

*Annex to Resolution No 614 of the Senate
of the University of Lodz
dated 18.12.2023*

**CURRICULUM
OF THE UNIVERSITY OF LODZ DOCTORAL SCHOOL OF EXACT AND
NATURAL SCIENCES
FOR THE ACADEMIC YEAR 2024/25**

**University of Lodz
Lodz 2023**

1. NAME OF THE DOCTORAL SCHOOL

University of Lodz Doctoral School of Exact and Natural Sciences

1. A CONCISE DESCRIPTION OF THE DOCTORAL SCHOOL WITH A STATEMENT OF LEARNING OBJECTIVES

University of Lodz Doctoral School of Exact and Natural Sciences, hereafter referred to as the Doctoral School, is an important contribution to the process of enhancing the quality of advanced academic education in the disciplines of mathematics, informatics, biological sciences, chemical sciences, physical sciences, earth and environmental sciences. The primary purpose of the Doctoral School is to provide doctoral students with optimal conditions for research and scholarly development. The curriculum gives the doctoral student the opportunity to acquire skills at an advanced level in the scope relating not only to the process of carrying out a doctoral dissertation, but also including professional training (strengthening the research workshop and improving skills in the field of teaching) and personal development (transversal competences, including creative skills, problem solving, active career planning as well as teamwork and entrepreneurship). These skills are necessary not only for successful completion of training in the Doctoral School, but also for career advancement.

The aim of the training is to broaden and deepen the knowledge of doctoral students in their chosen scientific discipline in an interdisciplinary environment that enables them to place the competencies related to a given scientific discipline in a broader context. The knowledge and competencies developed during individualized education will prepare the doctoral student to independently plan, design, and conduct research as part of an individual research plan. Doctoral students who complete their training at the Doctoral School will be prepared to critically evaluate the results of their research, which form the basis of scientific publications, as well as to present their findings to the international scientific community. The aim of the course is to prepare a doctoral student for teaching at the university level, where he/she can combine the acquired scientific knowledge with the use of the latest teaching methods. Graduates of the Doctoral School will acquire competencies that will enable them to engage in individual and team research, especially interdisciplinary research, conducted in national and international research teams, which will result in the responsible transfer of acquired knowledge and research results to the entities of the socio-economic environment.

2. INDICATION OF THE DEGREE EARNED BY THE GRADUATE

Upon completion of the University of Lodz Doctoral School of Exact and Natural Sciences and defense of the dissertation, the graduate receives the degree: (1) doctor of exact and natural sciences in the discipline of mathematics or (2) doctor of exact and natural sciences in the discipline of informatics or (3) doctor of exact and natural sciences in the discipline of biological sciences or (4) doctor of exact and natural sciences in the discipline of chemical sciences or (5) doctor of exact and natural sciences in the discipline of physical sciences or (6) a doctor in science in the discipline of the Earth and environmental sciences.

3. IDENTIFY THE PREREQUISITES, EXPECTED COMPETENCIES OF THE CANDIDATE EXPRESSED IN THE MANNER OF LEARNING OUTCOMES

Candidate:

- summarizes issues in the field of mathematics, informatics, biological, chemical, physical sciences or sciences about the Earth and the environment on the 7th level of the Polish Qualifications Framework;
- precisely formulates and exhaustively expresses thoughts and judgments about the conducted scientific research, using specialized terminology;
- characterizes and uses basic techniques and tools used in the study of the chosen discipline;
- describes the principles of research ethics, particularly respect for the work of others;
- demonstrates knowledge of a foreign language to study the world literature in the leading scientific discipline and planned personal research.
- is self-motivated, justifies the need to continually expand knowledge and implement new methods in scientific research.

4. INDICATION OF THE FIELDS AND DISCIPLINES TO WHICH THE LEARNING OUTCOMES REFER

The field of exact and natural sciences;

Disciplines: Mathematics; Informatics; Biological Sciences; Chemical Sciences; Physical Sciences; Earth and Environmental Sciences.

5. DETERMINING THE LEARNING OUTCOMES FOR THE UNIVERSITY OF LODZ DOCTORAL SCHOOL OF EXACT AND NATURAL SCIENCES, CORRESPONDING TO THE CHARACTERISTICS OF THE SECOND STAGE AT LEVEL 8 OF THE POLISH QUALIFICATIONS FRAMEWORK

Completion of the educational programme and the individual research plan, including the submission of a doctoral dissertation, lead to the achievement of the learning outcomes for the qualification at level 8 of the Polish Qualifications Framework (PRK).

Explanation of symbol designations: NSiP – learning outcomes specific for the University of Lodz Doctoral School of Exact and Natural Sciences. Then, an underscore is followed by symbol letter of effect category (W – the knowledge category, U – the skills category, K – the competence category) and two digits indicating the number of learning outcome. The code designations of the PRK description component are in accordance with the Annex to the Regulation of the Ministry of Science and Higher Education of 14 November 2018. (Dz. U. of 2018, item 2218): P8S = level 8, characteristics typical of higher education qualifications: WG = knowledge – depth and breadth, WK = knowledge – context, UW = skills – use of knowledge, UK = skills – communication, UO = skills – work organisation, UU = skills – learning, KK = social competence – evaluation (critical), KO = social competence – responsibility, KR = social competence – professional role

| Code | Learning outcomes | PRK code level 8 |
|----------|--|------------------|
| | KNOWLEDGE The graduate knows and understands: | |
| NSiP_W01 | theoretical basis, general issues and selected detailed issues of world achievements in the field of the discipline selected from among the following disciplines: mathematics; informatics; biological sciences; chemical sciences; physical sciences; Earth and environmental sciences, to the extent allowing to revise the existing concepts | P8S_WG |

| | | |
|------------------------------|--|--------|
| | and theories; | |
| NSiP_W02 | major discipline trends selected from mathematics, informatics, biological sciences, chemical sciences physical sciences or Earth and environmental sciences and other disciplines relevant to interdisciplinary research; | P8S_WG |
| NSiP_W03 | methodology and principles of planning advanced scientific research appropriate to the discipline chosen from among the disciplines of: mathematics; informatics; biological sciences; chemical sciences; physical sciences; earth and environmental sciences; | P8S_WG |
| NSiP_W04 | Economic, legal, ethical and other determinants of scientific activity | P8S_WK |
| NSiP_W05 | principles of financing scientific research, preparing and carrying out research projects including in international teams, knows sources of their financing and procedures of competition; | P8S_WK |
| NSiP_W06 | principles and methods for the preparation and evaluation of scientific publications and research projects in accordance with the principle of functioning of open science; | P8S_WK |
| NSiP_W07 | principles of commercialization of research results and transfer of knowledge to practical applications; | P8S_WK |
| NSiP_W08 | modern, innovative methods, concepts and tools for teaching and popularization of science in a discipline selected from among the following disciplines: mathematics; informatics; biological sciences; chemical sciences; physical sciences; earth and environmental sciences; | P8S_WK |
| SKILLS | | |
| The graduate can: | | |
| NSiP_U01 | use knowledge from different fields of science to creatively identify, formulate and innovatively solve complex problems or perform tasks of research, interdisciplinary, in particular: defines the purpose and subject of research, formulates a research hypothesis; develops methods, techniques and research tools and creatively applies them and makes inferences based on research findings; | P8S_UW |
| NSiP_U02 | make a critical analysis and evaluation of the results of research, expert activities and other works of a creative nature and their contribution to the development of science; | P8S_UW |
| NSiP_U03 | evaluate the possibility of transferring the results of research work to the economic and social sphere and initiate actions to achieve such transfer; | P8S_UW |
| NSiP_U04 | disseminate research results, mainly in the form of original scientific publications, as well as in popular science forms; | P8S_UK |
| NSiP_U05 | initiate debate and participate in scientific discussion, including in an international environment; | P8S_UK |
| NSiP_U06 | speak a foreign language to the extent necessary to participate in the international scientific community, in particular through participation in conferences, seminars, workshops, scientific expeditions or internships abroad; | P8S_UK |
| NSiP_U07 | prepare an application for funding of a research project; | P8S_UO |
| NSiP_U08 | plan and carry out individual and team research projects, also in an international environment; | P8S_UO |
| NSiP_U09 | act for their own development and inspire and organize the development of others, among others, during teaching activities and activities related to the dissemination of knowledge; | P8S_UU |
| NSiP_U10 | develop and implement teaching activities using modern, innovative methods and tools | P8S_UU |
| SOCIAL COMPETENCES | | |
| The graduate is prepared to: | | |
| NSiP_K01 | critically evaluate achievements in a scientific discipline chosen from among the disciplines of mathematics, informatics, biological sciences, chemical sciences, physical sciences, or | P8S_KK |

| | | |
|----------|--|--------|
| | earth and environmental sciences, and one's own contributions to the development of these disciplines; | |
| NSiP_K02 | recognition of the importance of knowledge in solving cognitive and practical problems, including those of an interdisciplinary nature; | P8S_KK |
| NSiP_K03 | fulfil the social obligations of researchers, providing the society with information and opinions resulting from the achievements of science in the field of a scientific discipline selected from the following disciplines: mathematics, biological sciences, chemical sciences, physical sciences or Earth and environmental sciences, and engaging in the education of specialists and undertaking activities leading to development of knowledge-based civil society; | P8S_KO |
| NSiP_K04 | think and act in an entrepreneurial way, create new ideas and seek innovative solutions, undertake intellectual challenges in the academic and public sphere and bear responsibility for the consequences of their decisions; | P8S_KO |
| NSiP_K05 | conduct research in an independent manner; | P8S_KR |
| NSiP_K06 | respect the principle of public ownership of research results with respect to the legal principles of intellectual property protection. | P8S_KR |

6. FRAMEWORK CURRICULUM PLAN AT THE DOCTORAL SCHOOL

The outline of study programme at the Doctoral School includes: compulsory courses, compulsory elective courses and optional courses. A doctoral student pursues an individual educational path according to the rules defined in the educational framework plan, which consists of: obligatory courses, elective courses chosen by the doctoral student, optional courses and teaching practice.

In addition to passing mandatory, mandatory elective, and optional classes, a doctoral student is required to:

- pursue an individual research plan and prepare a dissertation,
- twice during the course of studying (semesters IV and VI) present the results of their own research in an open seminar of the doctoral school,
- at least twice during the course of education present the results of own research in the form of a poster or an oral presentation in a foreign language at a scientific conference,
- receive at least one multi-day specialized training related to the implementation of the individual research plan.

Classes are conducted in Polish or English. The curriculum of the Doctoral School enables a doctoral student who is a non-Polish speaker to fulfil the program requirements.

| Type of classes | Total hours | Form of classes | Number of hours per year | | | |
|---|-------------|---------------------|--------------------------|----|-----|----|
| OBLIGATORY CLASSES | | | | | | |
| | | | I | II | III | IV |
| Doctoral seminar 1 – tutorial with doctoral supervisor | 80 | seminar | 20 | 20 | 20 | 20 |
| Doctoral seminar 2 – research seminar* | 80 | seminar | 20 | 20 | 20 | 20 |
| Higher education didactics 1** | 8 | lecture | 8 | - | - | - |
| Higher education didactics 2 | 12 | specialized classes | 12 | - | - | - |
| Ethical and legal aspects of scientific research ** | 12 | tutorial | 12 | - | - | - |
| Methodology of mathematics, informatics, biological, chemical, physical or earth and environmental sciences with elements of ethics | 8 | specialized classes | 8 | - | - | - |

| | | | | | | |
|---|--|---|----|----|----|---|
| Science funding and knowledge transfer 1** | 8 | lecture | 8 | - | - | - |
| Science funding and knowledge transfer 2 | 12 | specialized classes | 12 | | | |
| An introduction to effective publishing | 12 | specialized classes | 12 | - | - | - |
| Public speaking techniques | 12 | specialized classes | 12 | - | - | - |
| Teaching practice | 60 | independently conducting classes or participating in their conducting | - | 30 | 30 | - |
| ELECTIVE CLASSES | | | | | | |
| MODULE 1: Scientist's workshop | 36 | specialized classes | - | 36 | | - |
| MODULE 2: Specialized classes | A doctoral student takes a total of at least 36 hours of elective courses and selects at least 1 course from each module | | | | | |
| MODULE 3: Classes developing personal and social competencies | 24 | specialized classes | 24 | - | - | - |
| | A doctoral student completes at least 24 hours of elective courses | | | | | |
| OPTIONAL ACTIVITIES | | | | | | |
| Classes from the offer of doctoral schools at the University of Lodz or classes offered by the university or outside the University of Lodz | 14 | lecture workshops tutorial specialized classes | 14 | | | - |
| | A doctoral student completes at least 14 hours | | | | | |
| Minimum total hours | 378 | | | | | |
| | Including: Mandatory Classes: 244 hrs, Elective classes: 74 hrs. Teaching Practice: 60 hrs. | | | | | |

* These classes may be implemented in the form of a seminar with the a (not more than 10 hours/year), but mainly, after agreement with the doctoral supervisor, in the form of specialized seminars, workshops or doctoral supervisor other specialists from the country or abroad. The seminar is a discussion forum aimed at the exchange of research experience, analysis of methodological problems and research results in interdisciplinary research teams. It enables doctoral students to consult their own research projects with researchers from outside their home unit and to improve their communication in the area of science and life sciences to a degree that enables the doctoral student to actively participate in the international scientific community. The course includes an open doctoral school seminar (semesters IV and VI). All meetings must be documented on the course card that the doctoral student receives in the first month of training.

** Courses common for all doctoral schools at UŁ, conducted in Polish or English.

7. DESCRIPTION OF THE SUBJECTS OR MODULES OF THE LEARNING PROCESS

Descriptions of all courses as required by the Doctoral School are available prior to the start of classes in USOS.

Item description includes:

- the status of the course (belonging to a group of compulsory classes or a module of compulsory elective classes);
- number of hours and form of classes;
- language of instruction;
- assumed learning outcomes;
- the learning content leading to the achievement of the expected learning outcomes;
- the form of verification of the assumed learning outcomes.

Module 1: Scientist's workshop

The module includes workshop and methodological activities that develop professional competencies and practical skills, including: Academic English, writing scientific publications, tools for organizing scientific work, methods for analysing data in scientific research. Course offerings updated for each academic year.

Module 2: Specialized classes

The module includes specialized classes in the disciplines represented in the doctoral school and interdisciplinary courses. A doctoral student selects classes from the discipline in which he/she is pursuing a doctoral dissertation, from the field of exact and natural sciences, or interdisciplinary classes after consultation with the doctoral supervisor, as needed to fulfil an individual research plan. List of courses updated for each academic year.

Module 3: Classes developing personal and social competencies

Classes improving in particular communication and interpersonal skills, scientific career planning and personal development, working and managing a research team, including in an international scientific environment, and developing creativity, analytical and conceptual thinking skills. Sample Courses: Career Coaching, Voice Emission, Workshops on creativity and innovation, Workshops on IT tools and gamification, Intercultural competence. List of courses updated for each academic year.

Optional classes

The doctoral student chooses a min. 14 hrs. from the offerings of all UL doctoral schools, individual departments, university-wide classes, or classes from outside the UL. The choice of the type of optional classes is made in consultation with the doctoral supervisor. These classes must serve to broaden knowledge or develop competencies necessary for the doctoral student's academic work.

8. IDENTIFY THE RELATIONSHIP BETWEEN THE LEARNING OUTCOMES REFERRED TO IN PARA. 6 AND THE LEARNING OUTCOMES DEFINED FOR PARTICULAR SUBJECTS OR MODULES OF THE EDUCATION PROCESS

The learning outcomes defined in para. 6 of this document are consistent with the learning outcomes of the individual modules and subjects included in the educational plan.

The table specifying the relationship between the learning outcomes defined for the programme of study in the doctoral school and the learning outcomes defined for individual subjects or modules of the process of study can be found in **Annex 1**.

9. DESCRIPTION OF HOW THE LEARNING OUTCOMES OF THE PROGRAMME ARE VERIFIED WITH REFERENCE TO SPECIFIC SUBJECTS OR MODULES OF THE LEARNING PROCESS

Learning outcomes at the University of Lodz Doctoral School of Exact and Natural Sciences are achieved through the completion of compulsory courses, compulsory elective and optional courses included in the curriculum, teaching practice, and the completion of an individual research plan and dissertation.

Each course has assigned learning outcomes in terms of knowledge, skills and social competences, as well as indicated program content and credit requirements. The learning outcomes of individual courses are correlated with the learning outcomes for the entire course of study in the doctoral school.

Verification of learning outcomes is accomplished by:

- oral and written examinations, practical tests, evaluation tests, public presentation of test results, analysis of protocols of visitation by the course instructors and the course coordinator; detailed information on the form of course completion and on the achievement of the subject learning outcomes and curriculum content is available in the USOS system;
- analysis of information on the progress in scientific and research work, including the implementation of the individual research plan, commitment to teaching and the acquisition of social competencies, provided by the doctoral student in writing at the end of each academic year, reviewed by the doctoral supervisor and the director of the doctoral school;
- mid-term evaluation.

Classes in doctoral school are billed on an annual basis. In order to pass a year, a student must obtain credit for all courses prescribed in the educational plan for a given year, according to the choice made by the doctoral student.

10. POSSIBLE TIMETABLE FOR VISITING LECTURERS

There is no permanent timetable for visiting lecturers. Doctoral students have the opportunity to participate in classes conducted by scientists from abroad, including those employed by the University of Lodz as visiting professors. Offerings for the academic year depend on the schedule of visiting scholars from abroad.

11. DETERMINING THE SIZE, RULES AND FORMS OF THE TEACHING PRACTICE

Participants in the Doctoral School are required to complete a teaching practicum in the form of teaching in accordance with their doctoral discipline or participating in the teaching of 60 total teaching hours during the course of training. Doctoral students complete teaching internships in the second and third year. Classes taught by doctoral students are subject to visitation once a year.

Annex 1.

| Subject/Module | Reference to the learning outcomes for | | |
|---|--|--|--|
| | knowledge | skills | social competence |
| Doctoral seminar 1 -tutorial with doctoral supervisor | NSiP_W01 NSiP_W02 NSiP_W03 NSiP_W04 NSiP_W05 NSiP_W06 | NSiP_U01 NSiP_U02 NSiP_U03 NSiP_U04 NSiP_U05 NSiP_U06 NSiP_U07 NSiP_U08 | NSiP_K01 NSiP_K02 NSiP_K03 NSiP_K04 NSiP_K05 |
| Doctoral seminar 2 – research seminar | NSiP_W01 NSiP_W02 NSiP_W03 NSiP_W04 | NSiP_U01 NSiP_U02 NSiP_U05 NSiP_U06 NSiP_U08 | NSiP_K01 NSiP_K02 NSiP_K03 NSiP_K04 NSiP_K06 |
| Higher education didactics 1 | NSiP_W08 | NSiP_U04 NSiP_U09 NSiP_U10 | NSiP_K03 NSiP_K04 NSiP_K06 |
| Higher education didactics 2 | NSiP_W08 | NSiP_U10 | NSiP_K06 |
| Ethical and legal aspects of scientific research | NSiP_W04 NSiP_W06 NSiP_W07 | NSiP_U02 NSiP_U03 | NSiP_K01 NSiP_K03 NSiP_K04 NSiP_K06 |
| Methodology of mathematics, informatics, biological, chemical, physical or earth and environmental sciences with elements of ethics | NSiP_W03 NSiP_W04 | NSiP_U01 NSiP_U08 | NSiP_K02 NSiP_K05 NSiP_K06 |
| Science funding and knowledge transfer 1 | NSiP_W04 NSiP_W05 NSiP_W06 NSiP_W07 | NSiP_U03 NSiP_U07 NSiP_U08 NSiP_U09 | NSiP_K04 |
| Science funding and knowledge transfer 2 | NSiP_W04 NSiP_W05 NSiP_W06 NSiP_W07 | NSiP_U03 NSiP_U07 NSiP_U08 | NSiP_K04 NSiP_K06 |
| An introduction to effective publishing | NSiP_W04 NSiP_W06 | NSiP_U02 NSiP_U04 | NSiP_K01 NSiP_K06 |
| Public speaking techniques | NSiP_W08 | NSiP_U05 NSiP_U09 | NSiP_K03 NSiP_K06 |
| Teaching practice | NSiP_W08 | NSiP_U09 NSiP_U10 | NSiP_K03 NSiP_K06 |
| MODULE 1: Scientist’s workshop | NSiP_W03 | NSiP_U01 NSiP_U02 NSiP_U04 NSiP_U09 | NSiP_K03 NSiP_K06 |
| MODULE 2: Specialized classes | NSiP_W01 NSiP_W02 | NSiP_U01 NSiP_U02 | NSiP_K02 NSiP_K04 |
| MODULE 3: Classes developing personal and social competencies | NSiP_W04 | NSiP_U04 NSiP_U09 | NSiP_K03 NSiP_K04 |
| Optional classes | NSiP_W01 NSiP_W02 | NSiP_U02 | NSiP_K04 |