ASIIN Seal

Accreditation Report

Bachelor's Degree Programmes
Cyberphysics
Physics and Nanotechnology

Master's Degree Programme
Nanomaterials and Nanotechnology

PhD Programme
Nanomaterials and Nanotechnology

Provided by
Al-Farabi Kazakh National University

Version: 23 June 2023

Table of Contents

A About the Accreditation Process

Name of the degree programme (in original language)	(Official) English translation of the name	Labels applied for [1]	Previous accreditation (issuing agency, validity)	Involved Technical Committees (TC)[2]
6B05302 Киберфизика	6B05302 Cyberphysics	ASIIN	—	05, 13
6B05305 Физика и нанотехнология	6B05305 Physics and Nanotechnology	ASIIN	—	05, 13
M07120 Наноматериалы и нанотехнологии	7M07120 Nanomaterials and Nanotechnology	ASIIN	ASIIN 26.09.2014-30.09.2020	05, 13
8D07112 Наноматериалы и нанотехнологии	8D07112 Nanomaterials and Nanotechnology	ASIIN	—	05, 13
Date of the contract: 31.10.2022 **Submission of the final version of the self-assessment report:** 10.02.2023 **Date of the onsite visit:** 25.-27.04.2023 **at: Al-Farabi Kazakh National University, Faculty of Physics and Technology**				
Peer panel: Prof. Dr. Arno Schindlmayr, Paderborn University Prof. Dr. Rolf Haug, Leibniz University Hannover Prof. Gaukhar Omashova, South Kazakhstan University Dr. Bernhard Flöter, Volkswagen AG Bekzat Zhumabay, student at Satbayev University				
Representative of the ASIIN headquarter: Christian Daniels				

[1] ASIIN Seal for degree programmes.

[2] TC: Technical Committee for the following subject areas: TC 05 - Materials Science, Physical Technologies; TC 13 - Physics.

Responsible decision-making committee: Accreditation Commission for Degree Programmes	
Criteria used: European Standards and Guidelines as of May 15, 2015 ASIIN General Criteria, as of December 10, 2015 Subject-Specific Criteria of Technical Committee 05 – Materials Science, Physical Technologies as of September 29, 2016 Subject-Specific Criteria of Technical Committee 13 – Physics as of March 20, 2020 ASIIN Additional Criteria for Structured Doctoral Programmes as of March 15, 2021	

B Characteristics of the Degree Programmes

a) Name	Final degree (original / English translation)	b) Areas of Specialization	c) Corres-ponding level of the EQF[3]	d) Mode of Study	e) Double / Joint Degree	f) Duration	g) Credit points / unit	h) Intake rhythm & First time of offer
6B05302 / Cyberphysics	Bachelor of Natural Science	6B053 Physical and Chemical Sciences	Level 6	Full time	-	4 years	240 ECTS	2019, annually in fall
6B05305 / Physics and Nanotechnology	Bachelor of Natural Science	6B053 Physical and Chemical Sciences	Level 6	Full time	-	4 years	240 ECTS	2019, annually in fall
7M07120 / Nanomaterials and Nanotechnology	Master of Engineering Sciences	7M071 Engineering and Engineering Trades	Level 7	Full time	-	2 years	120 ECTS	2012, annually in fall
8D07112 / Nanomaterials and Nanotechnology	Doctor of Philosophy (PhD)	8D071 Engineering and Engineering Trades	Level 8	Full time	-	3 years	180 ECTS	2012, annually in fall

For the Bachelor's degree programme **6B05302 / Cyberphysics**, the institution has presented the following profile in the self-assessment report:

The programme aims „[t]o provide high-quality training of specialists in the field of cyberphysics, focused on solving interdisciplinary tasks requiring an integrated and systematic approach in multidisciplinary fields, with knowledge and competencies in demand for work at enterprises and manufacturing companies with a high level of innovation implementation in companies providing innovative consulting services and in research organisations capable of creating high-tech developments based on the junction of the latest achievements of physics and cybernetics."

The programme's webpages can be found here and here.

For the Bachelor's degree programme **6B05305 / Physics and Nanotechnology**, the institution has presented the following profile in the self-assessment report:

"The goal is to prepare competitive specialists, bachelors of physics and nanotechnology, with strong analytical scientific mindset and high level of English language proficiency, capable of carrying out an experimental or theoretical scientific research, teaching and

[3] EQF = The European Qualifications Framework for lifelong learning

making scientific and technical translations competently; to develop personal qualities in order to work as a team leader of professionals."

The programme's webpages can be found here and here.

For the Master's degree programme **7M07120 / Nanomaterials and Nanotechnology,** the institution has presented the following profile in the self-assessment report:

The programme aims to „[p]rovide preparation of specialists with sufficient knowledge and qualities of engineering technologists, researchers and investigators to conduct scientific and technical works in the field of nanotechnology and creation of nanomaterials with specified properties, using the knowledge of elective directions on synthesis of nanomaterials by physical and chemical methods, also analysis of properties of nanomaterials by modern methods of spectroscopy and microscopy."

The programme's webpages can be found here and here.

For the PhD degree programme **8D07112 / Nanomaterials and Nanotechnology,** the institution has presented the following profile in the self-assessment report:

"The program is aimed at training highly qualified scientific and scientific-pedagogical staff, who are able to: conduct fundamental, applied and innovative research in the field of obtaining nanomaterials and nanotechnology; develop new directions of nanomaterials and nanotechnology in the field of physics, chemistry, biology and medicine; commercialize the results of research and development work."

The programme's webpages can be found here and here.

C Peer Report for the ASIIN Seal

1. The Degree Programme: Concept, content & implementation

Criterion 1.1 Objectives and learning outcomes of a degree programme (intended qualifications profile)

Evidence:

- Self-Assessment Report
- University Website (here, here)
- Ministry of Education and Science Republic of Kazakhstan, Unified System of Management of Higher Education (ESUVO)
- Module Handbooks
- Discussions with programme coordinators, lecturers, students and industry representatives during the audit

Preliminary assessment and analysis of the peers:
Learning objectives (LO) are defined clearly for all study courses under review on both a programme and module level:

On the programme level, the LO are delineated and made accessible publicly on the Faculty's website as well as through the study programme database of the Kazakh Ministry of Education and Science. On the module level, the LO are defined clearly in the respective module handbooks, where they are linked narrowly to the overall programme goals.

Based on the provided documentation and discussions conducted during the audit, the expert panel recognises that the learning outcomes for the respective courses in the module handbook were originally drafted by the relevant lecturers, before being discussed jointly and aligned with government regulations. As a rule, learning outcomes are revised every 3–5 years as part of the University's cyclic monitoring of its educational programmes, during which feedback from student surveys, the local industry, as well as insights from alumni studies conducted by the University's Career Center ("Office of Professional Development and Career", located under the Department of Academic Affairs - DAA) is taken into consideration.

All study courses under review benefit from the Faculty's various ties to local industry and research partners. Students, in particular, benefit in the form of integrated internships, thesis collaborations, equipment sharing, and labour market involvement in programme reviews.

During the audit, the experts were explained that the programmes discussed seek to distinguish themselves from comparable study offerings at other Kazakh universities through specialisation, research orientation and practical components. In line with this, industry representatives attest that graduates from the Faculty of Physics and Technology are capable of working productively after a comparatively short time in contrast to graduates from other universities, as well as of using relevant research equipment.

Student and alumni feedback on the educational programmes under scrutiny is positive, stating high confidence in their ability to qualify for further studies and suitable employment after graduation. Noticeably to the peers, a visible majority of students and alumni appear to wish to stay in science after completing their academic training, often expressly at KazNU.

In summary, the auditors are convinced that the objectives and intended learning outcomes of the degree programmes reflect the intended level of academic qualification adequately, that they correspond sufficiently with ASIIN's Subject-Specific-Criteria (SSC), and adequately prepare graduates for their future entering of the labour market.

Ba Cyberphysics

The Bachelor's programme in Cyberphysics aims to qualify its students for later employment in fields such as smart environments, robotics, or information security.

The programme learning outcomes encompass a range of skills and competencies, including performing laboratory works and experimental research, conducting analytical calculations, organising scientific and technical information, comprehensively analysing processes and phenomena, adhering to professional and ethical standards, building computer models, developing software code, conducting market analysis, integrating computing resources, developing database strategies, and utilising mathematical tools and programming languages for problem-solving in the field of cyberphysics.

Graduates are suggested to pursue Master's studies in either Physics or Computer Science. A consecutive Master's programme in Cyberphysics is considered for introduction in 2024, which will, however, depend on the Ministry and the number of successful graduates from the Bachelor's programme.

Current students from the programme's first intake confirm that they perceive the programme to be innovative, that it will provide them with a range of opportunities for the future, and that it will have prepared them well for tasks requiring the integration of computer processes in the physical sphere. In this context, students also highlighted their obtaining of programming skills in C++ and Python.

All in all, the auditors gained a positive impression of the Ba programme in Cyberphysics, and do not find a need for significant conceptual changes. However, they perceive that summative feedback from the current pilot intake will be particularly valuable for the programme's quality management. The peers hence encourage the programme coordinators to gather comprehensive summative feedback from the first intake upon their study completion, especially to support pertinent communication with the Ministry. Moreover, the experts emphasise that graduates from the Ba Cyberphysics should be included in the conceptualisation of the envisaged consecutive Master's programme when the time comes.

Ba Physics and Nanotechnology

The Bachelor's programme in Physics and Nanotechnology aims to qualify its students for subsequent employment in relevant research institutes, as well as for the offered consecutive Master's and PhD studies in Nanomaterials and Nanotechnology. The programme's first intake will be completing its studies this year.

The programme learning outcomes encompass a range of skills and competencies, including explaining physical, chemical, and mathematical methods for research, applying physicochemical methods for producing nano-objects, analysing the relationship between structure and properties of objects, interpreting scientific concepts in physics and nanomaterials, identifying global and local science in innovative technology, utilising information technologies for research, practising interdisciplinary skills, conducting experiments and calculations, critically evaluating scientific concepts, applying physical laws to solve problems, and working in diverse teams with social and cultural sensitivity.

Students of the Ba Physics and Nanotechnology highlight the available laboratories as an attracting factor, stressing their view of nanotechnology as an important sector for Kazakhstan and their hope to work in international environments in the future.

In view of the National Nanotechnology Laboratory located in-house and the mentioned further study opportunities, the experts recognise the great potential of the Ba Physics and Nanotechnology for its graduates to tap into, and do not see any need for noteworthy conceptual changes. Given its current pilot intake, however, the auditors equally encourage

its coordinators to gather comprehensive summative feedback from the first intake upon their study completion as a basis for the further development of the programme.

Ma Nanomaterials and Nanotechnology

The consecutive Master's programme Nanomaterials and Nanotechnology aims to qualify its students for employment in advanced positions as researchers or chemical engineers in relevant research institutes and industry sectors. Furthermore, it seeks to prepare its graduates for the offered PhD studies in Nanomaterials and Nanotechnology, if so desired.

The programme learning outcomes encompass a range of competencies in the field of nanomaterials and nanotechnology. These include demonstrating knowledge and understanding of synthesis methods, utilising physical and chemical methods for obtaining nano-objects and analysing their properties, applying modern information technologies for research, critically evaluating scientific concepts, conducting original research, and actively participating in educational and research activities. Students are also expected to analyse priorities, communicate research findings, and defend their viewpoints in the scientific community.

In regards to the Ma Nanomaterials and Nanotechnology, students and graduates of the programmes spotlight its integrated scientific internship, related opportunities for mobilities abroad, and confirm to have faced no major obstacles in entering the Master's.

The experts appreciate the clarifications made by the programme coordinators during the audit concerning the educational / pedagogical subjects in the Ma programme, understanding that these are mandated through Ministry regulations seeking to ensure the qualification of Ma graduates to work as teaching assistants at universities after completing their degree. In conclusion, the expert group does not see any need for conceptual changes.

PhD Nanomaterials and Nanotechnology

Discussed in section "Additional Criteria for Doctoral Programmes".

Criterion 1.2 Name of the degree programme

Evidence:

- Self-Assessment Report
- University Website (here, here)
- Ministry of Education and Science Republic of Kazakhstan, Unified System of Management of Higher Education (ESUVO)
- Module Handbooks

- Discussions with programme coordinators, lecturers, students and industry representatives during the audit

Preliminary assessment and analysis of the peers:
Overall, the peers come to the conclusion that the titles of the degree programmes adequately reflect their intended objectives and learning content.

With reference to the newly established Ba "Cyberphysics", the experts initially voice concerns regarding its title, perceiving it to be unusual and potentially misleading. During the audit, the programme responsibles explain that the name was chosen to attract students who would like to acquire knowledge in both physics and computer science, and to stand out amongst physics-related courses in the national register for potential programmes in Kazakhstan, known as ESUVO. The peers are content with this explanation and see no further need for modification.

Within the available evidence, however, the auditors have observed inconsistent usage of the various programme's English titles, which needs to be rectified. In particular, the following recurring inconsistencies were observed:

- Ba C**y**berphysics (SAR, Module Handbook, here / C**i**berphysics (here, here, ESUVO)
- Ma/PhD Nanomaterials and Nanotechnolog**y** (SAR, Module Handbooks) / Nanomaterials and Nanotechnolog**ies** (multiple occurrences within the SAR, here, here, here, ESUVO).

Criterion 1.3 Curriculum

Evidence:

- Self-Assessment Report
- University Website (here, here)
- Module Handbooks incl. curricular overview and objectives-modules matrix
- Discussions with programme coordinators, lecturers, students and industry representatives during the audit

Preliminary assessment and analysis of the peers:

As overall noteworthy points concerning the curricula of all presented study programmes, the peers observe the following:

In the first semester, students are required to decide between Russian, Kazakh, or English as their preferred language of instruction. Courses are hence commonly offered in "groups" for each language. The minimum number of participants per group (i.e. language) is five.

Students may switch between different language groups if desired. As stated during the exchange with the programmes' lecturers, the University incentivises teaching in English (e. g. through decreased teaching load), and in turn requires staff to provide proof of English language proficiency on a B2 level (according to the CEFR) through an IELTS certificate or similar.

With both the Ma and PhD in Nanomaterials and Nanotechnology integrating mandatory scientific internships in their curricula, the experts raised the question of how the programme supported students with internships related to these subjects. During the discussion round with students and graduates, they outlined that internships are commonly found through lists of possible internship partners provided, the University's Career Office, as well as through networks of the faculty staff or upon own initiative. Based on the various related exchanges during the audit, the peers conclude that students do not appear to face difficulties in finding their internships in view of these resources.

In terms of research activities throughout the students' academic progression, the programme coordinators explain that Bachelor's students in their fourth year of study are required to complete a final attestation, which is similar to a thesis. Besides their equivalent final attestations and dissertations, Master's and PhD students are engaged in research activities throughout their studies and participate in recurring research seminars which take place every two weeks. At the end of each semester, Master's and PhD students are moreover required to discuss their research activities with a supervisor.

Asked about the Bachelor's graduates' options to pursue consecutive Master's studies at KazNU the programme responsibles declared that graduates of Cyberphysics and Physics and Nanotechnology have the option to pursue a Master's degree in either Computer Science or Physics. Although a credit-wise seamless transition is ensured, the responsibles admit that graduates of the abovementioned Bachelor's programmes may need to invest additional efforts in preparing for the competitive entrance examination for the general Master's in Physics if they seek to enrol in it; given that the examination is uniform for both graduates from the specialised and general Physics-related Bachelor's programmes offered at the Faculty as per the applicable government regulations. On their part, students likewise expressed their confidence in their ability to enter the available Ma/PhD programmes.

Student mobility

During the audit, both students as well as staff frequently highlight the ability to access funding for mobilities abroad through the University. While available at all programme levels, Master's and PhD students are particularly encouraged to do so in the course of their integrated scientific internships. The funds are made available through competitive

processes based on students' GPAs and language skills. Moreover, additional sources of funding such as faculty-administered funds, scholarships for summer schools abroad, as well as ERASMUS funds for exchange semesters are available.

Ba Cyberphysics / Ba Physics and Nanotechnology

Content

During the accreditation visit, the programme responsibles explain that all physics-related Bachelor's programmes offered at the Faculty of Physics and Technology provide a nearly identical foundation in the field of physics in the first two years of study, followed by specialised courses in accordance with the programme title. As examples for such specialised subjects, the coordinator mentioned courses in machine learning and cryptosystems for the Ba Cyberphysics, and advanced computer modelling and nanotechnology-related contents for the Ba Physics and Nanotechnology. In comparison, the responsibles clarified that the regular Bachelor's programme in Physics allows for specialisations within subdisciplines of Physics instead.

The peers asked both lecturers and students for clarification of the "student's individual work with teachers" as included in the workload calculations for a wide range of Bachelor's courses in the module handbook. From the respective elaborations, it became clear that lecturers regularly provide additional assignments throughout as means of students' formative assessment ahead of the final examinations. Students are encouraged to seek recurring feedback from the respective lecturers concerning their performance in class during office hours, accounting for the abovementioned contact hours.

Structure of the programmes

The curricula of the Bachelor's programmes under review account for 240 ECTS. They consist of three main parts: General Education Disciplines (56 ECTS), Core Disciplines (112 ECTS) and Major Disciplines (60 ECTS), as well as a final thesis/project (12 ECTS).

Courses under the **General Education Disciplines** section aim to foster students' critical and context-sensitive thinking, language, and soft skills. Courses under this section include e. g. *Modern History of Kazakhstan*, *Foreign Language*, as well as electives such as *Entrepreneurship* and seminars on the Kazakh thinkers al-Farabi and Abai. The section is designed and anchored in the curricula through regulations of the Kazakh Ministry of Science and Higher Education.

Courses under the **Core Disciplines** aim to provide students with a comprehensive understanding of physics, and to lay a foundation for further specialised courses. Between the two degree programmes at hand, a number of subject areas are shared under this

section, such as *Mechanics and Molecular Physics*; *Optics, Electricity and Magnetism*, *Computational Physics*, and *Atomic and Nuclear Physics*. Further offerings under this section depend on the respective programme, such as *Cyberphysics Methods* (in the Ba Cyberphysics) or *Atomic and Nanomaterials Physics* (in the Ba Physics and Nanotechnology).

The third curricular pillar, the **Major Disciplines** section, focuses on enhancing students' abilities to carry out research and to address specific issues relevant to their chosen study direction. Subject areas in this section include fields such as *Plasma Technologies and Biotechnology* and *Nanotechnologies and Power Plants* (in the Ba Physics and Nanotechnology), or Research Methodologies in Cyberphysics and *Applied Physical and Technical Solutions* (in the Ba Cyberphysics).

All of the three outlined sections include elective components, which the students confirm as being sufficient in variety.

Both programmes include a *Final Attestation* similar to a Bachelor's thesis, accounting for 12 ECTS and comprising a written performance as well as an oral presentation.

Upon closer inspection, the experts observe critically that dedicated mathematics courses in both Bachelor's programmes amount to six ECTS only (*Mathematical Analysis and Theory of Differential Equations* / *Higher Mathematics*), and are scheduled for no sooner than the third semester. During the audit, the programme responsibles however illuminate that government regulations require students to complete the mandated foundation courses under the **General Education Disciplines** section in the first semesters, hence not allowing for an earlier offering within the curriculum; and adding that mathematical contents are also included in other courses. The programme coordination nevertheless agrees that an earlier offering of courses in mathematics would be preferable, and assert that they will pursue to change this once the regulatory framework will permit them to do so. Likewise, students of both degree programmes in question second this consideration during the audit, confirming that an earlier offering of these courses would be desirable.

In view of the above, the peers understand that an earlier offering of dedicated mathematics courses within the Bachelor's curricula does not seem to be possible at present. Echoing the programme coordinators and students, the auditors, however, underline that a corresponding adjustment of the curriculum would be desirable.

Periodic Review of the Curriculum

During the audit, the University clarified that curricula of educational programmes are usually revised when new Ministry regulations need to be implemented, as has been the

case in 2018 and 2022. Educational programmes are reviewed every two years, not annually, to ensure they are up-to-date and relevant.

Likewise, the programme coordinators attested that, besides new credit schedules that came into effect after 2019, no major revisions of the two Bachelor's programmes introduced in 2017 have been undertaken so far.

In regards to course-related feedback, the students stated their perception that expressed needs (e.g. concerning available language groups for a given course) were heard by the Faculty, and steps taken subsequently.

In conclusion, the experts assess that the two Bachelor's programmes' curricula are coherent, well-defined; and serve to achieve the intended learning outcomes.

Ma Nanomaterials and Nanotechnology

Content The Ma Nanomaterials and Nanotechnology aims to equip students with comprehensive knowledge and skills to stay abreast of emerging knowledge and contribute to advancements in the field. The programme also focuses on developing the ability to articulate professional production tasks and employ modern technologies to solve them effectively. Additionally, it emphasises practical training, offering Master's students hands-on experience with essential nanotechnology equipment and analysis of nanomaterials. The programme aims to provide students with a deep understanding of conducting research in nanomaterials and nanotechnology.

Structure of the programme

The curriculum of the Master's programme under review consists of three main parts: Core Disciplines (35 ECTS) and Major Disciplines (49 ECTS), as well as a Research section (24 ECTS) and a final thesis/project (12 ECTS).

Similar to the Bachelor's curricula, courses under the **Core Disciplines** section aim to ensure the students are adequately skilled for the demands of their Master's studies. On the one hand, courses under this section foster language and teaching skills, the latter to prepare Master's students for employment as teaching and research assistants. On the other hand, students need to choose between the obligatory elective areas *Nanotechnology in Electronics* or *Structure and Electronic Properties of Nanomaterials*.

Under the **Major Disciplines** section of the Master's, students pursue further specialisation in fields such as *Plasma Methods in Nanotechnology* or *Nanocarbon Composite Materials*. Based on their obtained learning, students complete the **Research** section of the curriculum over the course of their studies, covering a recurring *Research*

Seminar, their mandatory *Scientific Internship*, as well as seminars supporting the conducting and writing of their **Final Attestation**.

Periodic Review of the Curriculum

During the audit, the programme responsibles explain that some adjustments were made to specific modules in the Ma Nanomaterials and Nanotechnology based on the feedback received from industry partners. These amendments included changes to the material science modules as well as an added biotechnology module focusing on nano-drugs. In addition, new equipment for ellipsometric analyses was purchased.

In conclusion, the experts assess that the curriculum of the Master's programme is coherent, well-defined, and serves to achieve the intended learning outcomes.

PhD Nanomaterials and Nanotechnology

Discussed in section "Additional Criteria for Doctoral Programmes".

Criterion 1.4 Admission requirements

Evidence:

- Self-Assessment Report
- KazNU Academic Policy
- National Testing Center, Ministry of Education and Science of the Republic of Kazakhstan

Preliminary assessment and analysis of the peers:
As per the University's *Academic* Policy document, admission is carried out in accordance with the "Standard Rules for admission to study in organisations implementing educational programmes of higher and postgraduate education", approved by order of the Ministry of Education and Science of the Republic of Kazakhstan No. 600 dated October 31, 2018.

Bachelor's level

Within the Kazakh context, applicants for Bachelor's studies are required to have undertaken the "Unified National Test" (UNT) as a nationwide university entrance examination. It commonly consists of assessments in the fields of mathematics, Kazakh history, language proficiency in either Kazakh, Russian, or English; as well as a study interest-specific component. Participants receive a certificate including a test score with which they apply at their desired university. Based on the received applicants' UNT results, KazNU, in accordance with the applicable regulations, determines the passing score for a given intake and admits applicants who pass the determined threshold.

Master's / PhD level

Similar to the above, entrance to Master's and PhD studies is granted through a competitive process. Individuals seeking to enrol in Master's studies need to sit for the "Comprehensive Test" (CT) conducted at sites approved by the National Testing Center and apply through the pertinent government online portal. Master's and doctoral admissions at KazNu are decided upon by the University's "University Admissions Committee" based on the results of the CT in combination with subject-specific entrance exams. Applicants for entering PhD studies moreover need to have at least nine months of professional experience to be eligible for admission.

Based on the provided documentation and the additional clarifications made during the audit, the panel confirms the admission regulations to be well-defined and binding.

Criterion 1.5 Workload and Credits

Evidence:

- Self-Assessment Report
- Module Handbooks incl. study plans and module descriptions
- Discussions with programme coordinators, lecturers, students and industry representatives during the audit

Preliminary assessment and analysis of the peers:

The experts attest that the study programmes under review implement the European Credit Transfer System (ECTS). The credits awarded are based on student workload, including both contact hours and self-study time as outlined for each course in the respective module handbooks.

The Bachelor's degree programmes each account for a total workload of 240 ECTS credits. The Master's degree programme comprises 120 ECTS credits, the PhD programme encompasses 180 ECTS credits. The standard duration of study for the Bachelor's degrees is 4 years (8 semesters), for the Master's degree it is 2 years (4 semesters), for PhD studies 3 years (6 semesters).The auditors hence find that all programme levels correspond to or surpass the applicable minimum requirements.

However, the peers observe that no structured mechanism to review students' working time in the respective courses appears to be in place, with lecturers explaining that individual contact time and experience are used to monitor student workload and to support where necessary. The peers thus strongly recommend integrating suitable

questions in the students' post-course assessment surveys to routinely gather documented feedback on the students' workload going forward.

With respect to the Ma Nanomaterials and Nanotechnology, the peers raised concerns about the apparently high number of dropouts, and questioned why this is the case. In response to this, the programme responsibles illustrated that dropouts are frequently related to students switching subjects or students losing their funding due to below-expectation performance. Moreover, Bachelor's graduates are known to drop out of the Master's programme due to picking up side employment, often forcing them to choose between their academic progression and (especially financial) career prospects. During the exchange with students and alumni, they too confirmed further motivations for dropouts, such as family reasons or wishing to continue studies abroad; often only getting the approval to study abroad after the start of the Master's programme. The auditors are satisfied with the explanations provided and do not see further need for intervention.

Overall, the experts assess the distribution of credit points to be sensible.

PhD Nanomaterials and Nanotechnology

Discussed in section "Additional Criteria for Doctoral Programmes".

Criterion 1.6 Didactic and Teaching Methodology

Evidence:

- Self-Assessment Report
- Module Handbooks incl. curricular overview and objectives-modules matrix
- Discussions with programme coordinators, lecturers, students and industry representatives during the audit.

Preliminary assessment and analysis of the peers:
The programmes under review integrate various teaching methods that are indicated in the respective module handbooks:

The **lectures** serve to illustrate topics within the respective study subjects, and familiarise students with appropriate approaches to these issues. Lecturers often involve assignments for the students to solve within a given time frame, using the concepts they have learned. Students are then asked to illustrate their solutions to the class, and discussion is encouraged to evaluate the strengths and weaknesses of each solution. **Seminars** are utilised within the curricula to deepen the students' understanding of a given phenomenon, as well as to develop their analytic abilities. Where appropriate, **lab works** and **project works** are combined with the aforementioned formats for students to apply

the theoretical knowledge they have obtained and foster their problem-solving skills. Further practical components, such as internships, further complement the students' theoretical learning and prepare them for future employments.

Courses are regularly offered in Russian, Kazakh and/or English, depending on the students' stated preferences, provided that a critical group size can be reached.

Asked by the experts about their ability to provide feedback on their learning experience, the students attending the audit confirmed that KazNU's online system allows students to provide anonymous, summative feedback on the lecturer and the module contents by the end of each course through questionnaires and comments. Besides such formal feedback, however, both lecturers and students also underlined during the audit that course-related issues may also be discussed directly and informally at any time.

As is clarified upon the peers inquiry, there are no dedicated courses on academic writing or good scientific conduct integrated into the Bachelor's curricula. Instead, Bachelor's students touch upon these topics throughout their study activities, and are introduced more closely to the relevant principles through their supervisor when working on their final attestation. Dedicated scientific writing courses are then offered at the Master's level. Throughout their studies, students use anti-plagiarism software for submissions. The originality scores required are 70% for Bachelor's students and 80% for Master's students.

In summary, the peer group considers the teaching methods and instruments to be suitable to support the students in achieving the intended learning outcomes. In addition, they confirm that the study concept of all three undergraduate programmes comprises a variety of teaching and learning forms as well as practical parts that are adapted to the respective subject culture and study format.

However, the experts are unsure about the University's explanations concerning the students' familiarisation with good academic practice, such as principles of scientific writing and responsible data handling as e.g. outlined by the German Research Foundation (DFG). The experts hence ask the University for a written statement on how the imparting of appropriate scientific conduct at all programme levels (Ba / Ma / PhD) is ensured in the curriculum.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 1:

In its response statement, the University provides further evidence and explains the following with regard to the imparting of good scientific practice on the respective programme levels:

On the Bachelor's level, the University explains that scientific conduct and writing are integrated into the curricula in multiple ways: In their first study year, students can opt to attend the elective subject "Scientific Research Methods" (5 ECTS) within the "General Education" section of the curriculum. In their second year, students then engage in laboratory work as part of their seminars on general physics and specialized subjects like mechanics and molecular physics; in which they conduct experiments and present their findings in standardized laboratory reports. Additionally, the programme coordinators point to the integrated scientific internships, within which students undertake research tasks under the supervision of faculty or industry experts; and in which they are required to write reports and present their findings to a practice attestation committee. Finally, students are assigned a diploma topic ("Final Attestation"), during which they utilize their report writing skills and receive mentorship in scientific writing through their supervisor.

On the Master's level, students are required to attend a specialized course called "Organisation and Planning of Scientific Research" (6 ECTS) within the "Major Disciplines" section of the curriculum. The course provides fundamental knowledge and understanding of conducting scientific research, and includes the selection of a thesis topic.

On the PhD level, students commence their study journey by selecting a supervisor and research topic in the first semester. Theoretical foundations are provided during the first semester, including the modules *Academic Writing* and *Scientific Research Methods*. The curriculum moreover includes *Research Seminars* to be attended throughout all six semesters, where doctoral students present their research findings to the department's teaching staff. Additionally, students are required to participate in scientific conferences and to prove publication of their research's main results in a scientific journal.

While the expert group is pleased about the explanations provided by the University, they see the elective nature of the "Scientific Research Methods" modules within the Bachelor's programmes as problematic, particularly in view of the University's self-stated research orientation. They hence strongly recommend making this module a university component in the future if the regulatory framework allows.

Apart from this, the peers thank the University for the submitted additional, national and institutional regulations that govern the composition of KazNU's study programmes.

Besides the additional considerations outlined above, the peers confirm their preliminary assessment.

2. Exams: System, Concept and Organisation

Criterion 2 Exams: System, concept and organisation

Evidence:

- Self-Assessment Report
- Module Handbooks incl. study plans and module descriptions
- Sample of Examination Papers and Final Theses provided during the audit
- Rules for Conducting Summative Assessments, KazNU

Preliminary assessment and analysis of the peers:
According to the Self-Assessment Report, the students' academic performance is evaluated based on a combination of formative and summative assessments. Formative assessments are held in the form of two so-called "milestone controls", each covering one-half of the semester syllabus. Students need to obtain an average of 50% in these to be admitted to the final course examination. The teacher determines the formats of the formative assessments and communicates these to the students in the course syllabus. The final assessment takes the form of a comprehensive exam.

Students who fail to score at least an average of 50% in both "milestone" assessments combined, who have missed more than 50% of classes for a given course irrespective of the presence of a valid documented reason, or who have pending tuition fee payments can be denied entrance to the final examination.

Educational achievements of students are evaluated in points on a 100-point scale. Students who fail to pass a course may retake the course, subject to the applicable reasons and regulations (e.g. previously failed examinations, violation of exam conditions, etc.).

The auditors judge exam requirements and regulations to be expedient, and do not see any need for their further amendment. Moreover, the experts do not have any complaints concerning the examinations and theses submitted to them for their perusal, and welcome the standard use of plagiarism detection software for essay and thesis submissions.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 2:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

3. Resources

Criterion 3.1 Staff and Development

Evidence:

- Self-Assessment Report
- Staff Handbooks
- Discussions with programme coordinators and teaching staff during the audit
- University Website (here)

Preliminary assessment and analysis of the peers:
At KazNU, staff members are distinguished as professors, associate professors, assistant professors, senior lecturers, and lecturers. Their academic position is based on research activities, publications, academic education, supervision of students, and other supporting activities.

When evaluating the qualifications of teaching staff, experience and publications are considered crucial factors. For the Bachelor's programme, teachers are only required to have a scientific degree. However, for the Master's and PhD programmes, a scientific profile is necessary. Teaching in English is factored into the teaching load by 1.5. Moreover, teaching staff must have an IELTS certificate, which is monitored by the University.

As a rule, moreover, lecturers are required to undergo a refresher course at the University's institute dedicated to professional development at least every three years. Furthermore, a funding programme has been set up for teaching staff to go to other international universities for internships lasting from three months up to one year. More recently, the Faculty participated in the Erasmus+-funded "ENTER" ("EngineeriNg educaTors pEdagogical tRaining") programme for staff development, aimed at creating multicultural and international approaches for formal post-graduate professional and pedagogical education for engineering educators.

Professors are encouraged and financially supported in developing their (in particular international) network. As discerned by the peers in the course of multiple discussions during the audit, the Faculty staff's individual profiles are vital for both their supervision of students, supporting students in finding suitable research internships, as well as fund-raising and increasing the reputation of the University. Overall, the peers see an appropriate network of national and international research institutions established within the Faculty of Physics and Technology.

In summary, the auditors confirm that sufficient resources for the staff's professional development are ensured, and welcome the outlined measures to incentivise staff to offer English-taught courses.

Criterion 3.2 Funds and equipment

Evidence:

- Self Assessment Report incl. Memoranda of Understanding with Company Partners
- Discussions with programme coordinators and teaching staff during the audit
- University Website (here, here)

Preliminary assessment and analysis of the peers:
During the audit, students and alumni of the programmes to be assessed express an overall contentment with the available labs and equipment, especially appreciating the efficient pooling of equipment drawing from across faculties, external industry and research partners, as well as other local universities.

While speaking to the expert panel, the programme lecturers on their part confirm that faculty staff have the necessary computational equipment to impart the intended learning outcomes to the students. In regards to experimental equipment, likewise, the expert panel is told by faculty staff that everyday needs are met, and everything needed for standard research is provided.

For processes involving big data and the modelling of physical processes, staff can make use of the University's "Center for Data Treatment" as well as resources of other faculties and external companies. In connection to this, the experts learn that a Kazakh-Chinese agreement has been signed to provide KazNU with a supercomputer under the New Silk Road University Alliance.

Asked if the overall funding is sufficient, the faculty staff generally agree, however point to the necessity of further individual activities and fundraising efforts. In this context, the

faculty staff also highlight their ability to invite and host foreign professors at KazNu through university funds for up to one year. Complementary to this, this programme responsibles equally stress that staff members are encouraged to foster the Faculty's international profile through establishing collaborations with partners abroad.

During the audit, the peers furthermore recognise the various industry collaborations of the Faculty for Physics and Technology. The central university library features various functional areas: co-working spaces, conference rooms, reading rooms, internet and multimedia zones, satellite TV sections, language laboratories, and laptop areas. The University's students are provided with access to over 300 national and international magazine titles as well as to 12 electronic databases, including prominent platforms like Elsevier, Scopus, and Springer.

In summary, the auditors are content with the presented equipment and facilities.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 3:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

4. Transparency and documentation

Criterion 4.1 Module descriptions

Evidence:

- Self-Assessment Report
- Module Handbooks incl. curricular overview and objectives-modules matrix
- KazNU Academic Policy

Preliminary assessment and analysis of the peers:

After studying the module descriptions, the peers confirm that they include the necessary information about the module title, persons responsible for each module, the teaching methods and workload, the awarded credit points, intended learning outcomes, the modules' contents, applicability, admission and examination requirements, the forms of assessment, as well as recommended literature. Clarifications on grade calculation are not included in the module handbooks and are defined in the University's *Academic Policy* document instead.

While the auditors are pleased to attest the above, they remark the following, however:

- There appears to be no indication within the module handbooks as to the last amendment date for the respective courses. The peers recognise that brief descriptions can be found on the "Welcome KazNU" portal, which are however insufficient, as they do not correspond to the applicable standards.
- Furthermore, indications of teaching methods in the module handbook for the Ba Cyberphysics partially appear to be stated indiscriminately as "lecture, seminar, lab works, practice, project", and should be checked for correctness.
- Likewise, the "Final Attestation" is indicated as 'elective' in the module handbook for the Ba Cyberphysics. This should be corrected and checked for the other modules.
- When comparing the module handbooks of the two Bachelor's programmes under review, the peers perceived that subsections and titles of identical courses are not named identically, such as "General Physics 1 / 2 / 3" = "Module of mechanics and molecular physics…".
- Finally, the auditors were under the impression that the module handbooks provided to the peers were unavailable through the Faculty's website. As per the applicable Standards and Guidelines, yet, the module handbooks need to be made available publicly in full detail (e.g. in PDF format). The shortened module descriptions available through the University "Welcome at KazNU" portal are insufficient.

Criterion 4.2 Diploma and Diploma Supplement

Evidence:

- Self-Assessment Reports
- Sample Diploma for each degree programme
- Sample Diploma Supplement for each degree programme

Preliminary assessment and analysis of the peers:
The peers confirm that the students of all degree programmes under review are awarded a Diploma and a Diploma Supplement after graduation. However, they determine that the provided Diploma Supplement samples in effect more resemble transcripts of records than a diploma supplement, and that various information is missing. The peers hence conclude that the University needs to revise the Diploma Supplement issued to align them with applicable standards within the European Higher Education Area (here, here, here). Moreover, the experts observe that no Bachelor's Diploma Supplement was provided.

Criterion 4.3 Relevant Rules

Evidence:

- Self-Assessment Report
- University Website (here, here, and here)
- Discussions with programme coordinators and teaching staff during the audit

Preliminary assessment and analysis of the peers:
The auditors confirm that relevant documents such as the University's Academic Policy, students' and staff's rights and duties or quality management guidelines exist and are published publicly on the University's website.

As mentioned before, however, the peers observe an inconsistent use of the English translations of multiple programmes under review, and that the complete detailed module handbooks for the respective programmes do not appear to be publicly available on the Faculty's website. Concerning the latter, a summative overview on the Faculty's website such as the one provided by a neighbouring faculty here is encouraged.

Upon inquiring about regulations concerning students with special educational needs, the experts learn that appeals can be submitted to the Faculty in such cases, e. g. if needing to attend classes remotely due to being unable to come to the campus. Classroom materials are uploaded to a Moodle-based learning management system, and can hence be accessed from anywhere.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 4:

The peers thank the University for the provided template Diploma Supplements for the Bachelor's programmes under scrutiny, and understand that the reviewed programme's will only graduate their first intakes in late 2023. In particular, the experts appreciate that the Bachelor's Diploma Supplements – in contrast to the reviewed Master's Diploma Supplements – intend to include the students' qualification profile (programme learning outcomes).

However, upon verifying the University's provided additional comments in the respective module handbooks, the peers notice a number of inconsistencies in the module handbooks, such as duplicated module descriptions and inconsistencies between the target semesters stated in the included module schedules and provided charts. They hence suggest a thorough revision of the module handbooks of all reviewed study programmes.

Besides the additional considerations outlined above, the peers confirm their preliminary assessment.

5. Quality management: quality assessment and development

Criterion 5 Quality management: quality assessment and development

Evidence:

- Self-Assessment Reports
- Discussions with programme coordinators and teaching staff during the audit

Preliminary assessment and analysis of the peers:

The University's quality management system with regard to its study programmes ("educational programmes," EP) is based on internal quality assurance cycles involving the relevant stakeholders (lecturers, students, industry partners) as well as external quality assurance.

The University's **internal quality assurance** mechanism is based on annual and cyclical (every 3–5 years) reviews of its offered study programmes. This evaluation involves the academic staff, employers, and students. The assessment by the academic staff includes examining the financial viability, qualification requirements of the teaching staff, relevance of contents to scientific research, societal and labour market needs, student workload and progress, effectiveness of assessment procedures, student expectations and satisfaction,

teaching conditions, and alignment of support services with the respective study programme goals. Furthermore, cyclical monitoring includes the review of training results and assessing the development of training outcomes; as well as the review of curricula.

Employers play an active role in monitoring and evaluating educational programmes, both during their development and implementation. They are engaged throughout the process to assess and enhance programme quality. Leading practitioners contribute as teachers and oversee professional practice, ensuring their expertise informs the educational process. This involvement enables evaluation and improvement of programme quality, benefiting from the insights and perspectives of employers.

Students participate in the monitoring and evaluation of the educational programme (EP) through formal questionnaires and informal surveys. In addition, the Registrar's Office conducts tracking of students' progress, utilising midterm exams, intermediate assessments, and final certification as indicators.

In terms of **external quality assurance**, the University invites external assessments through international accreditation, aligning with European standards and quality assurance recommendations. It collaborates with international and national accreditation bodies to plan and implement measures for accreditation, aiming to enhance programme quality and reputation.

In summary, the auditors are content with the quality assurance mechanism outlined in the University’s self-documentation and during the audit, with the exception of the abovementioned missing inclusion of means to gather factual student workload in the summative course evaluation surveys.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 5:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

D Additional Criteria for Structured Doctoral Programmes

Criterion D 1 Research

Evidence:

- Self-Assessment Report
- KazNU Academic Policy
- Module Handbooks
- Ministry of Education and Science Republic of Kazakhstan, Unified System of Management of Higher Education (ESUVO)
- Discussions with programme coordinators, lecturers, students and industry representatives during the audit

Preliminary assessment and analysis of the peers:
The doctoral programme Nanomaterials and Nanotechnology aims to qualify its students for employment in highly-qualified positions such as leading researchers and senior academic staff within the University as well as relevant research institutes and industry sectors. Amongst others, its learning objectives are focussed on qualifying its students for the process of writing and publishing scientific articles in nanotechnology, including selecting journals, article composition, submission, peer review, and evidence verification. They will also receive guidance on writing successful grant proposals, preparing research reports, and addressing ethical issues and spiritual values in science and technology.

The peers were initially surprised about the apparently low number of ECTS awarded for the doctoral thesis in the curriculum (53 ECTS) but were told during the audit that this is due to government regulations; and that research activities in fact account for two-thirds of the curriculum, including recurring bi-weekly graduate research seminars as well as a scientific internship. The remaining third of the curriculum, largely allocated within the first two semesters, is dedicated to fostering research skills as well as pedagogical skills to enable candidates to teach on the Bachelor's and Master's levels, and as a means to mentoring younger researchers.

As variously highlighted to the peer group by both current students and coordinators of the PhD programme, candidates are encouraged to connect their research to renowned research institutions located both across Kazakhstan as well as in-house. Moreover, a conduct of their mandatory research internship abroad – ideally with their international

supervisor – is strongly suggested (see Criterion D 3 Soft Skills and Mobility, Criterion D 4 Supervision and Assessment).

Taking the above into consideration, the expert panel sees the criterion as fulfilled.

On a formal note, however, the peer group notices that the programme objectives and learning outcomes communicated on the University's website (here) deviate from those stated in the Self-Assessment Report and the Unified System of Management of Higher Education of the Ministry of Education and Science Republic of Kazakhstan (ESUVO). This needs to be corrected to ensure that information are identical for all stakeholders across the relevant platforms.

Moreover, the experts noticed that the outlines for the modules *Participation in international scientific conferences* and *Publication of the main scientific results of the dissertation in scientific journals* are identical, which needs to be remedied. In connection to this, the experts suggest a thorough revision of the module handbook to check for further accidental duplications.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 1

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

Criterion D 2 Duration and Credits

Evidence:

- Self-Assessment Report
- KazNU Academic Policy
- Module Handbooks
- Discussions with programme coordinators, lecturers, students and industry representatives during the audit

Preliminary assessment and analysis of the peers:
The structured doctoral programme in Nanomaterials and Nanotechnology comprises 180 ECTS credits, including 25 credits of theoretical training ("Major Disciplines" section), 20 credits for practical training ("Core Disciplines" section), 123 credits of research work, and 12 ECTS credits for the final assessment.

The Ministry mandates that the PhD must be completed within three years. To incentivise timely study progress, milestones have been integrated into the candidate's PhD studies,

which are linked to ECTS. Doctoral students who have not successfully defended their thesis within three years after graduation are required to undergo a reapproval process for their research proposal on a fee basis to be eligible for dissertation defence.

Besides the governmentally prescribed foundation courses in the first semester, its contents largely depend on the individual candidate's specific research topics and their external supervisors' wishes.

The research work of doctoral students is organised on a semester basis, following the curriculum of their educational programmes. After each semester, doctoral students present an interim update on the progress of their individual research plan during a meeting with the scientific advisors of the Faculty. Additionally, at the end of each academic year, doctoral students provide a comprehensive report on their research progress during a meeting with the Academic Council of the Faculty or Research Institute.

As mandated by the government, PhD programmes at KazNU include the imparting of pedagogical skills to enable candidates to teach on the Bachelor's and Master's levels, and as a means to mentoring younger researchers.

All in all, the peers find the suggested programme contents, structure and length appropriate and aligned with the applicable expectations toward a PhD programme.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 2:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

Criterion D 3 Soft Skills and Mobility

Evidence:

- Self-Assessment Report
- KazNU Academic Policy
- Module Handbooks
- Discussions with programme coordinators, lecturers, students and industry representatives during the audit

Preliminary assessment and analysis of the peers:

As part of their Individual Study Plan, doctoral students collaborate with both their local and international advisors to develop a programme and schedule for their mandatory scientific internship. This internship aims to let PhD candidates benefit from theoretical,

methodological, and technological advancements made at national as well as international partner institutions of KazNU. Students are strongly encouraged to pursue their scientific internship abroad, ideally in collaboration with their foreign doctoral supervisor. As hinted at by the programme responsibles and confirmed by the students, financial support covering such mobilities is provided through the University.

In conclusion, the expert panel sees the criterion as fulfilled.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 3:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

Criterion D 4 Supervision and Assessment

Evidence:

- Self-Assessment Report
- Discussions with programme coordinators, lecturers, students and industry representatives during the audit

Preliminary assessment and analysis of the peers:
Doctoral students in the PhD Nanomaterials and Nanotechnology are supervised by at least two senior researchers, with one of them having to be from a suitable university or institute abroad. These international supervisors are usually found through personal contacts of the supervisors at KazNU, often through joint projects. The appointment of supervisors takes place within the first two months of enrolment, with the PhD topic being finalised during the first semester of study.

Supervisors are expected to participate actively in the development and approval of individual study plans for doctoral students, provide guidance in their educational and research endeavours, and ensure the timely completion of all tasks outlined in the individual work plan. They are moreover asked to ensure suitable conditions for the students' research work, including granting access to necessary resources, offering assistance and advice throughout the dissertation research process, as well as to help with the facilitation of research opportunities at external educational and scientific organisations.

Upon inquiring during the audit whether faculty members have enough time to supervise – especially to supervise PhD students – the auditors are assured that staff have enough

time to do so, stating that teaching loads were appropriate to permit for research and supervision.

In conclusion, the expert group believes that resources and capacities for proper supervision of PhD students are ensured. Furthermore, they welcome the mandatory involvement of an international supervisor as well as the provided support in conducting the integrated scientific internships abroad.

All in all, the expert panel sees the criterion as fulfilled.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 4:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

Criterion D 5 Infrastructure

Evidence:

- Self-Assessment Report
- On-Site Visit of Research Facilities
- Website of the National Nanotechnology Laboratory hosted at KazNU

Preliminary assessment and analysis of the peers:

During their on-site inspection of the Faculty's local research facilities, the auditor group recognises the facilities' suitability for both teaching and research purposes across all educational levels. The peers find that the more elementary teaching equipment at the undergraduate level is appropriate, and especially commend the quality of equipment displayed within the National Nanotechnology Laboratory hosted at KazNU, which students regularly have access to, including instrumentation by EDAX and Korvus.

During the audit, the attending PhD students express their appreciation especially concerning the inter-faculty accessibility of lab equipment as well as the University's international connections to help them access research equipment during their scientific internships abroad.

In summary, the expert panel sees the criterion as fulfilled.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 5:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

Criterion D 6 Funding

Evidence:

- Self-Assessment Report incl. examples of cooperation agreements and information on funding options
- University Website (here)

Preliminary assessment and analysis of the peers:
Doctoral students can access funds to cover their mandatory scientific mobility through funds granted by the (formerly called) Ministry of Education and Science administered at KazNU. Based on the discussions with students and programme coordinators during the audit, the peers are under the impression that the mentioned funds are accessible on a sufficient and reliable basis. To cover extended stays, students are referred to external funding providers such as the Erasmus+ programme, the German Academic Exchange Service (DAAD), the France-focussed Abai-Vern Scholarship, or the Kazakh Academic Shakhmardan Yessenov Science and Education Foundation.

Based on the above, the expert panel sees the criterion as fulfilled.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 6:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

Criterion D 7 Quality Assurance

Evidence:

- Self-Assessment Report
- KazNU Academic Policy

Preliminary assessment and analysis of the peers:

The regulations governing doctoral studies at KazNU comply with the relevant laws and standards of the Republic of Kazakhstan. These include the Law on Education, the Law on Science, the State compulsory standard of postgraduate education, the Rules of awarding degrees, and orders and regulations from the Ministry of Education and Science. These regulations outline the essential requirements and procedures for conducting doctoral degree programmes.

In accordance with the above, doctoral students at KazNU are expected to submit required written material on time, maintain records of feedback from their academic advisors, adhere to prescribed deadlines for report submissions, update their personal information with the university administration, proactively address any arising issues with their advisors and editors, and complete their doctoral dissertations within the stipulated timeframe.

As per the programme coordinators, no major curricular changes have been made to the PhD programme in recent years. However, various formal aspects were declared to have been changed, such as – crucially – the implementation of the European Credit Transfer System (ECTS), as well as procedures pertaining to PhD defence and minor adjustments of awarded credit points to align with revised governmental specifications. Otherwise, the PhD is subject to the cyclical review process outlined in chapter 5.

In conclusion, the expert panel sees the criterion as fulfilled.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 7:

In the absence of further comments or relevant additional evidences from the University, the peers confirm their above preliminary assessment.

E Additional Documents

Before preparing their final assessment, the panel ask that the following missing or unclear information be provided together with the comment of the Higher Education Institution on the previous chapters of this report:

D 1. (ASIIN 1.3, D1, D2) The Faculty is asked to provide the pertinent documents that outline the government-mandated components and limitations of the curricula (e.g. their General Education section, structure of PhD programmes).

D 2. (ASIIN 1.6) The Faculty is asked to provide a written statement of no more than one page on how the imparting of appropriate scientific conduct at all programme levels (Ba / Ma / PhD) is ensured in the curriculum.

D 3. (ASIIN 4.2) The Faculty is asked to provide an example of a Bachelor's Diploma Supplement, as it had not been included in the submitted SAR.

F Comment of the Higher Education Institution (23.05.2023)

The institution provided a thorough written statement as well as the following additional documents:

- Addressing D1: *Scientific-Research Procedure / Experimental-Research Procedure for Master's Level*, issued by the University;
- Addressing D2: *Regulations on the procedure for the development and approval of educational programs of higher and post-secondary education*, issued by the University;
- Addressing D2: *Procedure Of Scientific Research Work for PhD Level*, issued by the University;
- Addressing D3: Diploma Supplement templates for the Ba Cyberphysics and Ba Physics and Nanotechnology (first intake to graduate in 2023).

G Summary: Peer recommendations (30.05.2023)

Taking into account the additional information and the comments given by the University, the peers summarise their analysis and **final assessment** for the award of the seals as follows:

Degree Programme	ASIIN Seal	Maximum duration of accreditation	Subject-specific label	Maximum duration of accreditation
6B05302 Cyberphysics	With requirements for one year	30.09.2028	–	–
6B05305 Physics and Nanotechnology	With requirements for one year	30.09.2028	–	–
7M07120 Nanomaterials and Nanotechnology	With requirements for one year	30.09.2028	–	–
8D07112 Nanomaterials and Nanotechnology	With requirements for one year	30.09.2028	–	–

Requirements

For all degree programmes

A 1. (ASIIN 1.5) Ensure the structured gathering of student feedback on course workload, e.g. through integration of appropriate questions in the summative course evaluation surveys.

A 2. (ASIIN 4.1) Revise all module handbooks thoroughly, particularly in regards to duplicated module descriptions, indicated teaching methods, relation to the curriculum, target semesters, and last amendment dates.

A 3. (ASIIN 4.1) The full, detailed module handbooks must be made accessible publicly to be accessible to all stakeholders, e.g. in PDF format, on the Faculty's website.

For the Bachelor's degree programme in Cyberphysics

A 4. (ASIIN 1.2) The inconsistent use of the English programme title as "C**y**berphysics" / "C**i**berphysics" must be remedied across all relevant platforms and documents.

For the Master's degree programme in Nanomaterials and Nanotechnology

A 5. (ASIIN 1.1) The inconsistent statement of the programme's objectives and learning outcomes on the University's website (here) as compared to the Self-Assessment Report and the Unified System of Management of Higher Education of the Ministry of Education and Science Republic of Kazakhstan (ESUVO) needs to be corrected to ensure that information are identical for all stakeholders across the relevant platforms.

A 6. (ASIIN 1.2) The inconsistent use of the English programme title as Nanomaterials and Nanotechnology" / "Nanomaterials and Nanotechnologies" must be remedied across all relevant platforms and documents.

A 7. (ASIIN 4.2) Revise the issued Diploma Supplement in alignment with the applicable requirements of the European Higher Education Area, at minimum with regards to the student's qualifications profile (programme learning outcomes).

Recommendations

For the Bachelor's degree programme in Cyberphysics

E 1. (ASIIN 1.1) Gather comprehensive summative feedback from the first intake upon their study completion, especially in regards to the possible future introduction of a Master's degree in Cyberphysics.

E 2. (ASIIN 1.1) Graduates from the Ba Cyberphysics should be included in the conceptualisation of the envisaged consecutive Master's programme in due time.

E 3. (ASIIN 1.3) Adjust the curriculum to shift the dedicated mathematics' module (6 ECTS) from the third to an earlier semester.

E 4. (ASIIN 1.3) Change the module "Scientific Research Methods" within the Bachelor's programmes from an elective to a compulsory course.

For the Bachelor's degree programme in Physics and Nanotechnology

E 5. (ASIIN 1.1) Gather comprehensive summative feedback from the first intake upon their study completion as a basis for future programme development.

E 6. (ASIIN 1.3) Adjust the curriculum to shift the dedicated mathematics' module (6 ECTS) from the third to an earlier semester.

E 7. (ASIIN 4.1) Label the curricular sub-sections "General Physics 1 / 2 / 3" in accordance with their equivalent counterparts in the module handbook for the Ba Cyberphysics.
(ASIIN 1.3) Change the module "Scientific Research Methods" within the Bachelor's programmes from an elective to a compulsory course.

H Comment of the Technical Committees 13 Physics / 05 Materials Science, Physical Technologies (12.06.2023)

Technical Committee 05 – Materials Science, Physical Technologies (12.06.2023)

Assessment and analysis for the award of the ASIIN seal:

The Technical Committee discusses the requirements and recommendations proposed by the Expert Panel and follows the evaluation with changes. As described in the report, the sequence of courses in the first semesters is determined by national law and therefore cannot be changed by the university. Due to this fact, the TC suggests to remove E. 3 and E. 6.

The Technical Committee 05 – Materials Science, Physical Technologies recommends the award of the seals as follows:

Degree Programme	**ASIIN Seal**	**Maximum duration of accreditation**	**Subject-specific label**	**Maximum duration of accreditation**
6B05302 Cyberphysics	With requirements for one year	30.09.2028	–	–
6B05305 Physics and Nanotechnology	With requirements for one year	30.09.2028	–	–
7M07120 Nanomaterials and Nanotechnology	With requirements for one year	30.09.2028	–	–
8D07112 Nanomaterials and Nanotechnology	With requirements for one year	30.09.2028	–	–

Technical Committee 13 – Physics (12.06.2023)

Assessment and analysis for the award of the ASIIN seal:

The Technical Committee discusses the procedures and follows the assessment of the auditors without any changes.

The Technical Committee 13 – Physics recommends the award of the seals as follows:

Degree Programme	**ASIIN Seal**	**Maximum duration of accreditation**	**Subject-specific label**	**Maximum duration of accreditation**
6B05302 Cyberphysics	With requirements for one year	30.09.2028	–	–
6B05305 Physics and Nanotechnology	With requirements for one year	30.09.2028	–	–
7M07120 Nanomaterials and Nanotechnology	With requirements for one year	30.09.2028	–	–
8D07112 Nanomaterials and Nanotechnology	With requirements for one year	30.09.2028	–	–

I Decision of the Accreditation Commission (23.06.2023)

Assessment and analysis for the award of the subject-specific ASIIN seal:

The Accreditation Commission discusses the procedures and the changes proposed by the Technical Committee 05. The Commission however judges that the two recommendations in question should be retained to document the academic assessment made by the experts.

The Accreditation Commission decides to award the following seals:

Degree Programme	ASIIN Seal	Maximum duration of accreditation	Subject-specific label	Maximum duration of accreditation
6B05302 Cyberphysics	With requirements for one year	30.09.2028	–	–
6B05305 Physics and Nanotechnology	With requirements for one year	30.09.2028	–	–
7M07120 Nanomaterials and Nanotechnology	With requirements for one year	30.09.2028	–	–
8D07112 Nanomaterials and Nanotechnology	With requirements for one year	30.09.2028	–	–

Requirements

For all degree programmes

A 1. (ASIIN 1.5) Ensure the structured gathering of student feedback on course workload, e.g. through integration of appropriate questions in the summative course evaluation surveys.

A 2. (ASIIN 4.1) Revise all module handbooks thoroughly, particularly in regards to duplicated module descriptions, indicated teaching methods, relation to the curriculum, target semesters, and last amendment dates.

A 3. (ASIIN 4.1) The full, detailed module handbooks must be made accessible publicly to be accessible to all stakeholders, e.g. in PDF format, on the Faculty's website.

For the Bachelor's degree programme in Cyberphysics

A 4. (ASIIN 1.2) The inconsistent use of the English programme title as "C**y**berphysics" / "C**i**berphysics" must be remedied across all relevant platforms and documents.

For the Master's degree programme in Nanomaterials and Nanotechnology

A 5. (ASIIN 1.1) The inconsistent statement of the programme's objectives and learning outcomes on the University's website (here) as compared to the Self-Assessment Report and the Unified System of Management of Higher Education of the Ministry of Education and Science Republic of Kazakhstan (ESUVO) needs to be corrected to ensure that information are identical for all stakeholders across the relevant platforms.

A 6. (ASIIN 1.2) The inconsistent use of the English programme title as Nanomaterials and Nanotechnology" / "Nanomaterials and Nanotechnologies" must be remedied across all relevant platforms and documents.

A 7. (ASIIN 4.2) Revise the issued Diploma Supplement in alignment with the applicable requirements of the European Higher Education Area, at minimum with regards to the student's qualifications profile (programme learning outcomes).

Recommendations

For the Bachelor's degree programme in Cyberphysics

E 1. (ASIIN 1.1) Gather comprehensive summative feedback from the first intake upon their study completion, especially in regards to the possible future introduction of a Master's degree in Cyberphysics.

E 2. (ASIIN 1.1) Graduates from the Ba Cyberphysics should be included in the conceptualisation of the envisaged consecutive Master's programme in due time.

E 3. (ASIIN 1.3) Adjust the curriculum to shift the dedicated mathematics' module (6 ECTS) from the third to an earlier semester.

E 4. (ASIIN 1.3) Change the module "Scientific Research Methods" within the Bachelor's programmes from an elective to a compulsory course.

For the Bachelor's degree programme in Physics and Nanotechnology

E 5. (ASIIN 1.1) Gather comprehensive summative feedback from the first intake upon their study completion as a basis for future programme development.

E 6. (ASIIN 1.3) Adjust the curriculum to shift the dedicated mathematics' module (6 ECTS) from the third to an earlier semester.

E 7. (ASIIN 4.1) Label the curricular sub-sections "General Physics 1 / 2 / 3" in accordance with their equivalent counterparts in the module handbook for the Ba Cyberphysics.

E 8. (ASIIN 1.3) Change the module "Scientific Research Methods" within the Bachelor's programmes from an elective to a compulsory course.

Appendix: Programme Learning Outcomes and Curricula

According to the provided Self-Assessment Report, the University website (accessed 23/04/2023) and the Unified System of Management of Higher Education of the Ministry of Education and Science Republic of Kazakhstan (ESUVO, accessed 23/04/2023), the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the

Ba Cyberphysics

"**Purpose.** To provide high-quality training of specialists in the field of cyberphysics, focused on solving interdisciplinary tasks requiring an integrated and systematic approach in multidisciplinary fields, with knowledge and competencies in demand for work at enterprises and manufacturing companies with a high level of innovation implementation in companies providing innovative consulting services and in research organizations capable of creating high-tech developments based on the junction of the latest achievements of physics and cybernetics.

Programme learning outcomes

ON1 – Perform the laboratory works and experimental research, based on the knowledge of modern tools in the field of physics; process the obtained data; analyze the results and make the conclusions;

ON2 – Perform the analytical calculations within the framework of existing fundamental physical principles and laws, as well as apply them professionally to solve the non-standard problems;

ON3 – Organize the collection, processing, analysis and systematization of scientific and technical information in the framework of the concept of lifelong learning;

ON4 – Conduct a comprehensive analysis of processes and phenomena, based on a deep understanding of the fundamental laws of physics and their applicability;

ON5 – Follow the professional, ethical and environmental standards, based on a critical understanding of the laws of the functioning of the humanitarian and social spheres, taking into account their significance in human life;

ON6 – Select and build the computer models of physical processes and systems, as well as use the visualization tools for the obtained results;

ON7 – Develop and debug the software code at the level of software modules, modify existing modules and packages to solve the application problems;

ON8 – Organize the high-performance calculations, apply modern hardware and artificial intelligence methods to solve non-standard physical problems;

ON9 – Conduct the market analysis of hardware and software complexes and architecture models of modern computing systems and networks;

ON10 – Competently integrate the computing resources into systems of varying degrees of complexity, based on an understanding of the physical processes, occurring in them;

ON11 – Develop strategies for developing of usage of databases for automation and control of physical systems, as well as the real-time decision-making;

ON12 – Use the modern mathematical tools and high-level programming languages to solve the standard and research problems in the field of Cyberphysics."

Ba Physics and Nanotechnology

"**Purpose**. The goal is to prepare competitive specialists, bachelors of physics and nanotechnology, with strong analytical scientific mindset and high level of English language proficiency, capable of carrying out an experimental or theoretical scientific research, teaching and making scientific and technical translations competently; to develop personal qualities in order to work as a team leader of professionals.

Programme learning outcomes

ON1 – Explain physical, chemical and mathematical methods for the study of objects, phenomena and processes for applied and basic research;

ON2 – Apply physico-chemical methods for producing nano-objects and their composites for solving applied problems, as well as methods for describing structures, structures, composition, morphologies;

ON3 – Use fundamental and modern knowledge to solve problems related to identifying the relationship between the structure and properties of macro- and micro-objects;

ON4 – Interpretation modern scientific concepts and theories within the research context in the field of physics and nanomaterials to analyze the results of scientific research;

ON5 – Identify the similarities and differences of world and Kazakhstani science in the field of innovative technology in order to create new functional nanomaterials;

ON6 – Apply modern information technologies to search, store, process and transfer the necessary new scientific and innovative form of activity for experimental and theoretical research to develop and improve methods for the synthesis of nanostructured composite materials using plasma chemical technologies;

ON7 – To practice professional skills in scientific and technological activities to solve problems in interdisciplinary fields of physics and nanotechnology;

ON8 – Conduct laboratory experiments, as well as analytical and numerical calculations for physical research;

ON9 – To critically evaluate modern scientific concepts and theories in the field of physics and nanotechnology to determine the object and subject of independent research;

ON10 – Select the appropriate equipment, tools and research methods in accordance with their advantages and disadvantages and apply them to solve problems in a specific subject area;

ON11 – Apply fundamental physical laws to solve industrial, technical and everyday problems,

ON12 – To work as part of an interdisciplinary team, tolerantly perceiving ethnic, religious, social and cultural differences; to form civil and ideological positions; improve social, linguistic and physical training to ensure full compliance with the needs of the professions and society.“

Ma Nanomaterials and Nanotechnology

“**Purpose.** Provide preparation of specialists with sufficient knowledge and qualities of engineering technologists, researchers and investigators to conduct scientific and technical works in the field of nanotechnology and creation of nanomaterials with specified properties, using the knowledge of elective directions on synthesis of nanomaterials by physical and chemical methods, also analysis of properties of nanomaterials by modern methods of spectroscopy and microscopy.

Programme learning outcomes

ON1 – Able to show knowledge and understanding of conceptual, theoretical and practical methods for the synthesis of nanomaterials for specific scientific-technical and scientific-pedagogical tasks in the field of nanomaterials and nanotechnology.

ON2 – Use physical and chemical methods of obtaining nanoobjects and their composites for solving applied problems, as well as methods for describing the structures, structures,

composition, morphology and other properties of nanomaterials based on electron and probe microscopy and modern spectroscopy methods.

ON3 – Use fundamental and modern knowledge in related fields of nanomaterials and nanotechnology in the field of nanostructured education.

ON4 – Interpret modern scientific concepts and theories within the research context in the field of nanomaterials and nanotechnology to analyze the results of scientific research and educational work.

ON5 – To identify similarities and differences between the world and Kazakhstan science in the field of innovative technology in order to create new functional nanomaterials.

ON6 – Apply modern information technologies for search, storage, processing and transfer of a necessary new scientific and innovative form of activity for experimental and theoretical research for development and improvement of methods of synthesis of nanostructured composite materials by means of plasma chemical technology.

ON7 – Practice professional skills in scientific-technical and scientific-pedagogical activity for solving problems in interdisciplinary fields of nanotechnology.

ON8 – Draw conclusions on the results of the study, to make independent decisions in solving problems of obtaining nanomaterials with specified properties on the basis of the knowledge and to justify them.

ON9 – Critically evaluate modern scientific concepts and theories in the field of nanomaterials and nanotechnology to determine the object and subject of independent research.

ON10 – Develop research algorithms for obtaining and modifying nanostructured composite particles.

ON11 – Generate new ideas and knowledge by conducting original scientific theoretical and experimental research in related fields of nanomaterials and nanotechnology, the results of which are presented in the abstracted publications.

ON12 – Analyze the priorities of educational and research activities for decision-making and participation in their implementation, the manifestation of the conjugation of personal interests with the needs of society, to be able to report on the results of research in the scientific community at international conferences, to protect and defend their point of view.“

PhD Nanomaterials and Nanotechnology

"**Purpose**. The program is aimed at training highly qualified scientific and scientific-pedagogical staff, who able to: conduct fundamental, applied and innovative research in the field of obtaining nanomaterials and nanotechnology; develop new directions of nanomaterials and nanotechnology in the field of physics, chemistry, biology and medicine; commercialize the results of research and development work

Programme learning outcomes

ON1 – Develop methods of obtaining nanostructured and semiconductor materials based on plasma technologies and chemical synthesis

ON2 – Conduct experimental investigations using x ray diffraction analysis and optical microscopy and electrical research methods to obtain a description of the characteristics of nanomaterials

ON3 – Make theoretical estimates of the characteristics of nanomaterials using computer and numerical modeling methods

ON4 – Supervise design and engineering works aimed at creating new electronic devices, circuits and devices for various functional purposes based on nanomaterials

ON5 – Commercialization of research and development results through participation in competitions

ON6 – Improve the properties of nanocomposite materials and drugs using modern plasma technology and nanotechnology, including bionanotechnology

ON7 – Organize research activities in the field of nanomaterials, bio- and nanotechnology, using new methods of analysis and production technologies, taking into account economic and environmental efficiency

ON8 – Development of scientific and methodical manuals on the results of scientific research in the field of bio-/ nanotechnology and nanomaterials for their implementation in the educational process

ON9 – Analyze and evaluate the results of innovative activities, modern theories, problems and approaches, new trends in the engineering of innovative nanomaterials

ON10 – Maintain and diagnose scientific and technical equipment in the field of bio-/ nanotechnology and nanomaterials, make recommendations to improve the parameters and characteristics of the measurement system

ON11 – Make an expert conclusion of new nanomaterials and bio-/ nanotechnology, scientific projects and scientific articles in the field of nanotechnology and nanomaterials,

published in peer- reviewed journals included in international databases (Scopus, Clarivate Analytics)

ON12 – Ability to communicate effectively within the scientific community through an academic foreign language, using modern methods and technologies of scientific communication, willingness to participate in research activities at the international level to solve scientific and scientific-educational problems, development of strategies of scientific research in the field of nanomaterials and nanotechnology, including bionanotechnology.“

The following **curricula** are presented:

Ba Cyberphysics

GENERAL EDUCATION DISCIPLINES		CORE DISCIPLINES		MAJOR DISCIPLINES	
OBLIGATORY COMPONENT	ELECTIVE COMPONENT	UNIVERSITY COMPONENT	ELECTIVE COMPONENT	UNIVERSITY COMPONENT	ELECTIVE COMPONENT
51	5	94	18	36	24
56		**112**		**60**	

TERM

1	Module of social and cultural development & Instrumental module & Module Physical Training 25 ECTS			Module of mechanics and molecular physics 9 ECTS	34
2	Instrumental module & Module Physical Training 12 ECTS	Elective component **(1 of 6)** 5 ECTS		Module of mechanics and molecular physics 9 ECTS	26
3	Instrumental module & Module Physical Training 7 ECTS	Module of mathematical analysis bases and methods of computer physics & Optics, Electricity and magnetism module & Module of computational physics 24 ECTS			31
4	Module of social and cultural development & Module Physical Training 7 ECTS	Module of mathematical analysis bases and methods of computer physics & Optics, Electricity and magnetism module & Module of computational physics 22 ECTS			29

5	Module of Atomic and Nuclear Physics 6 ECTS	Module of Cyberphysics Methods / Module of physical and technical basics **(1 of 2)** 6 ECTS	Module of Module of Research Methodologies in Cyberphysics 18 ECTS	30
6	Module of Atomic and Nuclear Physics 9 ECTS	Module of Cyberphysics Methods / Module of physical and technical basics **(1 of 2)** 12 ECTS	Module of Module of Research Methodologies in Cyberphysics 9 ECTS	30
7	Module of modern plasma technologies 6 ECTS	Module of Internet of Things and intelligent analysis 6 ECTS	CyberPhysical and Nonlinear Systems Module / Module of Applied physical and technical solutions (1 of 2) 24 ECTS	36
8	Module of Atomic and Nuclear Physics 9 ECTS	Module of Internet of Things and intelligent analysis 3 ECTS	**FINAL ATTESTATION** 12 ECTS	24

Ba Physics and Nanotechnology

Course structure

GENERAL EDUCATION DISCIPLINES		CORE DISCIPLINES		MAJOR DISCIPLINES	
OBLIGATORY COMPONENT	ELECTIVE COMPONENT	UNIVERSITY COMPONENT	ELECTIVE COMPONENT	UNIVERSITY COMPONENT	ELECTIVE COMPONENT
51	5	94	18	36	24
56		**112**		**60**	

TERM					
1	Module of social and cultural development & Instrumental module & Module Physical Training 25 ECTS			General physics 1 9 ECTS	34
2	Instrumental module & Module Physical Training 12 ECTS	Elective component **(1 of 6)** 5 ECTS		General physics 1 9 ECTS	26
3	Instrumental & Physical Training 7 ECTS	Mathematics and theoretical Physics & General physics 2 & Computational physics 24 ECTS			31
4	Social and cultural dev. & Physical Training 7 ECTS	Mathematics and theoretical Physics & General physics 2 & Computational physics 22 ECTS			29
5	General physics 3 6 ECTS	Atomic and nano. physics / Phys. basics of instrument. **(1 of 2)** 6 ECTS	Plasma technologies and biotechnology 18 ECTS		30
6	General physics 3 9 ECTS	Atomic and nanomaterials physics / Physical basics of instrumentation **(1 of 2)** 12 ECTS	Plasma technologies and biotechnology 9 ECTS		30
7	Chemical basics of nanotech. 6 ECTS	Applied engineering calculations 6 ECTS	Nanotechnologies and power plants / Intelligent systems and electronics **(1 of 2)** **(1 of 2)** 24 ECTS		36
8	Chemical basics of nanotechnology 9 ECTS	App. engin. Calc. 3 ECTS	**FINAL ATTESTATION** 12 ECTS		24

Ma Nanomaterials and Nanotechnology

Course structure

RESEARCH	CORE DISCIPLINES		MAJOR DISCIPLINES	
UNIV. COMP.	UNIVERSITY COMPONENT	ELECTIVE COMPONENT	UNIVERSITY COMPONENT	ELECTIVE COMPONENT
24	20	15	31	18
24	**35**		**49**	

TERM					
1	History and phil. of science & Psychology and Pedagogy 6 ECTS	Nanotechnology in electronics & Structure and electronic properties of nanomaterials **(1 of 2)** 6 ECTS	Plasma methods in nanotechnology 12 ECTS	**RESEARCH** Research Seminar; Dissertation Writing 3 ECTS	27
2	History and philosophy of science & Psychology and Pedagogy 14 ECTS	Nanotechnology in electronics & Structure and electronic properties of nanomaterials **(1 of 2)** 9 ECTS	Plasma methods in nanotechnology 6 ECTS	**RESEARCH** Research Seminar; Dissertation Writing 4 ECTS	33
3	Theoretical basis of nanotechnology 13 ECTS	Nanocarbon composite materials in construction & Research methods and prospects for the use of nanomaterials & Obtaining technology of nanosize materials **(1 of 3)** 18 ECTS		**RESEARCH** Dissertation Writing 2 ECTS	33
4	**RESEARCH** Research Seminar; Dissertation Writing; Scientific Internship; Publication in the Proceedings of International Conferences 15 ECTS		**FINAL ATTESTATION** 12 ECTS		27

PhD Nanomaterials and Nanotechnology

Course structure

RESEARCH			CORE DISCIPLINES		MAJOR DISCIPLINES	
UNIV. COMP.	RESEARCH SEMINAR	DOCTORAL THESIS	UNIVERSITY COMPONENT	ELECTIVE COMPONENT	UNIVERSITY COMPONENT	ELECTIVE COMPONENT
49	21	53	15	5	20	5
123			**20**		**25**	

TERM							
1	Scientific-Research tools 5 ECTS	Elective component **(1 of 4)** 5 ECTS	Physical and chemical bases of nanotechnology 10 ECTS	Elective component **(1 of 7)** 5 ECTS	Res. Sem. 3 ECTS	Doc. Thes. 3 ECTS	31
2	Scientific-Research tools 10 ECTS	RS 2	Doctoral Thesis 11 ECTS	Graduate Seminar 6 ECTS			29
3	Research Practice 5 ECTS	Research Seminar 8 ECTS	Doctoral Thesis 14 ECTS	Sci. Conf. 3 ECTS			30
4	Research Practice 5 ECTS	Research Seminar 4 ECTS	Doctoral Thesis 15 ECTS	Graduate Seminar 6 ECTS			30
5	Res. Sem. 3 ECTS	Doctoral Thesis 8 ECTS	Graduate Seminar (6 ECTS) Scientific conferences (Participation) (3 ECTS) Scientific Internship (10 ECTS) 19 ECTS				30
6	RS 1	DT 2	Publication of the main scientific results of the dissertation in scientific journals 15 ECTS	FINAL ATTESTATION 12 ECTS			30