Peoples' Friendship University of Russia, Moscow

- Academy of Engineering -

International Accreditation of Study Programmes

Experts' Report

8th Meeting of the ZEvA Commission on November 5, 2019

Reference Number I-1736-1

Study Programme	Degree	Programme Duration	Type of Programme	Maximum annual intake
Engineering and Physical Technologies in the Nanoindustry	Master	2 years	Full-time	20

Accreditation contract signed on: September 27, 2018

Date of site visit: May 21/22, 2019

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I. Vote of the Expert Panel and Decision of the Accreditation Commission

1. Decision of the ZEvA Commission (ZEKo) of November 5, 2019

The ZEvA Commission follows the experts' report and agrees with their recommendations. The commission also takes note of the university's written response to the experts' report, as well as the experts' feedback in return.

The commission decides to accredit the Master's programme Engineering and Physical Technologies in the Nanoindustry *as offered by Peoples' Friendship University, Moscow, for a period of six years, provided the following pre-condition is met:*

- *The university has to ensure that all students have access to the laboratory infrastructure they need to achieve the intended learning outcomes of the programme, regardless of their nationality.*

In addition, the university is required to submit a follow-up report to ZEvA within a period of two years. The report needs to include concrete and detailed information on the ways in which the recommendations of the experts have been adopted.

This decision is based on the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG), the Framework of Qualifications of the European Higher Education Area and the recommendations of the ECTS Users' Guide as referred to in the ZEvA Manual for the External Assessment of Study Programmes.

2. Experts' Appraisal

2.1 Executive Summary

Based on the self-report and the outcomes of the on-site talks, the experts are convinced that the study programme provides a solid education at Master's level with good career opportunities for graduates mainly in Russia, but also abroad. The curriculum is well-structured, but could be improved by including a larger range of disciplines related to or directly contributing to nanotechnology. Furthermore, the international profile of the programme should be further sharpened.

The experts also see the urgent need to build up a state-of-the-art laboratory infrastructure on campus to make sure that all students of the programme can achieve their intended learning outcomes without hindrance.

2.2 Final Vote of the Expert Panel

The expert panel recommends the accreditation of the Master's programme in *Engineering and Physical Technologies in the Nanoindustry* as offered by *Peoples' Friendship University, Moscow* for a period of six years.

The accreditation should be granted only if the university provides evidence that the following prerequisite is fulfilled:

- All students (including students with special needs and international students) need to have equal access to the same teaching laboratories, either on or off campus.

To support the further enhancement of the programme, the experts give the following recommendations:

Programme Profile and Programme Management

- English should be chosen as primary language of instruction in order to be more attractive, enhance the general study experience and connect with international research. Also, renowned experts from abroad should be more frequently invited for guest lectures or Master classes.
- The students should be brought in touch with potential future employers on a more regular basis.

Curriculum

- The thematic scope of the programme should be widened by introducing a larger variety of (elective) courses from the contributing disciplines of nanotechnology. If the narrow focus of the programme is to be maintained, this should be clearly drawn out in the descriptions of the programme profile or in a different programme title.

- The number of classes during the final phase of the programme should be reduced in order to give students enough time for working on their Master's thesis. Generally, the university should aim for a more evenly distributed student workload across semesters.

Infrastructure and Equipment

- The experts strongly recommend a swift and substantial enhancement of the laboratory infrastructure on campus. In order to achieve this, the budget allocated for laboratory equipment should be significantly increased by means of internal and/or external funds.

Transparency

- The required entrance qualifications or prerequisites for the programme should be made more transparent. In particular, it should be pointed out clearly that the programme requires solid background knowledge in physics and quantum mechanics.
- It should be more effectively ensured that all students receive vital information concerning classes and examinations in due time.

Quality Assurance

- The university should intensify the implementation of its quality assurance tools at programme level. This applies especially to course evaluations, which should be more frequently applied and more strongly formalized.
- The experts strongly recommend introducing a close and regular monitoring of student workload at programme and/or class level as a standard quality assurance tool.

II. Evaluation Report of the Expert Panel

Introduction: Purpose, Design and Context of the Accreditation Procedure

In September 2018, People's Friendship University of Russia (RUDN) mandated ZEvA with the international accreditation of three Master's programmes, all of which are offered by the university's Academy of Engineering.

For the purpose of assessing the study programmes, the university was asked to submit a self-report in English including an appendix of documents, as e.g. selected course syllabi, CVs of teaching faculty, central statistical data, relevant formal regulations and policies as well as sample questionnaires for course evaluation. All documents were translated into English before submission.

During the entire review process, ZEvA was supported by the colleagues of the Russian accreditation agency AKKORK, who provided assistance in all organizational and administrative matters.

ZEvA and AKKORK jointly assembled three international expert panels (one group of experts for each programme) who conducted a two-day site visit in Moscow in May 2019. The site visit involved talks with members of the university leadership board, the director of the Academy of Engineering, the head of the quality assurance department, as well as teaching faculty, students and graduates of the programmes. Also, the experts were given a tour of the university campus.

The quality assessment was conducted based on the ZEvA Manual for the External Assessment of Study Programmes. The assessment framework laid out there was developed with close reference to the "European Standards and Guidelines for Quality Assurance in Higher Education (ESG)" (ENQA 2015), the "Framework of Qualifications for the European Higher Education Area" (2005) and the "ECTS Users' Guide" (European Communities, 2015).

This accreditation report refers to the Master's *programme "Engineering and Physical Technologies in the Nanoindustry*". It is based on the experts' assessment of the self-report and the outcomes of the on-site talks and will serve as a basis for the final accreditation decision of the ZEvA commission. Provided the decision is positive, ZEvA will award its quality seal for a limited time period, after which the university can apply for re-accreditation of the programme.

Separate accreditation reports were generated for the other two programmes of the cluster (Reference Ns. I-1737-1; I-1738-1). All reports will be published on the ZEvA website upon finalization.

The experts would like to thank the Vice-Rector for Academic Affairs of RUDN, the Director of the Academy of Engineering as well as all faculty, staff and students involved for the friendly reception and the open and constructive atmosphere during the on-site talks in Moscow.

1. General Aspects

1.1 Profile and Mission of the University

Peoples' Friendship University (RUDN) was founded in 1960, with the prime goal of providing higher education to students from developing countries in Asia, Africa and Latin America, as well as to Russian students from low-income families. The university is located in Moscow, with an additional branch in Sochi.

Still today, internationality and multi-culturality lie at the heart of the university's profile and mission: students from 150 countries are currently enrolled at RUDN. The university (slogan: "Discover the World in One University!") is co-operating with more than 250 foreign universities and research centres worldwide and offers a wide variety of foreign-language Master's programmes.

This strong international orientation also becomes apparent in the strategic aims that the university names for the period from 2018 to 2020 (cf. self-report, p. 5):

- *To increase the contribution of RUDN University to the development of human capital for solving regional and global problems of humanity in the fields of innovation and infrastructure, urban development, energy, sustainable development, linguistic and civilizational problems of modern society and healthcare;*
- *To strengthen the position of RUDN on the world stage as the most international university in Russia*
- *Significantly expand the presence of the university in the global digital socio-cultural and educational environment*
- *To strengthen the integration of the new brand of RUDN University into the international space.*

In 2012 RUDN was authorized to develop and apply its own educational standards in addition to the national standards. As the third university in Russia, RUDN also gained the status of an autonomous university in 2014. As such, RUDN can take independent management decisions on strategic, administrative and financial matters.

The university presently counts a total of around 31.000 students, about 8.500 of whom are from outside Russia. RUDN offers educational programmes (mainly Bachelor's, Master's and Ph.D. programmes) in all the subject disciplines of a classical university, including humanities and social sciences, natural sciences, medicine, engineering & technology, agriculture, languages and media, economics and management.

Organizational Structure

According to the website, RUDN hosts six faculties and 10 institutes, complemented by the Academy of Engineering as an independent organizational unit.

The university is headed by a Rector and 12 Vice-Rectors with different areas of responsibility, including the Vice-Rector for Academic Affairs. The most important collegial body at central level is the Academic Council, consisting of the members of the Rectorate, the President of the University, the heads of the faculties and institutes as well as elected representatives of the students and staff. The Academic Council is responsible for the general strategic management of the university, which includes the provision of quality educational services.

Furthermore, a Supervisory Board and a Fiduciary Board function as the main advisory bodies of the university. Various external stakeholders are represented in the boards, as e.g. state authorities, employers and graduates.

The Student Council is the umbrella organization that unites all student associations and committees under one roof. It represents and protects the interests of all RUDN students and ensures sufficient student participation in the general management and governance of the university. It also deals with student appeals and organizes extracurricular activities.

The Academy of Engineering came into existence in 2016 as part of an internal reorganization process resulting in the dissolution of the former Faculty of Engineering. It currently hosts about 3.000 students, one third of them foreigners, and more than 200 teaching staff. The Academy is involved in a broad range of study programmes, including 13 Master's programmes and 5 Ph.D. programmes taught in English. The academic disciplines covered include space technology, mining and geology, nanotechnology, as well as mechanical and electrical engineering.

Experts' Appraisal

From the experts' point of view, the mission and profile of Peoples' Friendship University are described very clearly on the university website and in the self-report. The university holds a unique position among Russian higher education institutions, especially as far as the aspect of internationality is concerned.

With a view to that, the Master's programme in Nanotechnology does not appear fully representative of the university and its strategic goals. The programme is exclusively taught in Russian, even though a substantial percentage of the students come from abroad. Outgoing student mobility, if at all, only plays a minor role.

Hence, the experts recommend switching to English as the primary language of instruction, or at least increasing the number of courses taught in English in order to facilitate outgoing mobility and to generally enrich the study experience. In addition, experts from abroad should be more frequently invited for guest lectures or Master classes, which then might be taught in English. The considerable efforts that have already been taken to this end should be continued.

The organizational structure of the university is laid out in sufficient detail in the self-report. The experts especially commend RUDN on the various options for students to participate in university governance and quality assurance. As far as the experts can see, all internal and external stakeholders are sufficiently represented in the internal governance structure of the

university. Nevertheless, a participation of students in the selection and hiring process of new faculty might be introduced.

In view of RUDN's special status as an autonomous university, the experts would like to stress that the university and its faculty should be relieved as far as possible from bureaucratic burdens and should be granted a higher degree of freedom in pursuing its scientific and educational activities. From the experts' point of view, this would include the autonomy to widely apply international educational standards in the study programmes; particularly US standards.

1.2 Student Support Services

RUDN has described its advisory and support structures for students in detail in its self-report. Services include special tutoring and mentoring for first-year students and international students. Furthermore, the university is planning to offer psychological and pedagogical counselling for students in the near future.

The Department of Social Development (DSD) is, among other things, responsible for the integration of students with disabilities and has set up a hotline to provide advice on issues related to inclusive education.

RUDN ensures that students with physical impairments receive equal access to learning resources at the library. Some of the dorms and lecture rooms are equipped to fit the special needs of disabled students. Also, special conditions may apply to them during examinations and in the process of student admission and selection.

A career center (Department of Students' Practices and Employment Organization) supports students in finding internship placements and working positions upon graduation.

Students may always approach their tutors and academic advisors in all academic matters. The students and graduates interviewed during the site visit reported that teachers, as a general rule, were accessible and supportive throughout.

To create equal opportunities for students and applicants, RUDN offers various scholarships, including financial support for incoming foreign students and for RUDN students who wish to study abroad.

Foreign students may turn to the "Foreign Students Recruitment and Support Department" for advice.

Experts' Appraisal

The experts have gained the overall impression that RUDN has implemented comprehensive and efficient support structures for its diverse student body. Students with special needs are offered a broad range of services and activities to help them integrate into university life and to make good progress in their studies. However, the on-site talks revealed that access to teaching labs might be limited for students with physical impairments. Programme coordina-

tors should pay special attention to this aspect in the future.

Lecturers appear to be very dedicated and always ready to provide advice to students whenever needed. Furthermore, the student organizations may be approached for appeals, requests and complaints of any kind.

Following the wish of the students interviewed on site, the experts recommend taking increased efforts to bring the students in touch with potential future employers on a more regular basis.

1.3 Student Mobility and Recognition of Credits

According to the self-report, RUDN has closed numerous cooperation agreements with universities all over the world. Agreements relate to the regular exchange of staff and/or students or to the joint development of educational programmes (double degree programmes), of which RUDN offers about 100. The university also actively participates in the Erasmus+ mobility programme.

The total number of outgoing RUDN students currently lies at around 800 per year, whereas the number of incoming foreign students is usually a lot higher, due to a high number of programmes directed especially at foreign students.

RUDN has gradually implemented ECTS in its study programmes since the year 2005. All graduates from Bachelor's and Master's programmes receive a Diploma Supplement in addition to the state diploma.

Experts' Appraisal

The experts commend RUDN on its extensive network of cooperating partners which includes a broad range of higher education institutions as well as other partners from inside and outside academia. The large number of double degree programmes is particularly impressive. As regards outgoing mobility, there still seems to be room for further optimization, which applies both to the university as a whole and also to the Master's programme discussed here. Hence, the experts strongly support the university's continuing participation in the Erasmus+ programme.

"Free movers" outside the framework of partnership agreements and the Erasmus programme seem to be an exception. Accordingly, no additional rules or criteria for the recognition of credits earned abroad were made known to the experts. In case such regulations exist, the university is kindly asked to provide the panel with more information on this aspect.

1.4 Quality Assurance

The self-report includes an elaborate description of the university's internal quality management system. The university has implemented a central department concerned with the quali-

ty assurance of educational programmes, which deals both with internal quality management and matters of external licensing, certification and accreditation. In addition, there are units responsible for quality assurance at decentral level.

The main quality objectives (quality strategy) of the university are published on the RUDN website. Also, a quality manual is provided which regulates the key processes of the quality assurance system.

The applied methods and tools for quality assurance include regular monitoring of performance indicators, centralized process management and continuous monitoring of student satisfaction, for example by means of interviews or round tables. Written satisfaction surveys are conducted among students, staff, employers and graduates on a regular basis. The results of the surveys are published in the form of quality reports.

Apart from the measures applied at central level, faculties may conduct their own surveys to assess the quality of teaching in particular study programmes or educational units. Based on the survey results, programmes may, for example, be updated in terms of content or teaching methods. Furthermore, each faculty and institute has its own student commission for the quality of education. At least once per semester the chairpersons of these commissions meet up with the Rector to discuss quality issues, which results in a protocol and an action plan.

In its self-report, RUDN has presented a list of 15 quality indicators that are monitored both for each study programme and for the entire university. These indicators refer to aspects of internationality (e.g. number of joint programmes), but also to the qualifications and research output of staff, average student performance and to student satisfaction with the quality of education.

Experts' Appraisal

Based on the information provided in the self-report and during the site visit, the experts conclude that RUDN has created a complex, state-of-the-art internal quality assurance system which involves all internal and external stakeholders to a satisfactory extent. The study programmes are regularly monitored and revised with a view to the strategic and operational goals of the university and to the aim of continuous improvement. The institutional quality assurance policy and quality strategy are published on the university website, and the responsibilities for quality assurance are clearly assigned.

In the course of the site visit, the experts got the impression that the quality assurance system is formally established and functional, but not yet entirely implemented and trusted to a sufficient degree. Both the students and staff interviewed on site displayed a relatively low awareness of the quality assurance tools and procedures, as well as the outcomes and consequences of quality surveys. Direct and informal feedback mechanisms exist, but there seems to be little familiarity and experience with the "official" instruments. Based on these impressions, the experts recommend promoting the implementation of quality assurance tools at programme level more intensely. This applies especially to course evaluations, which should be more frequently applied and more strongly formalized. Students should more often

get the chance to provide anonymous written feedback on classes by means of standardized questionnaires. The questionnaires should also include a free comment option, and the lecturers should reflect together with their students on the survey results and on the consequences drawn from them. Furthermore, the experts propose that the Academy of Engineering and/or RUDN establish measures to track and possibly publish the results internally.

Furthermore, the experts strongly recommend introducing a close and regular monitoring of student workload at programme/and or course level as a standard quality assurance tool. The on-site talks have revealed that the awarded ECTS credits do not always accurately reflect the actual workload, and to the experts' knowledge there is no mechanism yet to identify and remedy such discrepancies.

1.5 Transparency and Public Information

All key information concerning the study programme is publicly available (both in Russian and in English) on the RUDN website. This includes descriptions of the intended learning outcomes and career prospects for graduates. The course syllabi and the exam requirements are made known to the students at the beginning of the semester. Regulations on student assessment are documented and published.

Experts' Appraisal

The experts conclude that by and large, the students receive all the information they need about their study programme and its requirements in due time.

The students of Nanotechnology reported that sometimes they received vital information at too short notice, especially as far as organizational matters like short-term changes in schedules or examination procedures were concerned. The experts therefore recommend further optimizing the administrative processes in this regard.

From the experts' point of view it would also be of special importance to create full transparency regarding the programme profile and the entrance requirements (cf. Chapter 2.3).

2. Assessment of the Study Programme

2.1 Key Facts

The Master's programme "Engineering and Physical Technologies in the Nanoindustry" (named "Nanotechnologies and Microsystems Engineering" on the RUDN website) was first introduced in the year 2012 and currently counts 26 enrolled students and almost 40 graduates (figures quoted from the self-report). The programme is organized as a 2-year full-time course and awards a total of 120 ECTS credits. The main responsibility for the programme lies with the Department of Mechanics and Mechatronics at the Academy of Engineering.

Graduates of the programme are qualified to proceed to doctoral level as stipulated in the Russian and European qualifications frameworks.

2.2 Intended Learning Outcomes

The intended learning outcomes of the programme are published on the university website and are also outlined in the self-report. According to the university website, the career opportunities for graduates are as follows:

If you want a career in science, you will have the opportunity to work in the scientific field and engage in applied interdisciplinary research in the field of physics, chemistry, mathematics and electronics, create new materials and study their structure at the molecular and atomic level, develop methods for research and improvement of nanoobjects and diagnose existing nano- and microsystems.

In the field of different-purpose industrial production, engineering, energy, instrument-making, space industries, depending on the chosen direction, graduates can:

- *work with modern and high-precision measuring and diagnostic equipment, on the most modern and powerful base of high-resolution electron microscopes,*
- *design the nodes of electronic devices, robotic systems,*
- *effectively operate the technological systems used in the manufacture of nanomaterials and products on their basis.*

The self-report names the following educational objectives:

1. *Willingness of specialists to successfully conduct research activities in the field of materials research at the molecular and atomic level, as well as the creation of materials, objects and systems in various branches of science and technology, which use materials, devices (mechanisms), systems whose performance characteristics are determined by nanoscale effects.*
2. *Readiness of specialists for effective developmental, production and technological activities, ensuring the introduction and operation of new high-tech developments at the*

world-scale level.

3. *Willingness of specialists for successful work in the modern conditions of globalization and a competitive labor market.*
4. *The willingness of specialists for successful self-accomplishment, the desire to deepen the knowledge in their professional field, for constant intellectual and general cultural improvement.*

Furthermore, the following possible positions and professional activities for graduates are listed in the self-report:

- *Design engineer of analog hard-functional blocks (HF-blocks)*
- *Engineer in the development of digital libraries of standard cells and complex functional blocks*
- *Photo-mask design engineer for the production of nano-systems (including nanoscience and integrated circuits)*
- *Specialist in measuring the parameters and modifying the properties of nanomaterials and nano-structures*
- *Specialist in the design and maintenance of clean production facilities for micro and nano-electronic production*
- *Specialist of technical support of technological processes of devices of quantum electronics and photonics*
- *Case System Design Specialist*
- *Case System Production Technology Specialist*
- *Specialist in the design of micro- and nano-scale electromechanical systems*
- *Specialist in the production technology of micro- and nano-scale electromechanical systems*

Experts' Appraisal

From the experts' point of view the desired qualification profile and the career prospects of the graduates are clearly and comprehensibly described both in the self-report and online. The intended learning outcomes encompass all key aspects that are to be expected from a European higher educational programme (research skills, employability, soft skills and personal development).

The experts confirm that the intended learning outcomes of the programme are fully in line with the Master's level as defined in the Framework of Qualifications for the European Higher Education Area and with Level 7 of the European Qualifications Framework. In the self-report this is also demonstrated by means of a survey chart which relates the intended learning outcomes and their underlying standards to the Dublin Descriptors (Knowledge and Understanding; Application of Knowledge and Understanding, Making Judgments, Communication

Skills, Learning Skills/Learning Ability).

2.3 Profile, Content and Curricular Structure

As is common practice at RUDN University and other Russian universities, the theory-based part of the curriculum is divided into a block of “basic” compulsory courses and a “variable” part which includes both mandatory units and a number of elective subjects.

The basic part of the curriculum stretches across the entire duration of the programme and includes educational units on general aspects of nanotechnology, mathematical modelling and computer technology, as well as foreign language training. The variable part covers a wide variety of more specific aspects of Nanotechnology, with a recognizable focus on physics and (micro-)electronics, but also touching upon other disciplines as e.g. biology or biochemistry.

All in all, about one third of the programme (45 ECTS credits in total) is dedicated to research activities, which includes research in the context of the Master’s thesis as well as internship placements in industry, at universities (including RUDN University itself) or research institutions.

Experts’ Appraisal

Based on the self-report and the outcomes of the on-site talks, the experts conclude that the study programme provides a solid MSc education. The experts are confident that graduates of the programme have acquired the skills and knowledge to qualify them for research or engineering positions in high-technology industries mainly in Russia but also abroad. The programme fits in well with the general profile of the Academy of Engineering, and has so far been quite successful in terms of enrolment and graduation figures.

Nonetheless, the experts find that the programme does not (yet) entirely live up to its own goals. This applies particularly to the aspect of scientific research: although it is a declared goal of the programme to produce top-level researchers, the on-site talks have shown that in fact, a career in industry seems to be the path of choice for the majority of the graduates. This is reinforced by using Russian as the sole teaching language; to connect with international standards in research, the increased use of English as teaching language is, again, recommended.

Most students are actively involved in applied research from an early stage and are continuously encouraged to present their research results on internal conferences. Nevertheless, not all students have the same access to appropriate research infrastructure. The most substantial obstacle seems to be the lack of adequate laboratory infrastructure on campus that all students of Nanotechnology have constant and unlimited access to (cf. Chaper 2.6 for details). The on-site talks clearly revealed that the element of lab experience generally needs to be further strengthened within the curriculum for students to achieve the intended learning outcomes.

Furthermore, students reported that too much time for class work during the final phase of their studies often resulted in too less time for working on their Master thesis projects. The experts therefore recommend reducing the number of classes during the final phase of the programme. Generally, a more even distribution of student workload across semesters should be aimed for.

As far as the general programme profile is concerned, the experts find that the curriculum is quite strongly focused on physics and electronics. Other disciplines are included, too, but are not really linked with each other in the curriculum, considering that nanotechnology is a highly interdisciplinary field by definition. This high degree of specialization (and concurrent low degree of integration) also potentially limits employment prospects for graduates down to a relatively small section of the nanoindustry. Hence, the experts recommend widening the thematic scope of the programme by introducing a larger variety of (elective) courses from other disciplines contributing to nanotechnology besides physics and electronics, that is chemistry or life sciences. For example, teaching topics like surface coatings, thin-film technology or surface science from a chemistry perspective would add a lot of value to the programme and would also make it easier to create direct, cross-disciplinary links with other study programmes offered by the Academy of Engineering.

In case a narrow focus of the programme is maintained, this should be clearly drawn out in the descriptions of the programme profile or could be addressed by a change of the programme title, e.g. to Nanoelectronics. The required entrance qualifications should also be made more transparent in this context. In particular, it should be pointed out clearly that the programme requires solid background knowledge in mathematics, physics and quantum mechanics. This is even more advisable with a view to the relatively wide admission policy of the programme which results in a diverse body of students, ranging from physicists to trained civil engineers.

2.4 Methods of Teaching and Student Assessment

Apart from laboratory and practical exercises performed by students independently or in small groups, the self-report also mentions business games, case studies and interdisciplinary projects as applied forms of teaching. In addition to that, special importance is attributed to internship placements and other forms of practice-based training.

RUDN University has developed a “Fund of Assessment Tools” for each discipline in order to assess the students’ learning progress and the development of the desired competencies. The exam regulations of RUDN University and the syllabi that were submitted with the self-report mention a large variety of possible assessment methods for Master’s programmes, as e.g. written tests and quizzes, oral exams, laboratory work or reports. In most educational units several types of interim assessment are combined with one final examination. The in-class performance of students also has an impact on the overall grade.

According to the RUDN regulations failed exams may be repeated twice within the first two months of the following semester.

Experts' Appraisal

Based on all information provided, the experts conclude that the applied methods of teaching and assessment are adequate for a Master's programme of this discipline and are well aligned to the intended learning outcomes. It becomes especially clear in the documents that high importance is attributed to problem-solving skills in both teaching and assessment.

As already mentioned above, the lab-based elements of the curriculum should be further enhanced (cf. Chapter 2.3). The experts also recommend strengthening the students' capacity for independent self-study both in an academic and an industrial context. As a means to this end, compulsory written reports should be introduced as a regular form of assessment. These reports could be reviewed by professors and/or experts from business and industry, modelled on the procedures applied in leading US universities.

2.5 Teaching Faculty

At present, three professors and 10 associate professors are involved in the programme, supported by some senior lecturers and teaching assistants. Academic CVs of the teaching staff have been submitted as part of the self-report.

About 25% of the teaching faculty work for RUDN University full-time, all others are part-time lecturers. Four members of faculty have a background in Nanotechnology, and the majority of the lecturers hold a Ph.D. or a higher qualification.

Experts' Appraisal

Based on the self-report and the outcomes of the on-site the experts have no doubt that the teaching faculty involved in the programme are well-qualified and highly dedicated to their task and to their students. Communication between lecturers and students generally seems to be working well, which contributes substantially to student satisfaction. Also, the teaching faculty are clearly determined to continuously improve the quality of teaching and learning.

As already mentioned above, the experts recommend inviting foreign guest lecturers on a more regular basis in order to enhance the general quality of teaching and learning (cf. Chapter 1.1). Furthermore, it should be ensured that core components of the curriculum (especially units on quantum physics and quantum technology, as well as nonlinear dynamics) are taught by lecturers who are actively involved in related scientific research activities. Generally, the scientific component of teaching should be strengthened throughout.

2.6 Infrastructure, Resources and Learning Environment

During their visit in Moscow the experts were given a tour of the main RUDN campus, which included the central library, and some teaching and research labs at the Academy of Engi-

neering.. The self-report also contains extensive general information on the infrastructure and facilities at RUDN University.

In the course of the talks in Moscow the experts learned that the students of Nanotechnology frequently use external laboratory facilities run by cooperating institutions in and around Moscow, as e.g. Bauman State Technical University or the Kurchatov Institute. It was also reported that access to some of these laboratories is restricted for international students due to national security legislation, of which the students and graduates interviewed on site took a critical view.

Experts' Appraisal

The experts have found that as far as the general learning environment at RUDN University is concerned, the students are provided with sufficient resources and a modern infrastructure to support their learning progress. The library is well-equipped and provides a lot of work-space for students, as well as access to a large variety of e-papers via online databases like Scopus and ScienceDirect. State-of-the-art computers and software are also at hand on campus. If RUDN intends to put a special focus on nanoelectronics within the programme, specialized heavy CAD/CAM/CAE software should be purchased, and qualified experts from industry should be hired to instruct students in its use.

In accordance with the students and graduates the experts see the urgent necessity to extend the laboratory infrastructure on campus. The current facilities only allow for basic experiments and do not live up to the needs of graduate students in nanotechnology. For instance, some core instruments of nanotechnology such as scanning probe microscopes (AFM or STM) are not available. The external laboratories do not provide a fully satisfactory alternative, as they are not equally accessible to everybody. Hence, international students and students with special needs are put at a potential disadvantage.

For these reasons, the experts strongly recommend a swift and substantial enhancement of the laboratory infrastructure on campus. To this end, the budget allocated for laboratory equipment should be significantly increased by means of internal and/or external funds. This could also be achieved by attracting sponsors from industry. Alternatively, agreements with external laboratories should be closed that grant full and unconditional access to all students.

Either way, the experts consider it a necessary prerequisite for accreditation that all students are provided with identical learning conditions.