Education Programme

RZESZÓW UNIVERSITY OF TECHNOLOGY DOCTORAL SCHOOL

1. Basic Information

1. Education at the Doctoral School of the Rzeszów University of Technology, hereinafter referred to as the "Doctoral School," may be conducted in the following disciplines:

- Architecture and Urban Planning
- Automation, Electronics, Electrical Engineering, and Space Technologies
- Economics and Finance
- Technical Informatics and Telecommunications
- Chemical Engineering
- Civil Engineering, Geodesy, and Transport
- Materials Engineering
- Mechanical Engineering
- Environmental Engineering, Mining, and Energy
- Mathematics
- Physical Sciences
- Management and Quality Sciences

2. Education at the Doctoral School

Education at the Doctoral School:

2. Prepares for obtaining a doctoral degree;
3. Is conducted based on the education programme and an individual research plan;
4. Lasts 8 semesters and concludes with the submission of a doctoral dissertation, with the possibility of earlier completion provided the education programme is fulfilled and all learning outcomes are achieved.

3. Education Programme

The implementation of the education programme at the Doctoral School leads to the achievement of learning outcomes for qualifications at level 8 of the Polish Qualifications Framework, defined based on the Act of 22 December 2015 on the Integrated Qualifications System (Journal of Laws of 2018, item 2153) and regulations issued under Article 7(3) of this Act.

4. Learning Outcomes

The description of learning outcomes achieved at the Doctoral School in relation to qualifications listed at level 8 of the Polish Qualifications Framework is presented in the table below.

Symbol	Content	Reference to PRK
K_W01	Possesses advanced general knowledge related to the field and discipline of conducted research	**P8S_WG**
K_W02	Possesses well-founded theoretical knowledge of a specific nature, encompassing the latest scientific achievements related to the scope of conducted research, particularly sourced from scientific publications	**P8S_WG**
K_W03	Possesses knowledge regarding conducted research to a degree that allows the utilisation of global scientific achievements for preparing a doctoral dissertation	**P8S_WG**
K_W04	Is familiar with the main developmental trends in the scientific disciplines in which research is conducted	**P8S_WG**
K_W05	Possesses knowledge regarding the methodology of conducting scientific research	**P8S_WG**
K_W06	Possesses knowledge regarding the principles of preparing publications and disseminating research results, including in open access	**P8S_WG**
K_W07	Possesses knowledge regarding obtaining and managing research projects, as well as the economic, legal, and ethical aspects of scientific activity, and is familiar with fundamental dilemmas of modern civilisation	**P8S_WK**
K_W08	Possesses basic knowledge regarding the commercialisation of research results and technology transfer to the economic and social spheres, particularly issues related to intellectual property protection	**P8S_WK**
K_U01	Is able to acquire information related to scientific activity from various sources, including in foreign languages, to identify and solve research problems	**P8S_UW**
K_U02	Is able, using acquired knowledge, to critically evaluate the results of research and other creative works – not only their own – and their contribution to the development of the represented discipline; in particular, is able to assess the applicability and potential use of theoretical work results in practice, e.g., through transfer to the economic sphere	**P8S_UW**
K_U03	Is able to identify and formulate complex tasks and problems related to the represented scientific discipline, including conceptually new research tasks and problems leading to innovative technical solutions	**P8S_UW**
K_U04	Is able to define the aim and subject of scientific research, creatively apply methods, techniques, and research tools, and draw conclusions based on obtained results	**P8S_UW**
K_U05	Is able to document research results and create works of a scientific publication nature, including in a foreign language, in accordance with the principles of creating such works, particularly respecting copyright principles, and is able to disseminate the results of scientific activity, including in a popular science form	**P8S_UK**

K_U06	Is able to effectively communicate using various techniques in an international scientific and professional environment, including in a foreign language; has the ability to clearly present their achievements and concepts and provide appropriate arguments in scientific discussions and public debates on various topics; is able to lead a scientific discussion	**P8S_UK**
K_U07	Is able to use a foreign language at the B2 level to a degree that enables participation in an international scientific and professional environment	**P8S_UK**
K_U08	Is able to initiate a debate and participate in a scientific discussion	**P8S_UK**
K_U09	Is able to methodologically correctly plan a research or creative project related to scientific activity, conducted individually or in a team	**P8S_UO**
K_U10	Is prepared to conduct teaching activities at a university and other forms of education in a methodologically correct manner, using modern teaching techniques	**P8S_UU**
K_U11	Is able to plan and act for their own development, build their image as a researcher, and encourage others to do so; understands the need for continuous learning – enhancing professional and personal competencies	**P8S_UU**
K_K01	Demonstrates self-criticism in creative work; understands the need to follow and analyse the latest achievements related to the represented scientific discipline and critically evaluate the achievements of this discipline; acknowledges the importance of knowledge in solving cognitive and practical problems	**P8S_KK**
K_K02	Is able to think and act independently, creatively, and entrepreneurially; shows initiative in creating new ideas and seeking innovative solutions	**P8S_KO**
K_K03	Is aware of the social role of a doctoral school graduate; understands and feels the need to engage in training specialists in the represented discipline and other activities for the public interest, leading to the development of a knowledge-based society	**P8S_KO**
K_K04	Is aware of the importance of behaving professionally, conducting scientific activity independently, adhering to professional ethics principles, including intellectual property protection, and fostering the ethos of the scientific and professional community	**P8S_KR**

Doctoral candidates achieve learning outcomes by passing the courses included in the study programme and implementing an individual research plan.

5. Implementation of the Education Programme, Methods of Verifying Learning Outcomes, and Programme Content

The implementation of the education programme takes place through the doctoral candidate's participation in all classes assigned to the subjects. During training at the Doctoral School, the doctoral candidate is obliged to pass all mandatory subjects for a given discipline and may take other subjects outside the discipline. The doctoral candidate should attend classes in accordance with the discipline in which they conduct research and prepare their doctoral dissertation.

5.1 List of courses

Semester	Unit	Course	Lecture	Language course	Laboratory	Project/Seminar	Total Hours	Exam	Oblig.
1	DU	Assisting in Teaching Activities	0	0	0	15	15	N	
1	DJ	English with Specialised Terminology Used in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences 1)	0	30	0	0	30	N	
1	MT	Methodology of Planning and Conducting Scientific Research	0	0	0	15	15	N	
1	DU	Doctoral Seminar	0	0	0	30	30	N	
1	DU	Development Trends in Selected Disciplines in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences 1),2)	15	0	0	0	15	N	
Totals for Semester: 1			**15**	**30**	**0**	**60**	**105**	**0**	**5**
2	DJ	English with Specialised Terminology Used in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences 1)	0	30	0	0	30	Y	
2	ZE	Legal and Ethical Aspects of Scientific Activity	0	0	0	15	15	N	
2	DU	Conducting Teaching Activities	0	0	0	15	15	N	
2	DU	Doctoral Seminar	0	0	0	30	30	N	
2	DU	Development Trends in Selected Disciplines in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences 1),2)	15	0	0	0	15	N	
2	NC	Sources of Research Funding	5	0	0	0	5	N	
Totals for Semester: 2			**20**	**30**	**0**	**60**	**110**	**1**	**6**

3	EA	Modern IT Techniques	15	0	0	15	30	N	
3	DU	Conducting Teaching Activities	0	0	0	15	15	N	
3	DU	Doctoral Seminar	0	0	0	30	30	N	
3	ZP	The Art of Scientific Presentation and Building a Researcher's Image	0	0	0	15	15	N	
3	DU	Monographic Lecture in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences	15	0	0	0	15	N	
Totals for Semester: 3			**30**	**0**	**0**	**75**	**105**	**0**	**5**
4	ZM	Economic Aspects of Scientific Activity	15	0	0	0	15	N	
4	FB	Data Engineering and Analysis	15	0	0	15	30	Y	
4	DU	Conducting Teaching Activities	0	0	0	15	15	N	
4	DU	Doctoral Seminar	0	0	0	30	30	N	
Totals for Semester: 4			**30**	**0**	**0**	**60**	**90**	**1**	**4**
5	DU	Conducting Teaching Activities	0	0	0	15	15	N	
5	DU	Doctoral Seminar	0	0	0	30	30	N	
Totals for Semester: 5			**0**	**0**	**0**	**45**	**45**	**0**	**2**
6	DU	Conducting Teaching Activities	0	0	0	15	15	N	
6	DU	Doctoral Seminar	0	0	0	30	30	N	
Totals for Semester: 6			**0**	**0**	**0**	**45**	**45**	**0**	**2**
7	DU	Conducting Teaching Activities	0	0	0	15	15	N	
7	DU	Doctoral Seminar	0	0	0	30	30	N	
Totals for Semester: 7			**0**	**0**	**0**	**45**	**45**	**0**	**2**
8	DU	Conducting Teaching Activities	0	0	0	15	15	N	
8	DU	Doctoral Seminar	0	0	0	30	30	N	
Totals for Semester: 8			**0**	**0**	**0**	**45**	**45**	**0**	**2**
TOTALS FOR ALL SEMESTERS:			**95**	**60**	**0**	**435**	**590**	**2**	**28**

1) - the course content is tailored to the field of science to which the discipline in which the doctoral candidate conducts research and prepares the doctoral dissertation belongs

2) - for a given field of science, the number of course hours may be divided among several instructors representing the disciplines in which doctoral candidates conduct research and prepare their doctoral dissertations

5.2 Programme Content

Assisting in Teaching Activities	K_W01, K_U10, K_K03
• Prepares for conducting teaching activities by familiarising oneself with the subject matter and methods of conducting classes through observation.	
Economic Aspects of Scientific Activity	K_W07, K_U02, K_K02, K_K03
• The role and significance of scientific research in socio-economic development • Forms of commercialisation and their formal-legal, market, and institutional conditions • Commercial (market) potential of scientific research • Principles of knowledge commercialisation through the creation of spin-off companies	
Data Engineering and Analysis	K_W01, K_U05, K_U06, K_K01

• Basic concepts of probability theory. Classical and axiomatic definitions of probability. Conditional probability, total probability, Bayes' theorem. Independence of events. Random variable, probability distribution, cumulative distribution function, graphs, numerical characteristics of a random variable. Independence of random variables. • Basic concepts of statistics. Basic parameters for describing populations and samples. Distributions of sample statistics. Probability distributions used in statistics. Standardisation of a random variable. Estimation. Types and properties of estimators. Confidence intervals. Statistical tests, p-value. • Statistical data analysis. Multidimensional random variables. Linear, non-linear, multiple, and logistic regression. Tests of linear regression parameters. • Discrete Bayesian networks. Elements of graph theory. Conditional independence of events and graphical d-separation of network nodes. Chain rule, Markov blankets. • Learning Bayesian networks from data: structure learning, parameter learning, evaluation of network fit to data. Overview of learning algorithms. • Inference, variable elimination, network moralisation, transformation into an undirected network, network triangulation, clique graph, junction tree, information propagation in a junction tree. • Bayesian networks with continuous random variables, hybrid Bayesian networks.	
English with Specialised Terminology Used in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences 1)	K_W02, K_U01, K_U06, K_U07, K_K01
Career planning in the field of science – positions at universities, professional titles, and types of studies and scientific research • Applying for research grants – writing grant applications and academic CVs. • Higher education systems in Poland and abroad. Academic vocabulary in scientific discourse. • Scientific communication and the academic community. Terminology related to research areas and academic achievements. • Writing reviews and vocabulary related to argumentation and speculation. • Conducting literature reviews and describing conducted experiments. • Delivering lectures and presentations. Vocabulary and expressions used in presentations. • Presenting and discussing numerical data; tables and charts. • Writing introductions and abstracts in scientific publications. • Conjunctions in complex sentence structures: despite, therefore, because, as a result, etc. • Lexical elements in academic discourse: collocations, noun and adjective phrases. • Characteristics of scientific language – exercises. • Critical thinking – analysis and evaluation of presented information. • Methodology of conducting scientific research – describing research problems and methods for their description and resolution. • Revision and consolidation of material.	
Methodology of Planning and Conducting Scientific Research	K_W03, K_W05, K_W06, K_U01, K_U04, K_U09, K_K01
Basic concepts: science, knowledge, methodology. Scientific problem. Issues of knowledge validity. Theses and hypotheses. Regularities and laws. • Models and modelling. Materials and their processing: primary materials. Secondary materials. Scientific publications. Publication databases. Material processing. Research methods. Material processing. Systematisation. • Selected research procedures. Testing the significance of influence. Two- and three-level research plans. Mathematical processing of experimental results. • Selected optimisation methods. Optimisation based on a mathematical model. Gradient methods. Artificial intelligence methods in optimisation. Scientific work. Principles of preparing scientific publications • Doctoral candidates' presentations including: the topic of the future doctoral dissertation, the scientific problem, the method of solving the problem, and additional information related to the topic of the future doctoral dissertation. Discussion on the presented presentations.	
Modern IT Techniques	K_W01, K_U05, K_K01
• The impact of IT technologies on the development of science and civilisation – new needs, challenges, and threats. • Examples of applications of artificial intelligence methods in various scientific disciplines. • Basic concepts of artificial intelligence and machine learning. • Algorithms based on expert knowledge and data. • Methods of knowledge extraction from data. • Design of example decision support systems and their applications. • Use of software implementations of artificial intelligence methods in scientific research.	
Legal and Ethical Aspects of Scientific Activity	K_W07, K_W08, K_U02, K_U05, K_K04
• Presentation of the course subject matter. Establishment of course completion rules • General issues of research ethics – typology of ethical violations and their causes, evolution of research ethics in the 20th century, selection of research topics, selection of research methodology • Ethical aspects of experimentation – typology of ethical violations, experimentation on humans and animals, data collection and processing, technical infrastructure in experimentation • Ethical aspects of information processes in scientific research – information process, conducting scientific discussions, publishing research results, reviewing scientific works, applying for research funding • Legal and ethical aspects of intellectual property protection – copyright law, patent law, criticism, and the future of legal intellectual property protection • Ethical aspects of using IT techniques – ethical issues related to IT techniques, IT techniques in research practice, internet ethics • The future of research ethics – education in research ethics, ethics of technoscientific research • Threats in relationships within research teams, e.g., mobbing, appropriation of research results	
Conducting Teaching Activities	K_W01, K_U10, K_K03
Conducting teaching activities prepares for didactic work. The taught subjects are related to the scientific discipline in which the doctoral dissertation is being prepared. • Conducting teaching activities prepares for didactic work. The taught subjects are related to the scientific discipline in which the doctoral dissertation is being prepared. • Conducting teaching activities prepares for didactic work. The taught subjects are related to the scientific discipline in which the doctoral dissertation is being prepared. • Conducting teaching activities prepares for didactic work. The taught subjects are related to the scientific discipline in which the doctoral dissertation is being prepared. • Conducting teaching activities prepares for didactic work. The taught subjects are related to the scientific discipline in which the doctoral dissertation is being prepared. • Conducting teaching activities prepares for didactic work. The taught subjects are related to the scientific discipline in which the doctoral dissertation is being prepared. • Conducting teaching activities prepares for didactic work. The taught subjects are related to the scientific discipline in which the doctoral dissertation is being prepared.	
Doctoral Seminar	K_W01, K_W02, K_W03, K_W04, K_W05, K_W06, K_W07, K_W08, K_U01, K_U02, K_U03, K_U04, K_U05, K_U06, K_U07, K_U08, K_U09, K_U10, K_U11, K_K01, K_K02, K_K03, K_K04

• Doctoral Seminar K_W01, K_W02, K_W03, K_W04, K_W05, K_W06, K_W07, K_W08, K_U01, K_U02, K_U03, K_U04, K_U05, K_U06, K_U07, K_U08, K_U09, K_U10, K_U11, K_K01, K_K02, K_K03, K_K04 • The Doctoral Seminar course is conducted by the supervisor, assistant supervisor, or other persons designated by the head. It particularly concerns conducted research, analysis of research results, preparation of publications, and the doctoral dissertation. • The Doctoral Seminar course is conducted by the supervisor, assistant supervisor, or other persons designated by the head. It particularly concerns conducted research, analysis of research results, preparation of publications, and the doctoral dissertation. • The Doctoral Seminar course is conducted by the supervisor, assistant supervisor, or other persons designated by the head. It particularly concerns conducted research, analysis of research results, preparation of publications, and the doctoral dissertation. • The Doctoral Seminar course is conducted by the supervisor, assistant supervisor, or other persons designated by the head. It particularly concerns conducted research, analysis of research results, preparation of publications, and the doctoral dissertation. • The Doctoral Seminar course is conducted by the supervisor, assistant supervisor, or other persons designated by the head. It particularly concerns conducted research, analysis of research results, preparation of publications, and the doctoral dissertation. • The Doctoral Seminar course is conducted by the supervisor, assistant supervisor, or other persons designated by the head. It particularly concerns conducted research, analysis of research results, preparation of publications, and the doctoral dissertation. • The Doctoral Seminar course is conducted by the supervisor, assistant supervisor, or other persons designated by the head. It particularly concerns conducted research, analysis of research results, preparation of publications, and the doctoral dissertation. • The Doctoral Seminar course is conducted by the supervisor, assistant supervisor, or other persons designated by the head. It particularly concerns conducted research, analysis of research results, preparation of publications, and the doctoral dissertation.	
The Art of Scientific Presentation and Building a Researcher's Image	K_W06, K_W08, K_U06, K_U08, K_U11, K_K01, K_K03
• Basics of communication. Forms of effective verbal communication. Non-verbal communication. • Effective listening. Building a presentation and lecture. Techniques for managing stage fright. • Communication techniques in conflict resolution. Media contact. Public speaking.	
Development Trends in Selected Disciplines in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences 1),2)	K_W01, K_W02, K_W03, K_W04, K_U01, K_U03, K_K01, K_K02, K_K03
The course covers issues related to contemporary trends and development directions in science, related to the field and disciplines in which doctoral candidates prepare their doctoral dissertations. The detailed course content will be determined by academic teachers depending on the research field.	
Development Trends in Selected Disciplines in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences 1),2)	K_W01, K_W02, K_W03, K_W04, K_U01, K_U03, K_K01, K_K02, K_K03
• The course covers issues related to contemporary trends and development directions in science, related to the field and disciplines in which doctoral candidates prepare their doctoral dissertations. The detailed course content will be determined by academic teachers depending on the research field.	
Monographic Lecture in the Field of Technical Sciences, Social Sciences, or Exact and Natural Sciences	K_W01, K_W02, K_W03, K_U03, K_K01
• The course covers issues related to the field and disciplines in which doctoral candidates prepare their doctoral dissertations. The detailed course content will be determined by academic teachers.	
Sources of Research Funding	K_W07, K_U02, K_U03, K_K01, K_K02, K_K03
• Obtaining external funding – main objectives and principles. • Project vs. industry commission in the context of value for institutions and beneficiaries. • Subcontractor vs. partner in a project – advantages and disadvantages. • European vs. national funds. • Horizon Europe – main principles.	