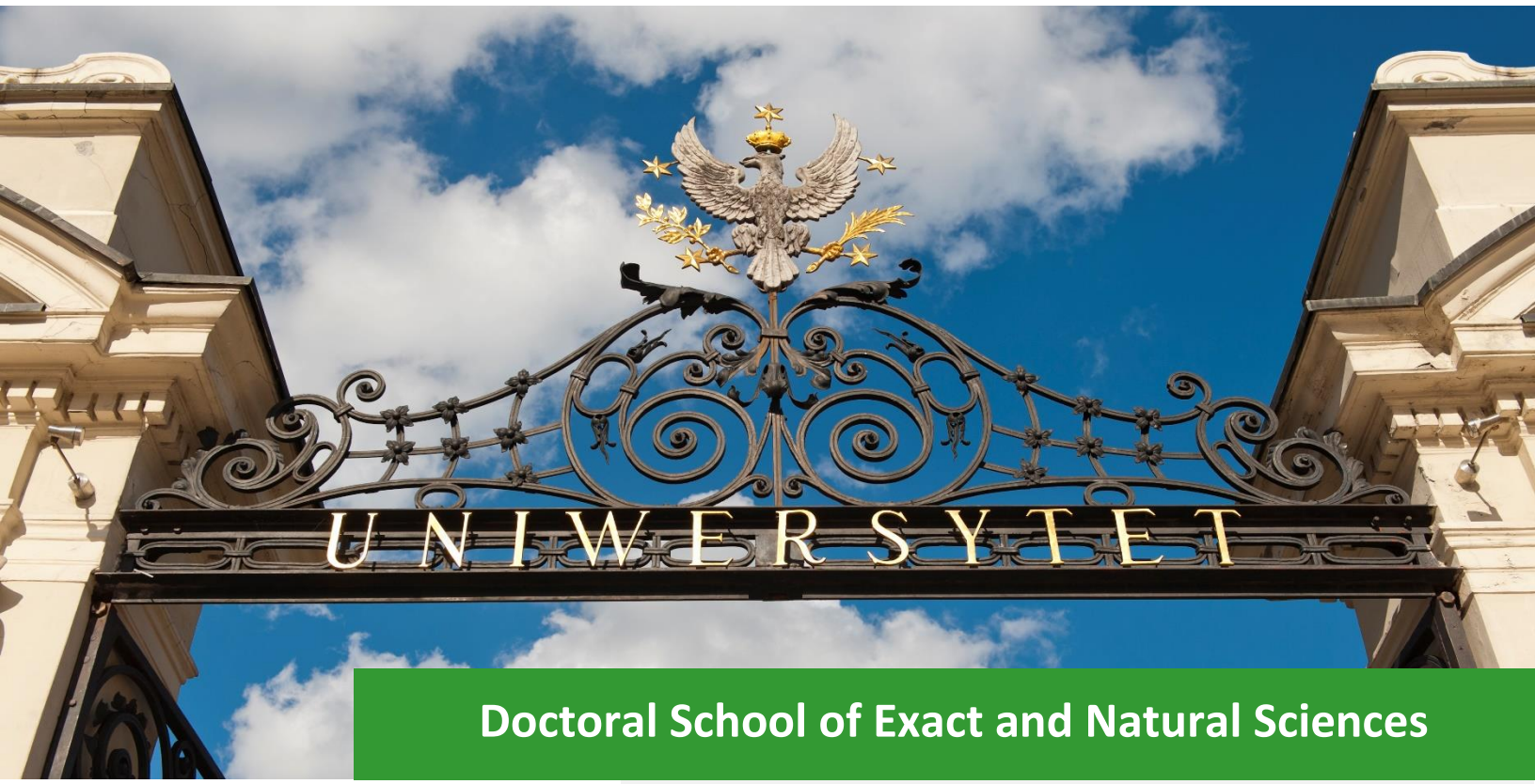
A GUIDE FOR THE CANDIDATES

RECRUITMENT 2021/2022



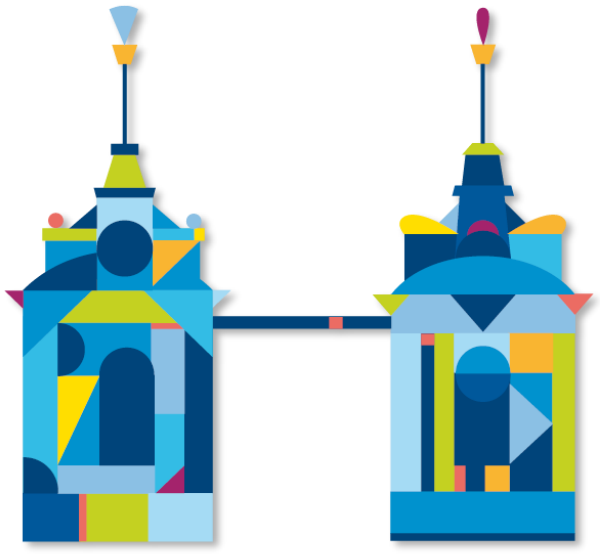
Doctoral School of Exact and Natural Sciences

Mathematics and Computer Sciences

Contents

Recruitment Legislation and Acts to Know

- Resolution no. 17 of the Senate of the Univeristy of Warsaw of 20 January 2021 on rules of admission to doctoral schools at the University of Warsaw (the Univeristy of Warsaw Monitor of 2021, item 13).
- Resolution no. 48 of the Senate of the Univeristy of Warsaw of 21 April 2021 on amending Resolution No. 17 of the Senate of the University of Warsaw of 20 January 2021 on the rules of admission to doctoral schools at the University of Warsaw (the Univeristy of Warsaw Monitor of 2021, item 113).
- Ordinance no. 66 of the Rector of the University of Warsaw of 9 April 2021 (the University of Warsaw Monitor of 2021, item 102)
- Ordinance no. 74 of the Rector of the University of Warsaw of 26 April 2021 (the University of Warsaw Monitor of 2021, item 124)
- Decision no. 2 of the Rector of the University of Warsaw of 5 March 2021 (the University of Warsaw Monitor of 2021, item 47)



About the School

The main element of education at the Doctoral School of Exact and Natural Sciences (SDNSP) is the implementation of an individual PhD project in one of the scientific disciplines (Astronomy, Computer Science, Mathematics, Biological Sciences, Chemical Sciences, Physical Sciences, Earth and Environmental Sciences) that are covered by the school, under supervision of a faculty member chosen by the doctoral student.

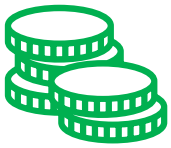
The education at SDNSP lasts 4 years and includes courses in the form of specialization and monographic lectures, workshops, seminars, two-day symposiums as well as courses and trainings to improve the skills of doctoral students in teaching.

The graduate of the Doctoral School of Exact and Natural Sciences has a highly specialized education acquired under the supervision of leading scientists and is prepared to undertake independent scientific and teaching activities at universities and research institutes. In addition, the graduate gains extensive knowledge beyond the discipline in which he/she prepares his/her doctoral dissertation, as well as skills in conducting scientific and teaching activities.

Academic disciplines under the admission procedure and the limit of places:

- astronomy – limit of **5** places
- mathematics and computer sciences – limit of **22** places
- biological sciences – limit of **17** places
- chemical sciences – limit of **18** places
- physical sciences – limit of **27** places
- Earth and related environmental sciences – limit of **11** places

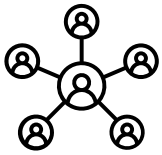
Scholarship



In accordance with Art. 209 of the act of 20 July 2018 – The Law on Higher Education and Science (Official Journal of Laws of 2018, item 1668 as amended) a doctoral student who does not hold a degree of doctor shall receive a doctoral scholarship. The total period of receiving the doctoral scholarship at doctoral schools shall not exceed 4 years. The amount of a monthly doctoral scholarship shall be at least: 37% of a professor's salary – up to the month in which the mid-term evaluation was conducted; 57% of a professor's salary – after the month in which the mid-term evaluation was conducted. The amount of the minimum basic salary of a professor is currently PLN 6,410 gross. The above-mentioned amounts may change if the Ministry responsible for higher education and science decides to announce a new base a professor's salary. During the four years of study, each PhD student receives a scholarship in the amount of PLN 2371.70 (gross) for the first two years of studies (before the mid-term evaluation) and PLN 3653.70 (gross) in the next two years after the mid-term evaluation. Supplement for people with disabilities: PLN 711.51. The scholarship is reduced by 11% due to compulsory deducted toward social security.

Supervisor

It is worth starting the recruitment process to a doctoral school at the University of Warsaw by finding a supervisor, who are willing to provide care for the doctoral student and perform scientific supervision over their research project. In order to find a supervisor, candidates for the Doctoral Schools are encouraged to search through the database of supervisors. The database contains the list of University of Warsaw researchers, who are willing to perform the function of the dissertation supervisor.



https://promotorzy.szkolydoktorskie.uw.edu.pl/en/search

Please note that not all potential supervisors are on the list. The candidates are also encouraged to consult the websites of the University of Warsaw faculties and academic units for the information on academic teachers conducting their research.

https://en.uw.edu.pl/about-university/faculties/

According to the School Regulations, a potential supervisor can only be a person with:

- the habilitated doctor (doktor habilitowany) degree or an equivalent degree or the title of professor as well as has to be an employee of the University of Warsaw or the employee of the institution co-running the School (Institute of Mathematics Polish Academy of Sciences);
- the status of retired professor at the University of Warsaw.

The dissertation supervisor can be a person, who remains a dissertation supervisor for no more than five doctoral students or persons applying for being awarded the doctor degree (e.g. participants of doctoral studies who have initiated a doctoral dissertation process). In exceptional instances, the Director of School may increase this limit.

Recruitment schedule

5th of May - 28th of June 2021	registration in the system of Internet Recruitment for Candidate (IRK), application for admission to the School, payment of the admission fee (PLN 150)

ADMISSIONS PROCEDURE

until 12th of July 2021	publication of the interview schedule
12th of July - 30th of July 2021	qualification proceedings
until 4th of August 2021	announcement of the ranking list
9th of August - 23rd of September 2021	accepting documents from qualified candidates
until 28th of September 2021	announcement of the list of the accepted candidates

How to apply?

1. See the admission requirements for the Doctoral School of Exact and Natural Sciences in the discipline of Mathematics and Computer Sciences.
2. Register in the Internet Recruitment for Candidate (IRK) system: **irk.uw.edu.pl**
3. Complete your personal details and submit all the necessary documents.
4. Pay the admission fee to the individual account visible in the IRK system.
5. Check the Doctoral School's website for qualification examination and interview dates.
6. Take the exam and interview by the deadline.
7. Check the Doctoral School's website and the IRK system for the results of the qualification proceedings.
8. Submit the required documents to the office of the Doctoral School of Exact and Natural Sciences.
9. Once you have received information in the IRK system about your admission to the Doctoral School, follow the instructions provided by the office of the School.

Required documents

The candidate shall submit a School admission application only through the IRK. The application shall include the following:

1) indication of the selected discipline in which the candidate plans to pursue education or in the case of applying for the Interdisciplinary Doctoral School – fields of science with the specification of the leading field (and where there is no leading field – at least two equivalent disciplines), PESEL number or passport number, nationality, contact information (residence address, e-mail address, telephone number), information whether the candidate agrees to receive administrative decisions by means of electronic communication, consent for processing of personal data for the purposes of the admissions procedure;
2) documents:
   - (applies to candidates holding a Master's degree or an equivalent degree obtained under separate regulations or, in accordance with their declaration, who shall hold such a degree by 23 September 2021) a scan of the graduation diploma of uniform master's degree or postgraduate studies or an equivalent diploma obtained under separate regulations, or in the case of candidates pursuing education in the European Higher Education Area – a certificate of holding a master's degree or a statement that the diploma or certificate confirming the award of a master's degree will be delivered by 23rd of September 2021, in the case of a diploma equivalent to a uniform master's degree or postgraduate studies graduation diploma, a candidate shall justify such equivalence. In case the diploma was issued in a language other than Polish or English, the candidate shall attach its certified translation;
   - (applies to candidates who are research project coordinators for a project carried out at the University as part of the "Diamentowy Grant" [Diamond Grant] program launched by the Minister responsible for higher education and science or submitted an application as part of this program that is currently pending review) the candidate shall submit a statement that he/she is funded a grant by the Minister responsible for higher education and science under the "Diamentowy Grant" [Diamond Grant] program or a statement that an application has been submitted as part of the "Diamentowy Grant" [Diamond Grant] program, providing the title of the candidate's project;
   - (applies to candidates who are a graduate of a first degree program or a students who have completed the third year of a unified master degree program, and have been approved by the Director in consultation with the qualification team to be considered for admission due to their exceptional, superior scientific achievements demonstrated so far) the candidate shall attach the Director's consent.
3) a description of the initial research project proposal in English; The description may not exceed four pages, font type: Times New Roman or equivalent, font size: at least 11 points, line spacing: 1, upper and lower margin: at least 1.5 cm, side margins: at least 2 cm;
4) a resume or CV outlining the candidate's scientific activity, including scholarly interests and achievements during the five calendar years preceding the application (if a candidate became a parent during this time, as evidenced by a scan of the child's birth certificate attached to the application, this period shall be extended by two years for each child), including, but not limited to:
   - publications,
   - research and organizational work at student research groups,
   - participation in scientific conferences,

- participation in research projects,
- awards and honorable mentions,
- research internships,
- research skills training programs completed,
- activities promoting science,
- activity in science movement representative bodies,
- average of their university grades,
- professional career,
- level of proficiency in foreign languages;

5) scans of materials evidencing scientific activity mentioned in their CV and/or resume;
6) a document confirming at least B2 proficiency level in English or a declaration of the level of proficiency in English allowing education at the School;
7) the scan of a declaration by the planned supervisor, confirming their agreement to undertake the duties of a supervisor and of the number of doctoral students, for whom they perform the duties a designated supervisor, in accordance with the template constituting Appendix no.4 to the Resolution no. 17 of the Senate of the University of Warsaw of 20th January 2021 on rules of admission to doctoral schools at the University of Warsaw (the University of Warsaw Monitor of 2021, item 13, as amended), the candidate may also attach a scan of their planned supervisor's opinion and opinions of other academics about the candidate and their scientific activity and/or proposed research project;
8) the photograph of a candidate's face that allows for their identification;
9) a declaration confirming whether the candidate was or is a doctoral student or a participant of doctoral studies or whether they have initiated a doctoral dissertation process or whether proceedings to award them a doctoral degree have been initiated – and if yes, the title of their doctoral dissertation or the research project prepared by a candidate, including the name and last name of the candidate's tutor or supervisor;
10) a declaration confirming that they have reviewed the Resolution no. 17 of the Senate of the University of Warsaw of 20 January 2021 on rules of admission to doctoral schools at the University of Warsaw (the University of Warsaw Monitor of 2021, item 13, as amended) and Articles 40 and 41 of the Code of Administrative Procedure;
11) contact data of two persons who will send recommendation letters regarding the candidate directly to the address **sd.nsp.mat@uw.edu.pl**, which is specific for a given disciplines. A failure of receiving the recommendation letters does not mean that the application for admission to the School is incomplete; the letters may be taken into consideration when evaluating the candidate's scientific potential;
12) scanned transcripts of records of the graduate and postgraduate studies or the uniform Master's degree studies, or equivalent documents (e.g. diploma supplement);
13) abstract of the master's thesis or master's project in English (up to 3,000 characters with spaces).

Admission fee

The admission fee is PLN 150 and is paid to the candidate's individual account generated in the IRK system.

Instruction for completing the application for admission to the SDNSP

In order to complete the application for admission to the Doctoral School of Exact and Natural Sciences correctly, there have been the instructions published on the School's website, which may be helpful when registering in the **Internet Recruitment of Candidates** (IRK) system.

Form of qualification proceedings

One-stage proceedings

I stage

- initial research project proposal
- scientific activity of the candidate
- written qualification examination
- interview

Number of points to be awarded

The maximum number of points to be obtained in the qualification proceedings:

100 points

Language of qualification proceedings

The interview shall be held in Polish or English, according to candidate's preferences indicated in the IRK. If Polish is selected, a part of the interview may be held in English.

Assessment criteria and methods

Initial research project proposal (maximum number of points – 5)

When evaluating the initial research project proposal, the following shall be taken into account:
1) the feasibility of the project in the context of documented competencies of the candidate;
2) the academic importance of the project;
3) anticipated added value for the scientific community of the academic discipline

Scientific activity of the candidate (maximum number of points – 15)

When evaluating scientific activity, the following elements, confirmed by means of scanned documents, shall be taken into account:
1) scientific publications (a scan of the front page is required; in the case of multi-author achievements, the percentage share of the candidate's participation in the achievement must be defined)
2) confirmed participation in student competitions;
3) confirmed participation in research projects (a scan of the certificate issued by the project coordinator is required);
4) presentations delivered or seminar and conference messages (a scan confirming presentation delivery is required);
5) documented research internships;
6) achievements within students' research groups (a scan of the certificate signed by the chairperson of the group is required).

Qualification examination (maximum number of points – 40)

Verifying the candidate's knowledge and skills within the particular academic discipline in writing. In justified cases (e.g. where the candidate stays abroad), at the written request of the candidate addressed to the chairperson of the qualification team appointed for the particular academic discipline, the written examination may be replaced with an oral examination carried out remotely with the use of generally available online tools.

Interview (maximum number of points – 40)

The interview entails an assessment of the candidate's scientific potential. The interview may comprise the following elements:
1) discussion of the candidate's Master's thesis (understanding of the subject, research hypotheses, their implementation, results obtained and conclusions);
2) questions about the academic record and the course of the graduate and postgraduate studies or the uniform Master's degree studies, including subjects related to the doctoral dissertation;
3) questions pertaining to information included in letters of recommendations, including the nature and results of cooperation of the candidate with the authors of these letters;
4) questions pertaining to the doctoral project and other information included in the documentation submitted by the candidate

Condition of admission to the School

Obtaining at least **50** points from the qualification proceedings.

Scope of the qualification examination

MATHEMATICS

Structure of the exam: 8 problems in the discipline of Mathematics within the pool of 16 problems proposed together with the discipline of Computer Science. For the final result, 4 best evaluated problems are chosen from the 16 proposed problems. The following list of topics is indicative only; exam problems may partly relate to other topics within the same general thematic range.

1. Mathematical analysis – functions of one variable

Examples of topics: real and complex numbers and their properties, sequences and their limits, Bolzano-Weierstrass's theorem, Cauchy's condition, criteria of existence of a limit, series of real and complex numbers, convergence criteria for series, series conditionally and absolutely convergent, multiplication of series, continuity and uniform continuity of functions, properties of continuous functions defined on compact sets, Darboux's property, differential calculus of real functions of one variable, Rolle's I Lagrange's theorems, using derivatives and limit when graphing a function, series of functions, pointwise and uniform convergence, power series, radius and circle of convergence, Taylor's expansion, indefinite integral, Riemann integral, improper integral.

2. Mathematical analysis – functions of many variables

Examples of topics: partial derivatives and directional derivative, gradient, Jacobian, extrema of functions of many variables, implicit functions, Lagrange's multipliers, theory of Lebesgue measure and integral, interchange of integration with the limit, Fubini's theorem, curvilinear and surface integrals, differential manifolds and differential forms.

3. Analytic functions

Examples of topics: Analytic functions, Cauchy-Riemann's equations, Cauchy's integral formula, maximum principle, residua.

4. Probability theory and statistics

Examples of topics: conditional probability, independence, random variables and their parameters, conditional expectation, Markov chains, types of convergence of sequences of random variables, laws of large numbers and the central limit theorem. Elements of statistics: estimators and their properties, testing hypotheses, linear regression.

5. Geometry and linear algebra

Examples of topics: determinants and linear equations, linear and affine spaces, linear transformations, eigenvalues and eigenvectors, Jordan's theorem, bilinear and quadratic forms, Sylvester's criterion, inner products, selfadjoint operators.

6. Algebra

Examples of topics: groups, cyclic groups, groups of permutations, group homomorphisms, kernel, normal subgroup and quotient group, Lagrange's theorem about the order of a subgroup, commutative rings, ideals, maximal and prime ideals, homomorphisms of rings, zero divisors, invertible elements, field of fractions, fields, prime field, characteristic of a field, algebraically closed field, fundamental theorem of algebra, roots of unity.

7. Topology

Examples of topics: metric and topological spaces, methods of defining a topology, Tikhonov's theorem, continuous mappings, Tietze's theorem, connected spaces, compact spaces, complete spaces, Cantor set and its properties, Baire's theorem, Banach's and Brouwer's fixed point theorems, fundamental group, compact surfaces.

8. Ordinary differential equations
Examples of topics: existence and uniqueness of solutions of ordinary differential equations, solving ordinary differential equations of one real variable, linear ordinary differential equations and sets of linear differential equations with constant coefficients and solving them, sets of linear equations with variable coefficients and fundamental matrix, stability of solutions.
9. Functional analysis
Examples of topics: Banach space, functionals and linear operators, dual space, Hilbert space, functional spaces Lp, spaces of continuous functions.

COMPUTER SCIENCES

Structure of the exam: 8 problems in the discipline of Computer Science within the pool of 16 problems proposed together with the discipline of Mathematics. For the final result, 4 best evaluated problems are chosen from the 16 proposed problems. The following list of topics is indicative only; exam problems may partly relate to other topics within the same general thematic range.
1. Programming languages
Examples of topics: language constructs encountered in imperative, objectoriented, functional and logic programming languages, semantics of programming languages, software verification techniques, type systems.
2. Discrete mathematics
Examples of topics: combinatorics, elements of graph theory, elements of number theory, asymptotics.
3. Probability theory and statistics
Examples of topics: conditional probability, independence, random variables and their parameters, conditional expectation, Markov chains, types of convergence of sequences of random variables, laws of large numbers and the central limit theorem. Elements of statistics: estimators and their properties, testing hypotheses, linear regression.
4. Algorithms and data structures
Examples of topics: knowledge and ability to create algorithms with provable guarantees on pessimistic (or expected) running time and on correctness, dynamic programming, sorting and selection, basic data structures (e.g. dictionary, priority queue), graph algorithms (e.g. minimal spanning tree, maximal matching, maximal flow) and text algorithms, linear programming.
5. Logic and databases
Examples of topics: Propositional logic, first- and second-order logic, relational algebra, SQL, intuitionism, expressivity and non-expressivity, decidability and complexity of logical theories.
6. Automata and formal languages
Examples of topics: Finite automata, regular expressions, context-free grammars, pushdown automata, recognizability and non-recognizability, closure properties, decidability and complexity of the problems of belonging to a language, nonemptiness, language inclusion.
7. Computation theory and computational complexity
Examples of topics: Turing machines, decidable and undecidable problems, complexity classes P, NP, PSPACE and others, hardness and completeness, Boolean circuits and complexity classes based on them, Las Vegas and Monte Carlo randomized algorithms, approximate algorithms.
8. Concurrent and distributed programming, computer systems
Examples of topics: Models of concurrency, communication and synchronization mechanisms, paradigms of distributed computation, data integrity models, proving correctness of concurrent programs, basic problems of concurrency and algorithms to solve them, computer system architecture, processes and mechanisms of process management, memory hierarchy and data storage, process communication and network protocols, computer system security.
9. Bioinformatics
Examples of topics: Sequence alignments. models of sequence evolution, phylogenetic trees, clustering of molecular sequences, hidden Markov models, efficient data structures for matches with errors, de Bruijn graphs.

Contact

For recruitment to the Doctoral School of Exact and Natural Sciences, please contact the School's office:

Doctoral School of Exact and Natural Sciences
93 Żwirki i Wigury Street, room 3061, 02-089 Warsaw

rekrutacja.nsp@uw.edu.pl, szkola.nsip@uw.edu.pl

https://szkolydoktorskie.uw.edu.pl/en/sdnsip-2/