# The programme of study (PRK) at the Doctoral School of Exact and Natural Sciences

The programme of study assumes that each PhD student will have an opportunity to follow a complete learning pathway in English.

The duration of the programme is eight semesters.

## I General university classes for all PhD students

| No. | Name | Number of compulsory hours | Number of voluntary hours | Semester | PRK |
|---|---|---|---|---|---|
| 1. | Higher education didactics | 20 | | I | UK_1, UK_2, UK_3, UU_1, UU_2 |
| | Higher education didactics | | 10 | I or II | |
| 2. | Ethics | 8 | | I | WG_2, KO_1, KO_2, KR_1 |
| 3. | Copyright | 4 | 4 | I | WK_4, WG_2, KO_2, KR_1 |
| 4. | Knowledge transfer (scholar's workshop) | 4 | | III | WG_2, WG_3, UW_3, UK_2, KK_3, KO_1, KO_2, KO_3 |
| 5. | Acquisition of grants (scholar's workshop) | 6+2 | | II or III or IV | WK_3, WK_4, UW_2, UK_4, UO_1, UU_1, KK_2 |
| 6. | Public speaking (scholar's workshop) | | 8 (4+4) | II or III | UK_1, UK_5 |

## *Description of the subjects:*

1. **Higher Education Didactics (20 hours – I semester, 10 voluntary hours – I or II semester))**
   Classes aimed at increasing the knowledge and skills of PhD students in the area of planning pedagogical work, analysing and assessing the course of educational processes, as well as determining and assessing their effects. The discussion will encompass issues concerning the correctness and conditions of the teaching-learning process.

2. **Ethics (8 hours, I semester)**
   The lecture presents the main issues related to academic ethics, with account being taken of its role in contemporary moral thinking. The material content of the lecture will encompass the analysis of basic concepts and methods used in this area, as well as the presentation of the great normative theories. The classes will feature discussions of concrete examples of applying ethical principles in practice.

3. **Copyright (4 hours, I semester and 4 voluntary hours, I semester)**

Providing the PhD students with the fundamental knowledge on copyright and neighbouring rights with reference to research and didactic activities. As a result, the PhD student will acquire knowledge on plagiarism and the rules of properly using other people's achievements.

4. **Knowledge transfer (scholar's workshop) – 4 hours, III semester)**
   Classes that develop the knowledge sharing skills. Their aim is to become familiar with the possibilities of knowledge transfer from a higher education institution to enterprises, public institutions and non-governmental organisations. The "know-how" is unique and specific for a given organisation (e.g. a higher education institution). The "know what", on the other hand, includes definitions of concepts, descriptions and professional terminology. The transferring methods may differ depending on the nature of the knowledge to be transferred and its recipients.

5. **Acquisition of grants (scholar's workshop) – 6 + 2 hours, II or III or IV semester**
   The aim of the classes is to provide the PhD students with knowledge on the principles of constructing research projects financed from external sources. The PhD students will acquire the skill of effectively drafting grant applications, which will increase the percentage of positively examined applications. Six hours of the classes will be dedicated to the principles of applying for grants and two hours to how they should be settled.

6. **Public speaking (scholar's workshop) – 8 voluntary hours, II or III semester (4 hours in Polish, 4 hours in English)**
   The classes aim at increasing the skills of PhD students in the area of public speaking by teaching them the principles and good practices that should accompany the preparation and delivery of speeches. The PhD student will become familiar with the theory and practice of effective public speaking.

## II Classes organised by the school for all PhD students

| No. | Name | Number of compulsory hours | Number of voluntary hours | Semester | PRK |
|---|---|---|---|---|---|
| 1. | Methodical workshop (group) | 4 | 4 | I or II | WG.2, WG.3, WG.4, UW.3, UK.2, UK.3, UU.1, UU.2, KO.1, KO.2, KR.1 |
| 2. | Methodical workshop (individual as part of internship) | 4 | 4 | I or II or III | |
| 3. | **Publishing strategy in a discipline/field (scholar's workshop)** | 10 | | I | WG.3, UW.1, UW.2, UO.1, KK.1, KK.2, KO.1, KR.1 |

| No. | Name | Number of compulsory hours | Number of voluntary hours | Semester | PRK |
|---|---|---|---|---|---|
| 4. | Scientific development – individual classes with the supervisor (scholar's workshop) | 30 (15 and 15) | 70h at the disposal of the director | II and III | WG.1, WG.2, WG.3, WG.4, WK.1, WK.2, WK.3, UW.1, UW.2, UW.3, UK.1, UK.2, UK.3, UK.4, UK.5, UO.1, UU.1, KK.1, KK.2, KK.3, KO.1, KO.2, KO.3, KR.1 |
| 5. | Research seminar with methodological elements taught for PhD students I | 60 | | I-IV | WG.1, WG.2, WG.3, WG.4, WK.1, WK.2, WK.3, UW.2, UW.3, UK.1, UK.2, UK.3, UK.4, UK.5, UU.1, UU.2, KK.1, KK.2, KK.3, KO.2, KO.3, KR.1 |
| 6. | Research seminar with methodological elements taught for PhD students II | 60 | | V-VIII | |
| 7. | Methodological classes to be selected from the list | 30 | | II or III or IV | WG.1, WG.2, WG.3, WK.1, UK.1, UK.4, UK.5, UU.1, KK.3, KR.1 |
| 8. | Interdisciplinary conference I | 15 | | III | WG.2, WG.3, WG.4, WK.1, WK.3, UW.1, UW.2, UW.3, UK.1, UK.2, UK.3, UK.4, KK.1, KK.2, KK.3, KO.1, KO.3, KR.1 |
| 9. | Interdisciplinary conference II | 15 | | VII | |
| 10. | Latest discoveries in exact and natural sciences | 15 | | II | WG.1, WG.2, WG.3, WG.4, WK.1, WK.3, UW.2, UW.3, UK.1, UK.2, UK.3, UK.4, KK.1, KK.2, KK.3, KO.1, KO.2, KO.3, KR.1 |

## *Description of the methodological subjects to be chosen by the PhD students in a form compliant with the 8th level of the programme of study (PRK)*

**1. and 2.**

- **Methodical workshop (group) – Composition: Laboratory for Didactics of the Faculty of Biology – 4 hours, I or II semester, 4 voluntary hours, I or II semester;**
- **Methodical workshop (individual as part of internship) – 4 hours, I or II or III semester, 4 voluntary hours, I or II or III semester**

The observation of classes conducted by the PhD student as part of the internship – the supervisor or another experienced educator, in order to submit comments to the PhD student at the end of the classes. Where justified, at the PhD student's request, the number of hours of class observations may be increased.

*Learning outcomes (for both types of the methodical workshop):* each PhD student is able to prepare classes at a contemporary level, deliver an informative lecture that stimulates discussion, teach classes to a group of students by conveying the knowledge and skills compliant with the developmental level of the discipline and its methodology, respond to the students' questions, inspire them to self-education, and is ready to undertake the tasks of a researcher in the society.

**3. Scholar's workshop (a publishing strategy in a discipline/field) – 10 hours, I semester**

The classes are taught in a form of a lecture by a person with extensive research experience, and a track record of prestigious grants, e.g. the ERC. The topics of the lecture will encompass such issues as article composition and publishing strategies, the preparation of grant applications, as well as the art of conference presentations and performances at seminars.

*Learning outcomes:* the PhD students know the strategies of disseminating scientific results, also in the open access mode, know the strategies of defining the goal and subject of scientific research, with account being taken of the social commitments of researchers and creators, know the general rules of performing critical reviews of the state of knowledge in their discipline, as well as reviewing their own contribution to this discipline, know the general rules of planning research projects while maintaining ethical integrity, and are ready to undertake the task of a researcher in the society.

**4. The scientific development of a PhD student – 30 hours (15 + 15 hours), II and III semesters, 70 voluntary hours at the disposal of the director, II and III semesters**

Individual classes with the supervisor. The classes involve practical elaboration on the issues addressed the "Scholar's workshop" lecture. In particular, inter alia, these classes will result in the possibility to carry out activities provided for in the Individual Research Plan. Moreover, the PhD students in the disciplines of Astronomy, Computer Science and Mathematics are expected to submit a grant application in the third year under the supervision of their supervisors.

*Learning outcomes:* the PhD students know their discipline-specific achievements at the level allowing for its creative development, the essential conditions for scientific activities in their discipline, the research methodology in their discipline against the background of the methodologies from other disciplines in exact and natural sciences, they know the rules and disseminate results in their discipline and in the social and economic environments, apply the strategies of defining the goal and subject of scientific research taking into account the social commitments of researchers and creators, are able to perform critical reviews of the state of knowledge in their discipline, as well as to review their own contribution to this discipline, plan and fulfil – also in the international environment – research projects while maintaining ethical integrity, and are ready to undertake the task of a researcher in the society.

## 5. and 6. Research seminar I and II (compulsory presentation in English) – 60 hours of seminar I, I – IV semesters and 60 hours of seminar II, V-VIII semesters

Each PhD student will participate in specialist research seminars related to the section which encompasses the subject of the doctoral dissertation prepared. Such a seminar is dedicated to PhD students. The credit is based on attendance and oral presentation in English at least once a year.

*Learning outcomes:* the PhD students know their discipline-specific achievements at the level allowing for its creative development, the essential conditions for scientific activities in their discipline, the research methodology in their discipline against the background of the methodologies from other disciplines in exact and natural sciences, they know the rules and disseminate results in their discipline and in the social and economic environments also in a foreign language, are able to perform critical reviews of the state of knowledge in their discipline, as well as to review their own contribution to this discipline, and are ready to undertake the task of a researcher in the society.

## 7. Methodological classes (to be selected from the list) – 30 hours, II or III or IV semester

The PhD students will receive an offer of methodological classes, from which they will be able to choose those that are best suited to the subjects of their doctoral dissertations. The classes will encompass disciplinary and interdisciplinary issues within the framework of “exact and natural sciences”.

At the request of the Chairperson of the Scientific Council of the Discipline, the Scientific Council of the Fields, the PhD Student Self-government or the Director of the Doctoral School, it is possible to amend the list of methodological classes. Such a change must be approved by the Board of the Doctoral School.

The Individual Research Plan will specify the classes to be taken by a given PhD student.

*Learning outcomes:* the PhD students know the development trends in their field against the background of other natural and exact sciences, as well as the related dilemmas of the modern civilisation, the PhD students know their discipline-specific achievements at the level allowing for its creative development and the research methodology in their discipline, know how to make use of the sources (books, articles, etc.) that present the results in their discipline, also in a foreign language, are able to present advanced ideas and results in their discipline, are able to organised self-education in their discipline, and are ready to undertake the task of a researcher in the society.

## 8. and 9. Interdisciplinary conference I and II – 15 hours of interdisciplinary conference I, III semesters, 15 hours of interdisciplinary conference II, VII semesters

The conference has the form of a scientific discourse, which – in its essence – is intended to initiate debate. Such an interdisciplinary event will provide the PhD students with an opportunity to have a closer look at the development tendencies of exact and natural sciences, as well as at how they address the dilemmas of the contemporary civilisation, and to become familiar with how the methodology of research leads to new discoveries being made by their colleagues. Such a form will allow for practical training of the techniques for result dissemination within the environment which does not determine the career of future researchers, but at the same time creates conditions similar to those during presentations in the international forum. The conference will also give the PhD students a chance to make a critical assessment of the results presented by other PhD students, as well as to take an independent and critical look at their own achievements against the background of the achievements of other individuals at a similar stage of development. Such a critical analysis will make it possible to reinforce the independence of future researchers. Additionally, the interdisciplinary form will force popular-scientific presentation of the results obtained.

*Learning outcomes:* the PhD students know the development trends in their field against the background of other natural and exact sciences, as well as the related dilemmas of the modern civilisation, the essential conditions for scientific activities in their discipline, the research methodology in their discipline against the background of the methodologies from other disciplines in exact and natural sciences, they know the rules and disseminate results in their discipline and in the social and economic environments also in a foreign language, are able to perform critical reviews of the state of knowledge in their discipline, as well as to review their own contribution and the contribution of others to this discipline, and are ready to undertake the task of a researcher in the society.

## 10 Latest discoveries in Exact and Natural Sciences – 15 hours, II semester

The aim of the subject is to expand the cognitive perspective of the PhD students in terms of scientific research as well as to highlight the most important achievements of various scientific disciplines. This subject will calibrate the meaning of *significant scientific achievement* and stimulate interdisciplinary cooperation. At the same time, it will allow future researchers to acquire a broad view of exact and natural sciences, while demonstrating the important dilemmas of modern society. Each of the seven disciplines at the School presents on a one-off basis for 90 minutes (classes every two weeks) the latest and most important discoveries of a given discipline.

*Learning outcomes:* the PhD students know the development trends in their field against the background of other natural and exact sciences, as well as the related dilemmas of the modern civilisation, the essential conditions for scientific activities in their discipline, the research methodology in their discipline against the background of the methodologies from other disciplines in exact and natural sciences, they know the rules of disseminating results in their discipline and in the social and economic environments, perform critical assessments of scientific research results in their discipline and in related disciplines, as well as assess their own contribution to this discipline, and are ready to undertake the task of a researcher in the society.

## III Internship

**Form of internship:** participation in the preparation of classes for undergraduate and graduate students, assistance in the teaching of laboratory classes designed for undergraduate and graduate students, independent teaching of classes by the PhD student.

| Discipline | Hours of internship in the particular semesters | | | | total |
|---|---|---|---|---|---|
| | I, II | III, IV | V, VI | VII, VIII | |
| **Astronomy** | 30 | 60 | 30 | 0 | 120 |
| **Biological sciences** | 0 | 30 | 30 | 0 | 60 |
| **Chemical sciences** | 45 | 45 | 45 | 45 | 180 |
| **Physical sciences** | 30 | 60 | 60 | 30 | 180 |
| **Computer Science** | 30 | 60 | 60 | 30 | 180 |
| **Earth and Environmental Sciences** | 0 | 30 | 30 | 0 | 60 |
| **Mathematics** | 30 | 60 | 60 | 30 | 180 |

*Learning outcomes:* each PhD student knows the achievements of his/her discipline, its development tendencies and the research methodology in such a way as to freely refer to them during didactic classes, to prepare classes at a contemporary level, deliver an informative lecture that stimulates discussion, teach classes to a group of students by conveying the knowledge and skills compliant with the developmental level of the discipline and its methodology, respond to the students' questions, inspire them to self-education, and is ready to undertake the tasks of a researcher in the society.

WG.2, WG.3, WG.4, UW.3, UK.2, UK.3, UU.1, UU.2, KO.1, KO.2, KR.1

**Recommendation** – *from 90 to 180 hours Minimum – 30 hours; maximum – 180 hours*

## IV Additional classes organised by the school for all PhD students

Content-related/specialist classes. Suggested issues for each discipline are presented below. All content-related classes will also feature methodological aspects. The classes will be taught by outstanding and recognised representatives of the particular disciplines. In the 4th year, there are no compulsory classes with an exam. The choice of concrete classes will have to be agreed with the supervisor.

- **Astronomy:** *Monographic lectures* (30/30/30, flexible timetable) Selected from amongst the monographic subjects dedicated for the PhD students or the undergraduate and graduate students (I and II degrees). (e.g. lectures for the PhD students in astronomy: "Advances in Modern Astrophysics", "Gravitational Waves Astronomy" "Data Mining").
- **Chemical sciences:** *Specialisation lectures* (60 hours in total) concerning the main directions of development, as well as *monographic lectures*: 2 lectures to choose from, with 15 hours each (30 hours in total).

- **Physical sciences:** *Lecture on: Graduate Advanced Physics* (30 hours of lecture and 30 hours of practical classes) to be selected by the PhD students during the first three years of studies, from the list of offered lectures presenting the most important branches of theoretical and experimental physics, with particular account being taken of the latest achievements in a given branch.

- **Computer Science:** *Monographic subjects* and *PhDOpen courses* (30/30/30, flexible timetable). PhDOpen courses (1 course: 10h): these are intensive courses in selected fields of contemporary computer science conducted by world's experts. The course is completed by a project assessed by the tutor. Each year, the offer will include at least two monographic lectures dedicated to PhD students.

- **Mathematics** *Monographic subjects* (30/30/60, flexible timetable). Each year, at least two monographic lectures dedicated to PhD students will be offered. Moreover, the PhD students will be able to choose monographic lectures from the offer of the Faculty of Mathematics, Computer Science and Mechanics, related to the subject of their doctoral dissertations.

- **Earth and Environmental Sciences** *Monographic subjects* (30/30/30, **flexible** timetable). Monographic subjects, such as "Statistics for naturalists" and "Workshop on GIS programmes", as well as other monographic subjects for the PhD students to choose from will be offered each year.