Employers contribute to every aspect of programme implementation at a systemic level through membership in the Teaching Commission, Programme Council, and State Examination Board, agreeing the curriculum and subject-specific work programmes, suggesting and agreeing graduate qualification work subjects, reviewing graduate qualification works and research projects, acting as work experience internship supervisors, and helping students find employment.

Additional material

The interview with employers that the experts carried out during their visit to SPBU showed employers to be very interested in developing the programme "Applied Physics and Mathematics" and appreciate its graduates.

10. Participation of students in determining the content of the programme ***Criterion assessment: good***

Strong points of the programme

- SPBU in general and this programme in particular use a number of mechanisms for student governance and involving students in determining the content of programmes. The mechanisms include the SPBU Student Council, student surveys on the quality of knowledge, the questionnaire through which students can express their opinion of a subject / for of instruction that is part of the subject study programme.

Recommendations

- The student interview showed students to be largely unaware of how they can influence programme content and inform programme managers and/or the University's administration of their opinion and suggestions. The experts believe that some of the above mechanisms only exist on paper at present. The student questionnaire survey data included in the educational institution's self-evaluation report confirmed it with only 12% of students in the Bachelor's programme reporting their opinion to be taken into account in developing the programme. The experts recommend the managers of the programme to improve the student feedback mechanisms. In particular, surveys and questionnaire surveys should be a regular work practice.

Subject-specific feedback as well as that for the entire programme can be arranged as follows:

1. Anonymous questionnaires to be filled out upon the completion of each subjects. Teachers can review them to obtain useful information.

2. Students can elect a course representative to attend meetings to discuss academic and general issues.

11. Student services at the programme level

Criterion assessment: excellent

Strong points of the programme

- Students in the programme as well as across SPBU enjoy a broad range of student services such as further competencies, sports, public work, and cultural events.

Recommendations

- The student interview revealed two aspects of student services that could be improved:

- 1) since the main academic building is located far away from the main part of Petersburg, dormitory accommodation should be provided to all students in the programme;
- 2) the working hours of campus food service facilities should ensure that at least one canteen is open on weekends.

12. Career guidance. Assessment of the training quality of prospective students (for the Bachelor's Programme)

Criterion assessment: excellent

Strong points of the programme

- SPBU has a multifaceted well-established student attraction system. Both university-wide events like open days and excursions to the SPBU Research Park and those catering the needs of the Bachelor's programme "Applied Physics and Mathematics" are offered. Of special importance among them are the SPBU Physics Competition aimed at identifying the most knowledgeable schoolchildren and the Schoolchildren's Laboratory Experimental Platform at the premises of the Research Park, which offers yearly summer practices in physics to 10th grade students.

EXPERTS' CV

Full name of an expert: Dmitrii Stepanov

Company and position	Associate Professor, Department of Mathematical Modeling, Bauman Moscow State Technical University
Academic degree and academic title	PhD in Physics and Mathematics
Additional titles and degrees	none
Education	Faculty of Mechanics and Mathematics, M. Lomonosov Moscow State University
Professional achievements	12 academic works
Research interests	Algebra and algebraic geometry
Practical experience in the field of the programme subject to assessment	Experience as a Mathematics teacher at a technical higher education establishment (12 years)

Full name of an expert: Andrei Indenbom

Company and position	Andrei Vladimirovich Indenbom
Academic degree and academic title	PhD in Chemistry
Additional titles and degrees	none
Education	Chemical Faculty, M. Lomonosov Moscow State University
Professional achievements	over 35 academic works
Research interests	Physical chemistry and bioelectrochemistry
Practical experience in the field of the programme subject to assessment	Supervision of graduate and postgraduate qualification works at MIPT (17 years), teaching Physical Chemistry (4 years)

Full name of an expert: Sara Tanner

Company and position	Associate Professor, Department of Computing Science and Mathematics, Dundalk Institute of Technology
Academic degree and academic title	PhD in Applied Mathematics
Additional titles and degrees	
Education	Beloit College, USA; Newcastle University, UK
Professional achievements	Publications in astrophysics
Research interests	Analytical and numerical methods used to study the evolution of magnetic fields in the Solar System. Analytical and numerical methods used to study solar coronal loops and prominences. Analytical and numerical methods used to model solar magnetoconvection.
Practical experience in the field of the programme subject to assessment	Teaching and research activity

Full name of an expert: Nikolai Asaturov

Company and position	Student, BMSTU
Academic degree and academic title	
Additional titles and degrees	
Education	
Professional achievements	
Research interests	
Practical experience in the field of the programme subject to assessment	