WROCŁAW DOCTORAL SCHOOL OF INSTITUTES
OF POLISH ACADEMY OF SCIENCES

CURRICULUM

of the Wrocław Doctoral School of Institutes of Polish Academy of Sciences

(English translation, the Polish version is legally binding)

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WROCŁAW

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Wrocław 2021

The guidelines

The Wrocław Doctoral School of Institutes of Polish Academy of Sciences is an international and interdisciplinary doctoral school providing education in the physical, chemical, biological and medical sciences.

Curriculum

The curriculum is divided into modules, which may be fulfilled throughout the 4-year period of education. Each module is defined as obligatory or not. The number of classes offered is a statutory obligation of the School and may be extended by a decision of the School Council. In justified cases, the School's curriculum may be tailored to the needs of an individual participant by a decision of the School Council and in accordance with the School Regulations.

The curriculum which is compulsory for each doctoral student

TLS	GEN	ADV	INT	SEM	PRC	ENG	Total
35 hr	90 hr	20 hr	10 hr	16 sessions / 80 hr	70 hr	0 hr	305 hr

Acronyms:

- **TLS** – (TOOLS) Tools for scientific research
- **GEN** – (GENERAL) Research methods and general issues
- **ADV** – (ADVANCED) Advanced topics
- **INT** – (INTERDISCIPLINARY) Interdisciplinary classes
- **SEM** – (SEMINARS) Seminars
- **PRC** – (PRACTICAL) Practical training
- **ENG** – (ENGLISH) English language course

Required – the minimum number of hours of classes that a doctoral student must attend and complete in accordance with the School Regulations. In the case of seminars, compulsory attendance refers to the number of presentations required of doctoral students.

1 hr - 1 lesson hour (45 min.)

W - lecture, **S** - seminar, **L** - laboratory classes, **T** - teaching

Another obligatory element of education is the doctoral student's active participation in seminars of the Doctoral Entities and in seminars of the research group in which the doctoral student is carrying out his/her individual research plan.

Classes are held in English, except special cases, e,g., SEM and PRC modules, which may be held in English or Polish.

Module name:	**Tools for scientific research**	**TLS**
Description:	Classes developing "soft" competences which facilitate the effective performance of scientific research	
Content:	Research methodology (W)	10 hr
	Formulating a research problem, planning research, conducting experiments, developing and interpreting results, analyzing errors, and reasoning	
	Dissemination of research results (W)	8 hr
	Editing reports, writing scientific publications - including in particular international journals, bibliometrics and bibliography managers, scientific communication, and promotion of research results	
	Management and economics of research (W)	8 hr
	Acquisition of funds for scientific research, preparation of grant projects, project management methods, basis for commercialization of scientific research results, protection of intellectual property, and public procurement	
	Ethics and bioethics (W)	9 hr
	Ethical and legal conditions of scientific activity	
Remarks:	The curriculum shall be established by the School Council for each academic year. The indicated number of hours is the minimum number of hours offered in a 3-year cycle	
Qualifications:	P8S_WG_3, P8S_WG_4, P8S_WK_2, P8S_WK_3, P8S_UW_1, P8S_UW_3, P8S_UO, P8S_KO_1, P8S_KO_2, P8S_KO_3 , P8S_ KR	
Required:	**35 hr**	Offer: 35 hr

Module name:	**Research methods and general issues**	**GEN**
Description:	Lectures presenting an overview of contemporary research techniques and the most important issues from particular disciplines - general issues and selected detailed issues	
Content:	Experimental methods (W)	60 hr
	Series of monographic lectures (2-8 h) on experimental issues and methods used in superconductivity, magnetism, catalysis and surface physicochemistry, optical spectroscopy, structural research, phase transformations, etc.	
	Methods for the synthesis of samples (W)	20 hr
	Series of monographic lectures (2-8 h) on various methods of synthesis of research materials (monocrystalline, polycrystalline and nanomaterials, thin layers), e.g., sol-gel method, Czochralski method, Bridgman method, remineralization, culture of crystals from solution, sputtering of thin layers, sintering of ceramics, etc.	
	Computational methods (W)	20 hr
	Series of monograph lectures (2-8 h) on computational methods and computer tools, e.g., for determination of metal band structures, calculation of crystal field, microscopic parameters of semiconductors, introduction to specialized and auxiliary software (Mathematica, Matlab, FullProf Suite, Origin, Table Curve, Diamond, etc.)	
	Immunology (W)	20 hr
	A series of lectures presenting the main areas of immunology. The subject matter of the lectures is focused on the issues related to the implemented doctoral projects	
	Statistical analysis (W)	30 hr
	Classes conducted in the form of lectures and workshops focused on the ability to independently solve problems related to statistical analysis of biomedical data	
	Research techniques in life sciences (W)	50 hr
	A series of monographic lectures on techniques used in biological and medical research. Individual blocks include: molecular biology techniques, instrumental techniques in immunochemistry, new generation sequencing, electron microscopy, and flow cytometry.	
Remarks:	The curriculum shall be established by the School Council for each academic year. The indicated number of hours is the minimum number of hours offered in a 3-year cycle	
Qualifications:	P8S_WG_1, P8S_WG_2, P8S_UW_1, P8S_UW_2, P8S_UK_1, P8S_UU_2	
Required:	**90 hr**	Offer: 200 hr

Module name:	**Advanced topics**	**ADV**
Description:	Lectures presenting selected advanced issues and research techniques that are the subject of current research conducted around the world	
Content:	Current issues of physics and chemistry of solid state (W)	20 hr
	Series of monographic lectures (2-8 h) on current trends in physics and solid state chemistry - topics discussed in literature and scientific conferences, e.g. topological materials, spintronics, complex correlated systems, critical phenomena, unconventional superconductivity, etc.	
	Advanced methods of solid-state physics (W)	20 hr
	Series of monographic lectures (2-8 h) on crystal field (with exercises), magnetism of lanthanides and actinides, magnetism of solids and strong correlations, coherent states of condensed matter, properties of materials under high pressure, etc.	
	Clinical immunology (W)	30 hr
	Blocks of monographic lectures on selected issues of clinical immunology, including immunogenetics, cancer immunology and transplantation immunology	
	Current issues of bacteriology and virology (W)	30 hr
	A series of monographic lectures on selected issues in bacteriology and virology. The topics of individual lectures concern problems important for cognitive, practical and epidemiological reasons	
	Practical cytometry (W)	20 hr
	A series of monographic lectures covering the structure and principle of flow cytometry, design of an experiment, data analysis, including multi-parametric analysis. The application of cytometry in qualitative and quantitative studies of physical and biological properties of cells and tissues as well as advanced cytometric techniques are presented	
Remarks:	The curriculum shall be established by the School Council for each academic year. A detailed list of lectures should be selected in consultation with doctoral students and supervisors. The indicated number of hours is the minimum number of hours of classes offered in a 3-year cycle.	
Qualifications:	P8S_WG_1, P8S_WG_2, P8S_UW_1, P8S_UK_1, P8S_UK_4,	
Required:	**20 hr**	Offer: 120 hr

Module name:	**Interdisciplinary classes**	**INT**
Description:	Interdisciplinary classes combining physics, chemistry and biology	
Content:	Modern trends in immunology and microbiology (W)	10 hr
	Immunology and microbiology for physicists and chemists	
	Physics research methods in biology and medicine (W)	20 hr
	A series of monographic lectures (2-8 h) on issues combining physics, chemistry and biology, including: biospectroscopy and bioimaging, laser and light applications in biology/medicine, tissue spectroscopy, imaging with the use of computed tomography methods in physics and biology/medicine, etc.	
Remarks:	The curriculum shall be established by the School Council for each academic year. The indicated number of hours is the minimum number of hours offered in a 3-year cycle	
Qualifications:	P8S_WG_1, P8S_WG_2, P8S_WK_1, P8S_UW_1, P8S_UK_1	
Required:	**10 hr**	Offer: 30 hr

Module name:	**Seminars**	**SEM**
Description:	Seminar classes in which doctoral students present both their and others' research, learn about global trends in research, and develop the ability to initiate and participate in scientific discourse.	
Content:	Advanced seminar (S)	8 presentations
	A seminar held in a research department or a doctoral student's research group that enables a working doctoral student to present the results of his/her research to a group of specialists at least once a semester. Participation in all seminars of the group is obligatory.	
	Review seminar (S)	4 presentations
	A seminar held in a research department or a student's research group, in which the doctoral student's task is to present a selected specialized scientific publication from the international literature and to critically refer to it and the results presented within it in a group of specialists at least once a semester. Participation in all seminars is obligatory.	
	Scientific session of the doctoral student (S)	4 presentations
	Open, 1- or 2- day-long seminar, held once a year among all doctoral students, giving them the opportunity to present and evaluate their scientific research to the School authorities. Participation in all sessions is obligatory	
	Institute seminar (S)	1 presentation
	A seminar at the Doctoral Entity in which the doctoral dissertation is being carried out. Participation in all seminars is obligatory	
Qualifications:	P8S_WG_1, P8S_WG_2, P8S_WK_1, P8S_UW_2, P8S_UK_1, P8S_UK_3, P8S_UK_4, P8S_UK_5, P8S_KK_1, P8S_KK_2	
Required:	**16** presentations minimum.	

Module name:	**Practical training**	**PRC**
Description:	Classes in which doctoral students put their knowledge and skills into practice to plan and conduct research, self-education, and transfer of knowledge, at both the popularization and advanced levels.	
Content:	Local internships (L)	40 hr
	Internships in the laboratories of institutes forming the School, of which at least 10 lesson hours must be conducted in the Doctoral Entity (ILT&SR or II&ET), in which the doctoral dissertation is not being carried out.	
	Teaching practices (T)	20 hr
	Conducting classes with students and interns, as well as workshops organized by the Institutes for external participants.	
	Popularization practices (T)	10 hr
	Participating in popularization activities: giving lectures at or outside the Institutes, conducting scientific shows, participating in science fairs, etc.	
Remarks:	The list of laboratories for local internships available to doctoral students shall be presented by the School Council for each academic year. The dates of classes are set individually by the doctoral students and laboratory supervisors.	
Qualifications:	P8S_WG_4, P8S_UK_2, P8S_UU_1, P8S_UU_2, P8S_KO_1, P8S_KO_2, P8S_KK_3	
Required:	**70 hr**	Offer: 70 hr

Module name:	**English language course**	**ENG**
Description:	Classes developing language skills to at least B2 level, including specialized terminology, communication, etc.	
Content:	English language course	60 hr
	Classes in the form of conversations with an English teacher or a native speaker	
Qualifications:	P8S_UK_1, P8S_UK_5	
Required:	**0 hr**	Offer: 60 hr

Learning outcomes

The learning outcomes are fulfilling the requirements of level 8 of the Polish Qualification Framework as outlined below:

Knowledge

The doctoral student knows and understands:

a) existing paradigms or world heritage to the extent that it is possible to revise them, including theoretical foundations and general and specific issues and selected topics specific to the scientific and/or artistic discipline in question (P8S_WG_1);
b) the main trends in the development of the scientific or artistic disciplines in which they are educated (P8S_WG_2);
c) research methodology (P8S_WG_3);
d) rules on the dissemination of scientific results, including in open access mode (P8S_WG_4);
e) the fundamental dilemmas of modern civilization (P8S_WK_1);
f) the economic, legal, ethical and other relevant conditions for scientific activities (P8S_WK_2);
g) basic principles for the transfer of knowledge to the economic and social spheres and for the commercialization of scientific results and know-how related to those results (P8S_WK_3).

Skills

A doctoral student is able to:

a) use knowledge from different scientific or artistic fields to creatively identify, formulate and innovatively solve complex problems or perform research tasks, and in particular:
    - to define the purpose and subject of scientific research, and formulate research hypotheses,
    - to develop research methods, techniques, and tools and apply them creatively, and
    - to draw conclusions on the basis of scientific evidence (P8S_UW_1);
b) critically analyze and evaluate the results of scientific research, expertise, and other creative work as well as their contribution to the development of knowledge (P8S_UW_2);
c) transfer the results of scientific activities to the economic and social spheres (P8S_UW_3);
d) communicate on specialist subjects to the extent necessary to actively participate in the international scientific community (P8S_UK_1);
e) disseminate results of scientific activities, including for laypeople (P8S_UK_2);
f) initiate a debate (P8S_UK_3);
g) participate in scientific discourse (P8S_UK_4);
h) have a thorough knowledge of a foreign language at B2 level of the Common European Framework of Reference for Languages to the extent that he/she can participate in the international scientific and professional community (P8S_UK_5);
i) plan and implement individual or team research or creative projects, including in an international environment (P8S_UO);
j) independently plan and act towards their own development and inspire and organize the development of others (P8S_UU_1), and
k) plan and implement classes or groups of classes using modern methods and tools (P8S_UU_2).

Social competences

The doctoral student is ready to:

a) critically evaluate his/her achievements within a given scientific or artistic discipline (P8S_KK_1);
b) critically evaluate his/her own contribution to the development of a given scientific or artistic discipline (P8S_KK_2);
c) recognize the importance of knowledge in solving cognitive and practical problems (P8S_KK_3);
d) fulfil the social obligations of researchers and creators (P8S_KO_1);
e) initiate activities in the public interest (P8S_KO_2);
f) think and act in an entrepreneurial way (P8S_KO_3);
g) maintain and develop the ethos of research and creative environments, including:
   - conducting scientific activity in an independent manner, and
   - respecting the principle of public ownership of research, taking into account the principles of protecting intellectual rights (P8S_KR).