# Resolution No. 41/2026
# of the Senate of Lodz University of Technology
# of 27 March 2026
# on establishing the training program of the Interdisciplinary Doctoral School of Lodz University of Technology

Pursuant to Article 28 (1) (12), Article 200 (3) and Article 201 (4) of the Act of 20 July 2018 – Law on Higher Education and Science (i.e. Journal of Laws of 2024, item 1571, as amended), it is resolved as follows:

§ 1

The training program at the Interdisciplinary Doctoral School of Lodz University of Technology, which is appended to the resolution, is established and applies to doctoral candidates beginning their training in the academic year 2026/2027.

§ 2

The resolution comes into force on 27 March 2026.

Professor Krzysztof Jóźwik Ph.D., D.Sc.
Rector of Lodz University of Technology

*/-signed with a qualified digital signature/*

# The training program at the Interdisciplinary Doctoral School of Lodz University of Technology

§ 1
**General provisions**

1. The training at the Interdisciplinary Doctoral School of Lodz University of Technology (IDS TUL) is conducted on the basis of the training program and the individual research plan (IRP).
2. The training at the IDS TUL prepares for the award of the doctoral degree and ends with the submission of a doctoral dissertation within the deadline specified in the individual research plan.
3. Completion of training at the IDS TUL enables a doctoral candidate to achieve the learning outcomes for qualifications at level 8 of the Polish Qualification Framework for the discipline or field within which the doctoral dissertation is developed, as defined in the Regulation of the Minister of Science and Higher Education of 14 November 2018 on the characteristics of second-level learning outcomes for qualifications at levels 6-8 of the Polish Qualification Framework (Journal of Laws 2018 item 2218).
4. The training at the IDS TUL creates conditions for:
   1) conducting independent research and scientific cooperation in research teams;
   2) preparation by a doctoral candidate of scientific publications and applications for funding of scientific, research and implementation projects;
   3) preparing a doctoral dissertation under the tutorship of a supervisor(s), or a supervisor and an auxiliary supervisor;
   4) participation in the life of the scientific community in Poland and abroad;
   5) obtaining learning outcomes for qualifications at level 8 of the Polish Qualifications Framework and acquiring other skills and experience related to the implementation of the training program and individual research plan.
5. The training program at the IDS TUL is implemented in 12 disciplines as listed below:

**I. In the field of Engineering and Technology:**

1. Materials Engineering
2. Mechanical Engineering
3. Automation, Electronics, Electrical Engineering and Space Technologies
4. Information and Communication Technology
5. Civil Engineering, Geodesy and Transport
6. Architecture and Urban Planning
7. Chemical Engineering

**II. In the field of Natural Sciences:**

8. Chemical Sciences
9. Mathematics
10. Physical Sciences

**III. In the field of Agricultural Sciences**

11. Food and Nutrition Technology

**IV. In the field of Social Sciences**

12. Management and Quality Studies

6. The learning path in each discipline includes the following courses:
   1) Entrepreneurship and the Elements of Law (PEP);
   2) Methodology of Scientific Research (MBN);
   3) Basic courses in the discipline (PP1, PP2, PP3);
   4) Elective course from another discipline (PD);
   5) Elective courses realized as a project (P1, P2, P3);
   6) "Hot Topics in Science and Technology" module;
   7) Research Seminar.
7. The program contents of individual courses are determined by the relevant Discipline Council with a view to achieving the learning outcomes set out in this training program. The program contents are posted on the website of the Interdisciplinary Doctoral School of Lodz University of Technology.
8. The course schedule is as follows:
   1) 1st year:
      a) semester 1 (December, January): PEP and MBN;
      b) semester 2: PP1, PP2, PP3;
   3) 2nd year: P1, P2, P3, PD;
   4) semester 2-6: "Hot Topics in Science and Technology";
   5) semester 1-8: Research Seminar
9. PD is carried out outside the PhD discipline, and P3 outside the PhD area.
10. A doctoral candidate participates in a Research Seminar and in the "Hot Topics in Science and Technology" module as part of the training program. The rules for the implementation of the Research Seminar and the module 'Hot Topics in Science and Technology' are laid down in the Regulations of IDS TUL. The module 'Hot Topics in Science and Technology' is not obligatory for doctoral candidates pursuing the ministerial programme 'Implementation Doctorate'.
11. The doctoral candidate may retake the PEP, MBN, PP1, PP2, PP3 courses once during the second year of training. A course from a different discipline and elective courses are indicated by the doctoral candidate in a declaration submitted to the IDS TUL office by the end of April in the first year of doctoral training.
12. A prerequisite for a doctoral candidate to take the mid-term evaluation is the completion of the core curriculum in the discipline.
13. The training program may provide for teaching internship in the form of teaching or participation in teaching, not exceeding 60 teaching hours per year. The rules of teaching internship implementation are specified in the Regulations of the IDS TUL. The internship is preceded by a preparatory course.
14. By pursuing the training at the Interdisciplinary Doctoral School of Lodz University of Technology, the doctoral candidate achieves the following learning outcomes:

| **Program learning outcomes** | | |
|---|---|---|
| **ID** | **After completing the course, the doctoral candidate** | |
| **In the scope of knowledge (knows and understands how):** | | |
| W1 | identify, on the basis of following published research results, review monographs and technical or art achievements in the world literature, the scope of the current state of knowledge and the main trends of research in the field related to the doctoral dissertation | P8S_WG |
| W2 | correctly interpret the basic legal, economic and financial principles related to scientific, research, implementation and publishing activities and their implications for practice, including the dissemination of knowledge in open access and related legal and ethical issues | P8S_WK |
| W3 | is able to cite and correctly interpret basic issues from a chosen additional discipline not related to the dissertation. | P8S_WG |
| W4 | apply the methodology of conducting, implementing and evaluating research appropriate to the area related to the dissertation | P8S_WG |

| | | |
|---|---|---|
| **In the scope of skills (is able to):** | | |
| U1 | plan research, predict its results and correctly analyse the obtained scientific results, perform analysis and creative synthesis of scientific and creative achievements in order to identify and solve research problems and problems related to innovative activity | P8S_UW |
| U2 | communicate using various communication channels and techniques with specialists in the field of doctoral studies, in the native language and at least one foreign language, taking into account in particular skills related to writing and editing scientific texts, various forms of presentation and conducting discussions, as well as participation, initiating and conducting scientific discourse | P8S_UW<br>P8S_UK<br>P8S_UU |
| U3 | independently acquire knowledge and broaden own competences and take effective action aimed at intellectual development and at managing own scientific development, inspire also the development of other people, participate in the exchange of experiences and ideas within research groups and teams, including in the international environment | P8S_UW |
| U4 | choose a research methodology appropriate to the issue under investigation in relation to the doctoral dissertation | P8S_UO |
| **In the scope of social competence (is ready to):** | | |
| K1 | make a critical assessment and analysis of scientific achievements, including own accomplishments in the field of doctoral studies, implement social tasks related to the ethos of the researcher, carry out activities for the development of the knowledge-based economy | P8S_KK<br>P8S_KO |
| K2 | observe the rights and obligations of the researcher, respect the independence and due diligence of conducting research, comply with applicable legal and ethical standards | P8S_KR |

11. Learning outcomes are acquired as follows:

| | |
|---|---|
| Entrepreneurship and the Elements of Law (semester 1) | W2, U3, K2 |
| Methodology of Scientific Research (semester 1) | W4, U1, U2, K1 |
| Basic course 1 (semester 2) | W1, W4, U3, K1, K2 |
| Basic course 2 (semester 2) | W1, W4, U3, K1, K2 |
| Basic course 3 (semester 2) | W1, W4, U3, K1, K2 |
| Course from another discipline (semester 3-4) | W1, W3, U3, K2 |
| Project 1 (semesters 3-4) | W4, U4, K1 |
| Project 2 (semesters 3-4) | W4, U4, K1 |
| Project 3 (semester 3-4) | W4, U4, K1 |
| Individual research plan (semesters 1-8) | W1, W4, U1, U2, U3, U4, K1, K2 |
| Research Seminar (semesters 1-8)) | W1, W4, U2, K1, K2 |
| Hot Topics in Science and Technology module (semesters 2-6) | W1, U4, K1 |

§ 2
## Individual training plan

1. In justified cases, e.g. for doctoral candidates pursuing the ministerial programme "Implementation Doctorate" or those pursuing an interdisciplinary doctoral dissertation with the assistance of two supervisors from different disciplines, it is possible to implement an individual training plan (IPK).
2. The individual training plan enables the choice of courses from the core curriculum, elective courses and other courses, including those implemented as individual or group projects, also of interdisciplinary character.
3. The doctoral candidate, in close cooperation with his/her supervisor(s) or supervisor and an auxiliary supervisor, prepares the IPK, based on the acquired education and competences, assumptions and objectives of the doctorate, qualification requirements for level 8 of the Polish Qualification Framework and requirements included in the Regulations of the IDS TUL.
4. The implementation of the IPK enables a doctoral candidate to achieve the learning outcomes for the qualification at level 8 of the Polish Qualification Framework for the discipline or field in which the doctoral dissertation is being developed.
5. IPK is approved by the Presidium of the Scientific Council of IDS TUL and a representative of the discipline to the Scientific Council of the IDS TUL in which the doctoral candidate pursues the training.

§ 3
## Description of learning paths

List of attachments to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology, TUL:

1) Appendix No. 1 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Materials Engineering;
2) Appendix No. 2 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Mechanical Engineering;
3) Appendix No. 3 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Automation, Electronics, Electrical Engineering and Space Technologies;
4) Appendix No. 4 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Information and Communication Technology;
5) Appendix No. 5 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Civil Engineering, Geodesy and Transport;
6) Appendix No. 6 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Architecture and Urban Planning;
7) Appendix No. 7 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Chemical Engineering;
8) Appendix No. 8 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Chemical Sciences;
9) Appendix No. 9 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Mathematics;
10) Appendix No. 10 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Physical Sciences;
11) Appendix No. 11 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Food and Nutrition Technology;

12) Appendix No. 12 to the Training Program at the Interdisciplinary Doctoral School of Lodz University of Technology – learning path in the discipline of Management and Quality Studies.

# TRAINING PROGRAM IN DISCIPLINE:
# Materials Engineering

1. Basic information

*Field: Engineering and Technology*
*Discipline: Materials Engineering*
*Degree awarded: PhD in Engineering and Technology in the discipline of Materials Engineering*

2. Training demand

Training in the discipline of materials engineering prepares graduates for employment in scientific laboratories, research and development centers, universities – particularly technical universities – as well as in managerial roles within industry. The aim of the training is to introduce candidates to the latest scientific achievements, and to equip them with the knowledge and practical skills required to conduct scientific research and analyze research results in the area chosen as the subject of their doctoral thesis. There is currently a high demand for graduates of doctoral schools at technical universities who are well-prepared to conduct scientific research.

As part of the training, candidates acquire specialist knowledge in the discipline of materials engineering, broaden their cognitive abilities, and gain the experience and skills necessary for research work.

Upon completion of the training and defense of their doctoral thesis, graduates possess extensive specialist knowledge, the ability to collaborate with domestic and international researchers, and the analytical skills essential for academic work. Candidates who do not plan to pursue an academic career utilize the cognitive abilities and teaching and organizational experience gained during their doctoral training in their subsequent professional careers.

3. Detailed entry requirements

Applicants for admission to the Interdisciplinary Doctoral School of Lodz University of Technology in the discipline of materials engineering must hold a master's degree in one of the following fields of science: engineering and technology, medical and health sciences, natural sciences, agricultural sciences, arts.

4. Teaching methods

The teaching methods include: lectures, tutorials, laboratories, projects, seminars.

5. Graduate's profile

A graduate in materials engineering knows and understands the world's scientific and creative achievements in the discipline of Materials Engineering and the resulting practical applications. They are able to analyze and creatively synthesize academic work, enabling the identification and resolution of research problems, as well as the implementation of innovative projects. They are able to build on these achievements, plan personal development and inspire others to do the same, and exchange experiences and ideas within national and international communities. They are prepared to undertake independent research to expand their scientific and creative output, to face professional and social challenges whilst taking into account ethics and responsibility for the results, and to develop appropriate professional conduct.

The strategic aim of the training is to prepare highly qualified staff for the needs of an innovation-driven industry, to work in consultancy and design firms, companies dealing in engineering materials and specialist research equipment, as well as in laboratories involved in quality control and the certification of engineering materials. This is made possible by innovative and interdisciplinary scientific research and its application in staff

training program in line with the 'knowledge-based society' model. In particular, the aim of the teaching programme is to prepare a specialist who knows and understands the achievements of his/her discipline of interest at the level which allows him/her to revise current paradigms, but also understands the fundamental dilemmas of the present civilization; economical, juridical and other important in the field of research activity. Besides, the aim is to prepare a graduate doctoral candidate to use his/her broad knowledge to identify, formulate and solve complex problems or execute research tasks. Likewise, the aim is to create an awareness of the need of disseminating research results, initiating debates, participating in science discourses, using foreign language at the level allowing to take part in an international scientific and professional environment, as well as planning and pursuing individual and group research or creative undertakings, also in an international environment.

The graduate doctoral candidate understands the need of developing his/her qualifications by taking part in trainings, courses and also doing own scientific research preserving all ethical standards. They are ready to solve problems related to materials engineering, holding to the present state of art.

6. Training program (detailed description)

The training curriculum in the discipline Materials Engineering is designed in full compliance with the requirements of Level 8 of the Polish Qualifications Framework and corresponds to the characteristics of the second cycle of the European Qualifications Framework, applicable to doctoral qualifications. Learning outcomes include advanced fundamental and applied knowledge, the ability to independently define research problems, design and conduct research of a high degree of originality, and social competences related to responsibility for the development of the discipline and the quality of the work carried out. The program takes into account current global trends in materials engineering, including the development of functional and smart materials, materials engineering for the energy transition, the circular economy, and the digitalization of research processes. At the same time, the program is embedded in the broader context of global civilizational challenges, such as sustainable development, the social responsibility of science, research ethics, inclusivity and internationalization, which ensures that graduates are prepared to operate in an international, interdisciplinary and socially responsible scientific and industrial environment. The training process employs modern teaching methods, such as Problem-Based Learning (PBL), Case-Based Learning (CBL), research-based learning and a project-based approach, which foster the development of critical thinking, independent research skills and advanced problem-solving competencies.

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Course title and semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem 1) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1) | L | 15 | 2 |
| D | World Trends in Materials Engineering (Sem. 2) | L | 15 | 2 |
| D | Construction Materials (Sem. 2) | L | 15 | 2 |
| D | Research Methods of Materials Science (Sem. 2) | L | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | "Hot Topics in Science and Technology" (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Mechanical Engineering**

1. Basic information

*Field: Engineering and Technology*
*Discipline: Mechanical Engineering*
*Degree awarded: PhD in Engineering and Technology in the discipline of Mechanical Engineering*

2. Training demand

The Interdisciplinary School of Lodz University of Technology in the discipline of mechanical engineering prepares a highly qualified specialist to work in industry, research units, R&D units and at technological universities. The educational aim of this programme is to introduce gradually the applicant into research works. Within the doctoral school, candidates broaden considerably their general and specialist knowledge, which allows them to conduct individual investigations as well as research and engineering projects in the discipline of mechanical engineering. Doctoral candidates at IDS TUL may also gain didactic and organizational experience, establish scientific contacts through participation in trainings, lectures, conferences, seminars and academic mobility. With the extended scope of knowledge and skills gained, PhD candidates are able to carry out research activities and projects and to implement novel solutions into industrial practice.

3. Detailed entry requirements

According to the legal regulations in force, the formal requirement to be fulfilled by a candidate is to be a graduate of the second-cycle studies and to have a scientific title of Master of Science. It is preferable to be a graduate of a technological university in widely understood mechanical engineering, which, however, does not exclude graduates of programmes of study related to mathematics, applied physics or information technology at technological universities or universities. A candidate should demonstrate a capability of individual work, acquisition and application of knowledge from various disciplines, and show predispositions for objective analysis and evaluation of the collected observations and results of investigations.

4. Teaching methods

Teaching methods vary from course to course and during the course reflecting the teaching attitude towards mechanical engineering and demands of material being presented. These comprise lectures, presentations with details being presented on the board, research seminars, projects and case study problem solving tutorials. Most often, mixed methods are employed in course. Level of the courses is based on the profile of candidates as well as the chosen methods.

5. Graduate’s profile

An IDS TUL graduate in mechanical engineering demonstrates extensive knowledge in fundamental and applied sciences related to mechanical engineering and acquired skills allowing for solving interdisciplinary problems. He/she is prepared to implement modern methods, technical solutions and technologies while designing mechanical systems. The graduate is able to use advanced analytical, computational and experimental techniques in the discipline of mechanical engineering. He/she is prepared to participate in computer-aided projects. Graduates are capable of acquiring and widening their knowledge on the basis of literature in the range required during work and can analyze critically the proposed solutions, indicate crucial limitations of the issues being

solved and solve creatively the problems involved. The graduate can apply the knowledge acquired to solve selected scientific and technical problems, plan and analyze the results of experimental investigations. The extended scope of knowledge and the skills acquired enable him/her to conduct research and project activities and implement novel solutions into industrial applications. On graduating from the doctoral school and having written a PhD dissertation, the candidate demonstrates broad specialist knowledge, an ability to participate in scientific cooperation with other centers in Poland and abroad. The graduate shows research skills indispensable in further scientific work as well as research and implementation activities. The potential labor market for the graduate covers technological universities, companies active in the discipline of mechanics and machine development and maintenance, designing, industrial technologies, IT, as well as R&D departments and design offices in manufacturing companies. The technical solutions graduates arrive at individually can be employed in their own innovation and implementation start-ups or technical support companies.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/ Second half) | T | 15 | 2 |
| D | Mathematical Modelling I (Sem. 2) | L | 15 | 2 |
| D | Mathematical Modelling II (Sem. 2) | L, S | 15 | 2 |
| D | Mathematical Modelling - project (Sem. 2) | P | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | „Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Automation, Electronics, Electrical Engineering and Space Technologies**

1. Basic information

*Field: Engineering and Technology*
*Discipline: Automation, Electronics, Electrical Engineering and Space Technologies*
*Degree awarded: PhD in Engineering and Technology in the discipline of Automation, Electronics, Electrical Engineering and Space Technologies*

2. Training demand

The development of knowledge-based economy and industry 4.0 requires new technologies in the field of automation, electronics, electrical engineering and space technologies which increases the demand for high-class specialists, including Ph.D. in engineering and technical sciences, employed in higher education institutions, research and development units, management consulting companies, as well as in small and medium-sized enterprises. Graduates are expected to possess in-depth and theoretically sound knowledge of their discipline, an awareness of emerging trends, and the ability to think creatively and innovatively. It is also important to be able to lead a team, set priorities, and manage one's own time as well as that of others.

3. Detailed entry requirements

Doctoral candidates may qualify for admission if they have a master's degree in science or master's degree in engineering, in particular in the following disciplines: automation, electrical engineering, electronics, energy. Candidates should demonstrate the ability to present and defend their research plans, to evaluate and comment on the work of others, to participate in discussions on technical and scientific issues, to organize their self-education, and to conduct self-directed research. They should also be able to acquire and apply the knowledge of other disciplines.

4. Teaching methods

Teaching methods vary depending on the course and the way it is delivered, reflecting the requirements of the subject matter. They include traditional lectures, tutorials, laboratories, projects, research seminars. The offered courses enhance knowledge in electrical, electronic, automation engineering and related areas. The level of the courses depends on the profile of the doctoral candidates, as do the methods that will be implemented in the training.

5. Graduate's profile

A graduate has a detailed knowledge corresponding to his/her own area of scientific research in automation, electronics and electrical engineering and space technologies. A young scientist is prepared to manage their own research team. They are able to manage R&D departments and create independent businesses such as spin off/out or start up. A graduate has the ability to modify, evaluate and consult new solutions in terms of their efficiency, profitability and innovation. They are able to critically review research data, draw conclusions, present and defend their own opinions. They also have basic teaching skills. A graduate pursues research ethos that promotes exceptional expertise as well as ethical responsibility in the quest for knowledge and the development,

conservation and transfer of such knowledge. They are aware of their professional responsibilities to society and to the specific communities in which they work.

PhD in Automation, Electronics, Electrical Engineering and Space Technologies is highly valuable and opens up employment opportunities across a wide range of sectors, including corporate research and development departments, universities and the small and medium-sized enterprise sector. Thanks to a comprehensive education a graduate can be a leader of design and creative teams. They can work in consulting companies, and in the state/local government sector (public sector agencies, local government).

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/ second half) | L/T | 15 | 2 |
| D | Signals and Systems (Sem. 2) | L/S | 15 | 2 |
| D | Modeling of Dynamical Systems (Sem. 2) | L/LB | 15 | 2 |
| D | Statistics for Control, Electronic, and Electrical Engineering (Sem. 2) | L/P | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | “Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Information and Communication Technology**

1. Basic information

*Field: Engineering and Technology*
*Discipline: Information and Communication Technology*
*Degree awarded: PhD in Engineering and Technology in the discipline of Information and Communication Technology*

2. Training demand

Development of a knowledge-based economy in new technologies in the discipline of information and communication technology raises the demand for high-class specialists, including degree of doctor of technical sciences, employed in scientific institutions, research and development units, consulting and advisory boards, as well as in the small and medium sector companies. IDS TUL prepares the most talented candidates to write and defend dissertations.

3. Detailed entry requirements

Completing the master's degree in technical sciences or exact sciences, in particular in the following fields of study: electrical engineering, electronics and telecommunications, automation and robotics, computer science, biomedical engineering, information technology or applied mathematics. Candidate should show the ability to self-education, organization of his or her own work, presentation, discussion and communication skills.

4. Teaching methods

Lectures, individual and group projects, laboratory sessions, seminars.

5. Graduate's profile

Doctorate holder in information and communication technology knows and understands the worldwide scientific knowledge related to the area of PhD thesis and their implications for practical applications, especially in the discipline of engineering. The graduate can perform thorough analysis and synthesis of scientific results in order to identify and solve research tasks with introduction of innovative solutions and observations. The graduate can plan development and inspire others to participate in discussions, problem solving, also in an international environment. The graduate is ready to start independent scientific research, undertake challenges both in science and society, putting emphasis on ethical aspects and social impact of undertaken tasks.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University f Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/ Second half) | S | 15 | 2 |
| D | Advanced Data Processing Algorithms and Structures (Sem. 2) | P | 15 | 2 |
| D | Advanced Human-Computer Interaction Methods (Sem. 2) | P | 15 | 2 |
| D | Computational Intelligence (Sem. 2) | P | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | “Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Civil Engineering, Geodesy and Transport**

1. Basic information

*Field: Engineering and Technology*
*Discipline: Civil Engineering, Geodesy and Transport*
*Degree awarded: PhD in Engineering and Technology in the discipline of Civil Engineering, Geodesy and Transport*

2. Training demand

The dynamic growth of the knowledge-based economy generates a constant demand for highly qualified experts capable of operating at the interface between science and modern industry. The discipline of civil engineering, geodesy and transport form the foundation of strategic economic sectors such as advanced structural design, materials engineering, sustainable construction and intelligent transport systems.
Key reasons justifying the training:

- Labor market responsiveness: Analyses of employment trends indicate that specialists in civil engineering and transport have one of the highest rates of professional activity. This stems from a unique combination of advanced theoretical knowledge with practical analytical skills, enabling the efficient resolution of complex technical problems.
- Fostering innovative attitudes: The doctoral training process promotes methodological rigor and the ability to anticipate technological risks and opportunities. These competencies are essential in an innovation-driven economy, where critical analysis of details and the ability to forecast technical outcomes determine competitive advantage.
- Bridging the generational gap in academia: The generational gap observed in the Polish higher education system creates a real need to train a new generation of academic and teaching staff. The program prepares future assistant professors and research team leaders capable of raising the quality of education at higher education level and in elite technical education institutions.
- Interdisciplinarity and knowledge transfer: Graduates with the skills to conduct interdisciplinary research become catalysts for change in industry and science. Their ability to combine different fields of engineering enables the creation of innovative research directions and the effective transfer of technology to the R&D (Research & Development) sector.

3. Detailed entry requirements

The admissions process for the Interdisciplinary Doctoral School of Lodz University of Technology in the discipline of civil engineering, geodesy and transport is aimed at candidates demonstrating high research potential and a solid academic grounding in the field of technical sciences.

Academic requirements:

- Educational background: Applications are open to graduates of second-cycle (or long-cycle Master's) degree programs in civil engineering, mechanical engineering, materials engineering and related fields, provided that their curriculum has provided an adequate foundation for conducting research in the chosen discipline.
- Language skills: Candidates should demonstrate a command of English sufficient to enable them to use academic literature fluently and present research findings at an international level.

Pre-application recommendations:

- Choice of supervisor: Applicants are advised to contact a potential supervisor or scientific advisor before the formal recruitment process begins. Reaching a preliminary agreement on the scope of collaboration and obtaining approval for the research proposal is crucial to the success of the PhD project.
- Analysis of research areas: Given the specific nature of the research units at Lodz University of Technology, prospective doctoral candidates should conduct a detailed review of the topics covered in seminars and the research profiles of groups operating within the discipline.
- Alignment of research topics: Choosing a preferred research group is highly recommended due to the university's specialized focus. Admission should be based on an analysis of the available research infrastructure and current directions of scientific development at Lodz University of Technology (taking into account the fact that the curriculum does not cover all sub-disciplines of civil engineering).

4. Teaching methods

The teaching process in the discipline of civil engineering, geodesy and transport is based on a combination of advanced theory and research practice. Teaching methods are closely tailored to the specific nature of the modules and the individual academic needs of doctoral candidates, promoting an interdisciplinary approach to solving complex engineering problems.

Teaching methods used:
- Laboratory and experimental classes: Conducted using unique research equipment and the latest measurement techniques, enabling world-class materials and structural research.
- Project-based and problem-solving methods: Analysis of case studies and solving real-world engineering problems using specialist engineering software.
- Modelling and numerical methods: Intensive training in the development of proprietary numerical codes and the implementation of algorithms for the analysis of non-linear problems in structural mechanics and transport.
- Seminars and academic discourse: Interactive teaching methods that encourage the exchange of research findings, critical analysis of international literature, and the development of doctoral candidates' research skills.
- Lecture-based and blended methods: A combination of traditional academic lectures with modern multimedia tools, enabling the optimization of knowledge transfer.

Scope of content and personalization:

The curriculum offers a broad spectrum of training that covers, among other things, theoretical and applied mechanics, materials engineering, construction chemistry, and advanced concrete and steel structures. The academic level of the courses and the selection of teaching tools are subject to flexible adaptation, taking into account the doctoral candidate's research profile and the requirements placed on modern engineering and technical staff.

5. Graduate's profile

A graduate of the Interdisciplinary Doctoral School of Lodz University of Technology in the discipline of civil engineering, geodesy and transport is a highly qualified researcher, equipped to independently lead research projects and implement innovative solutions in the field of advanced engineering technologies.

Knowledge and substantive competences:
- Expertise in the field: The graduate possesses in-depth, systematic knowledge of global scientific literature within their specialization and related disciplines. They demonstrate proficiency in advanced topics in microstructural materials mechanics, metaphysical problems and thermomechanics, understanding their theoretical foundations and practical technical implications.

• Understanding of the application context: They are able to identify links between the results of basic research and their potential for implementation in various branches of engineering and industry.

Research and analytical skills:
• Innovative problem-solving: Thanks to the ability to critically analyze and synthesize scientific results, the graduate is able to independently identify research gaps and formulate and solve complex, innovative tasks.
• Technical proficiency: They efficiently select and utilize advanced research tools, numerical methods and measurement techniques, ensuring the highest reliability of the cognitive processes undertaken.
• Communication and international collaboration: They are prepared to participate actively in the international scientific community, are able to present research findings and stimulate discussion within a global context.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School od Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/ Second half) | T | 15 | 2 |
| D | Physics of Building Materials (Sem. 2) | L | 15 | 2 |
| D | Reliability and Optimization in Civil Engineering (Sem. 2) | L | 15 | 2 |
| D | Computational methods in non-linear solid mechanics (Sem. 2) | L | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | “Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Architecture and Urban Planning**

1. Basic information

*Field: Engineering and Technology*
*Discipline: Architecture and Urban Planning*
*Degree awarded: PhD in Engineering and Technology in the discipline of Architecture and Urban Planning*

2. Training demand

The Institute of Architecture and Urban Planning at Lodz University of Technology is one of the leading centers in the Central Poland microregion, dedicated to training doctoral candidates in the discipline of urban planning and architecture. The Interdisciplinary Doctoral School of Lodz University of Technology prepares doctoral candidates for work in academic institutions, research and development units, and higher education institutions – particularly technical universities – by gradually introducing candidates to academic work using the latest scientific achievements and findings in the discipline of their choice. Graduates of the IDS TUL possess not only in-depth specialist knowledge, but above all a unique ability to synthesize complex spatial problems, which allows them to flexibly shape their career path in a dynamically changing economic environment that extends beyond the discipline of architecture and urban planning.

3. Detailed entry requirements

The formal requirement for applicants to the IDS TUL is completion of a second-cycle degree in architecture. Applicants are expected to demonstrate:

1) **research competence** – the ability to work independently, define research problems, and demonstrate proficiency in the objective analysis and evaluation of collected observations and research findings;
2) **analytical aptitude** – the ability to acquire and apply knowledge from various fields and disciplines;
3) **methodological awareness** – the submission of a preliminary concept for a doctoral thesis.

4. Teaching methods

Teaching at the IDS TUL is based on the Research-led Teaching model. Teaching methods are tailored to each subject, reflecting the pedagogical approach to architecture and urban planning as well as the requirements of the material covered. These include, amongst others:

1) expert and discussion seminars;
2) research workshops;
3) Design Thinking;
4) case studies;
5) meetings with renowned theorists and practitioners from leading global centers, aimed at exchanging experiences and methodologies.

5. Graduate's profile

Graduates of the Interdisciplinary Doctoral School of Lodz University of Technology are independent researchers who are able to apply the current state of scientific knowledge in the discipline of architecture and urban planning with ease. As they progress in their careers, they hone their practical and theoretical skills in an

interdisciplinary manner. During their studies, they acquire knowledge of the most advanced trends under the guidance of lecturers from institutions in Poland and abroad. IDS TUL prepares young researchers both for independent research and for collaboration within research teams, for the implementation of new techniques and technologies used in the discipline of architecture and urban planning, as well as for the creation of independent entities such as spin-offs or start-ups. Furthermore, they acquire the knowledge required to work in organizations linked to local and central government administration, cultural institutions, and activities within the creative industries. They develop competencies in strategic consultancy, with a particular focus on efficiency, cost-effectiveness and innovation, including within the broader context of sustainable development.

Graduates of IDS TUL can find employment in sectors related to architecture, urban planning, design and culture in the broadest sense. They are ready to take on managerial roles in the creative sector and have the ability to develop innovative solutions in leading centers in the field of architecture and urban planning.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/ Second half) | T | 15 | 2 |
| D | Aesthetics and Aesthetics of Architecture (Sem. 2) | L | 15 | 2 |
| D | Heritage Conservation and Urban Regeneration within the Architecture and Urban Planning Research Domain (Sem. 2) | L | 15 | 2 |
| D | Research Methods in Urban Studies (Sem. 2) | L | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | “Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Chemical Engineering**

1. Basic information

*Field: Engineering and Technology*
*Discipline: Chemical Engineering*
*Degree awarded: PhD in Engineering and Technology in the discipline of Chemical Engineering*

2. Training demand

The current demand for highly qualified engineering staff is very high and comes from the needs of higher education and research institutes, both in Poland and abroad. Our own analysis shows that doctoral candidates often receive job offers even during their doctoral training. Some of them are sent to a doctoral school by their employers. Rapid development of economy, science and industry allows for the assumption that this trend will continue in the coming years.

3. Detailed entry requirements

The formal requirement for candidates is the graduation from MSc course in chemical engineering or other technical course of a similar scope. In addition, the candidate should demonstrate the ability to work on their own, the ability to acquire and apply knowledge from various fields, as well as demonstrate predispositions for the objective analysis and evaluation of the collected observations and experimental results.

4. Teaching methods

Lectures, tutorials, laboratories, projects, research seminars.

5. Graduate's profile

The graduates of the IDS TUL in the discipline of chemical engineering are fully skilled persons in terms of scientific knowledge in chemical and process engineering. By developing their scientific and professional careers they improve the practical applications of this area of knowledge, also taking environmental problems into account, developing and designing research and industrial installations. In the course of training, they gain knowledge related to the most advanced technologies and development trends under the supervision of lecturers from Polish and foreign scientific centers. Ultimately, doctoral candidates are directed to thoroughly study the issues related to their individual doctoral theses. Advanced design and laboratory work prepare young scientists for the tasks related to the creation of their own research teams, managing R&D departments in enterprises, creating the consortia for developing new technologies, development of products, processes and services as well as creating the independent entities like spin off/out or start-ups. In addition, they gain knowledge required to work in institutions related to technical and process safety. They can also modify, evaluate and consult new technological and product solutions in terms of their efficiency, profitability and innovativeness, also in the wider context of a sustainable and low-carbon circular economy.

For the specialists in this area all industries and institutions associated with advanced chemical engineering are open. These are processing, chemical, pharmaceutical and food industries, energy production, renewable energy sources sector. Referring to the experience of economies of innovation leaders, we are fully convinced that people with a PhD degree in chemical engineering are not only talented scientists, but they also represent the most valuable and creative human capital – as the middle and senior management in the industry and business. They

also create breakthrough technologies and solutions in the leading research and development centers. The important sectors of employment for our graduates are also state and local government administration institutions as well as NGOs. They are looking for our graduates to work as specialists carrying out expert, advisory and supervisory tasks to ensure environmental safety, the safety of production processes and product safety.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/ Second half) | T | 15 | 2 |
| D | Transport Phenomena 1 (Sem. 2) | L | 15 | 2 |
| D | Transport Phenomena 2 (Sem. 2) | L | 15 | 2 |
| D | Introduction to Chemical Reactor and Bioreactor Engineering (Sem. 2) | L | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | “Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Chemical Sciences**

1. Basic information

*Field: Natural Sciences*
*Discipline: Chemical Sciences*
*Degree awarded: PhD in Natural Sciences in the discipline of Chemical Sciences*

2. Training demand

IDS TUL is the only institution in central part of Poland to educate doctors of natural sciences in the discipline of chemical science, in 1. chemistry or 2. chemical technology, having engineering background. The studies shall prepare the candidate for work in research units, research and development units, universities - especially technical universities - by gradually introducing the candidate to research work using the latest achievements and results of scientific work in the field of doctoral studies chosen by the candidate. After obtaining doctorate, the graduates have not only extensive knowledge of chemistry and chemical technology, but also the ability to define and synthetically describe problems, analyze and propose solutions. These features allow them to adapt flexibly to work in areas related not only to chemistry.

3. Detailed entry requirements

IDS TUL accepts graduates of master courses: chemistry, chemical technology, chemical engineering, material engineering, physics and related disciplines (e. g. biochemistry, biophysics), not necessarily completed at polytechnic faculties. In addition, the candidate should demonstrate the ability to work independently, to acquire and apply knowledge in a variety of fields, and to demonstrate aptitude for objective analysis and evaluation of the observations made and collected results of the research.

4. Teaching methods

Lectures, tutorials, laboratories, projects, research seminars.

5. Graduate's profile

IDS TUL prepares graduates to work in research and development units and universities, especially technical universities. The graduate has extensive and in-depth knowledge of concepts, principles and theories in the discipline of chemistry and chemical technology, with particular emphasis on the areas related to the prepared doctoral thesis, which was gained under the supervision of researchers, including those from renowned foreign centres. The graduate is able to work with the use of modern research techniques, knows the mechanisms for raising funds for scientific research and implementation work from both domestic and international sources, and is prepared to work independently or in a group – including international ones. Advanced design and laboratory works prepare young scientists for tasks related to creating their own research teams, managing R&D departments in enterprises, creating consortia developing new technologies, developing products, processes and services – as well as creating independent entities such as spin off/out or start-ups. They can also modify, assess and consult on new technological and product developments in terms of their efficiency, cost-effectiveness and innovativeness – including in the broader context of a sustainable and low-carbon circular economy. Graduates are able to conduct didactic classes at the first and second level of studies, they are also able to conduct scientific research in

accordance with the rules of ethics in science and technology. Graduates understand the need for continuous learning and maintaining the ethos of research community.

The specialists in these areas are also awaited by industries and institutions related to advanced materials, technology of production and processing. It is primarily the chemical industry in its broadest sense, but also, among others, the agro-food industry, pharmaceuticals, construction chemicals, transport sector and automotive industry. Based on the experience of innovation leader economies, it can be said with confidence that doctorate holders in chemical sciences are not only talented scientists, but also the most valuable and creative individuals – as middle and senior management both in industry and business. This group will be also able to create breakthrough material solutions and technologies in leading research and development centres. An important sector for employment is central and local government bodies, as well as non-governmental organizations, which seek out these graduates for expert, advisory and supervisory roles in areas such as environmental safety, production processes, occupational safety, product safety, etc.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Course | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/second half) | P | 15 | 2 |
| D | Advanced Inorganic and Organic Chemistry (Sem. 2) | P | 15 | 2 |
| D | Advanced Molecular and Macromolecular Materials Science (Sem. 2) | L | 15 | 2 |
| D | Advanced Physical Chemistry (Sem. 2) | L | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | “Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Mathematics**

1. Basic information

*Field: Natural Sciences*
*Discipline: Mathematics*
*Degree awarded: PhD in Natural Sciences in the discipline of Mathematics*

2. Training demand

The knowledge-based society requires highly skilled experts in various branches of industry, banking system, high schools ranking among the top ones, higher education and research and development units. According to the thorough investigations mathematicians are commonly those with lowest unemployment rate for the PhDs. This is a consequence of training which is being implemented, and which is based on utmost scrutiny and a high-level analysis. Moreover, mathematical research skills lead to the habit of checking all details and foreseeing possible opportunities which is believed to be indispensable in a modern society. With such a profile of research and related skills PhD holders in mathematics are especially valued as possible employees in areas that require sophisticated analytical skills not to be learned through traditional courses. Last but not least there is some demand of employing new instructors and assistant professors at universities and colleges in Poland due to the fact of increasing generation gap that has been observed. Moreover, graduates with an attitude to interdisciplinary research will bring some new ideas and may influence future research directions.

3. Detailed entry requirements

Mathematics graduates are eligible for training in the Interdisciplinary Doctoral School of Lodz University of Technology. The candidates are advised to get in touch with possible future supervisors and start cooperation prior to the examination procedure. Future candidates are advised to investigate topics related to seminars held in the discipline of mathematics and at Lodz University of Technology as well as the formal and informal research requirements demanded by research groups. The choice of preferable research group prior to entrance examination is warmly advised since not all existing main branches of mathematics are present at TUL.

The enrolment exam includes a discussion on mathematical interests of candidates pertaining to:

1) their MSc. thesis whose main ideas are to be presented and suitably commented;
2) scientific achievements obtained so far – if any;
3) oral exam covering the following topics (questions are formulated by the committee during discussion):
   a) mathematical analysis (continuity, differentiability and integrability of functions of one and several variables - basic notions, theorems and relations),
   b) fundamental notions and theorems in functional analysis (examples of Banach and Hilbert spaces, theorems of Hahn-Banach, Banach-Steinhaus and Banach-Alaoglu, open mapping and closed graph theorems) with necessary background information,
   c) fundamentals in topology (continuity, compactness, connectedness, homeomorphisms),
   d) Lebesgue measure and integration (construction, integrability, modes of convergence, comparison with the Riemann Integral integral),
   e) numerical analysis and differential equations (algorithm, convergence, approximation vs interpolation, solvability, uniqueness, continuation),
   f) basics of probability theory (random variables and their characteristics, laws of large numbers, central limit theorem),
   g) linear algebra (Jordan matrices, eigenvalues, linear mappings),

h) discrete mathematics (induction, recurrence, relational structures, basics of combinatorics and graph theory).

4. Teaching methods

Teaching methods vary from course to course and during the course reflecting the teaching attitude towards mathematics and demands of material being presented. These comprise traditional board and chalk lectures, presentations with details being presented on the board, seminars, projects and case study problem solving tutorials. Very often a sort of mixed method is employed. Offered courses allow for broadening mathematical knowledge and developing mathematical skills. Level of the courses is based on the profile of candidates and so are the methods which would be chosen through the course.

5. Graduate's profile

A graduate of IDS TUL in the discipline of mathematics knows and understands the worldwide scientific knowledge related to the area of PhD thesis and its implications for practical applications, especially in the discipline of engineering. The graduate can perform thorough analysis and synthesis of scientific results in order to identify and solve research tasks with the introduction of innovative solutions and observations. The graduate can plan development and inspire others to participate in discussions, problem solving, also in an international environment. The graduate is ready to start independent scientific research, undertake challenges both in science and society, putting emphasis on ethical aspects and social impact of undertaken tasks.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/ Second half) | T | 15 | 2 |
| D | Modern Mathematical Analysis (Sem. 2) | L | 15 | 2 |
| D | Stochastic Processes (Sem. 2) | L | 15 | 2 |
| D | Selected Problems in Graph Theory (Sem. 2) | P | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | "Hot Topics in Science and Technology" (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Physical Sciences**

1. Basic information

*Field: Natural Sciences*
*Discipline: Physical Sciences*
*Degree awarded: PhD in Natural Sciences in the discipline of Physical Sciences*

2. Training demand

The PhD training program in physics prepares the PhD candidates for work in research units, research and development units, universities - especially technical universities. The aim of the training program is to gradually introduce a candidate to research work and expose her/him to the latest achievements and scientific results in the discipline of physics. In science faculties of both technical universities and universities, there is a "generation gap" among those conducting research. There is a need for staff trained to conduct research and didactic work at faculties of exact sciences.

3. Detailed entry requirements

Completing the master's degree, or equivalent, in physics, chemistry or other disciplines of science, allowing a candidate to undertake training in physics. PhD candidates need to show good performance at undergraduate level. Admission to IDS TUL in the discipline of physical sciences is on competitive base. The candidates are advised to get in touch with possible supervisors and discuss the topic of the future research project, prior to the interview. During the interview candidates are required to be able to briefly present their MSc thesis and other scientific achievements, future goals, and to prove knowledge of physics at undergraduate level.

4. Teaching methods

Teaching methods are course dependent and include: lectures, tutorials, laboratory, research seminars, participation in workshops, conferences. Collaborative work in research groups.

5. Graduate's profile

After completing a program in physics and obtaining a PhD degree a graduate not only has an extensive knowledge in this discipline, but also has the ability to set, analyze and propose solutions to problems and their synthetic description. A graduate is capable of establishing collaborations and conducting team research projects in international environment. The graduate is ready to start independent scientific research, undertake challenges both in science and society, putting emphasis on ethical aspects and social impact of undertaken tasks.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1) | T | 15 | 2 |
| D | Current Trends in Physical Sciences 1 (Sem. 1) | L | 15 | 2 |
| D | Advanced Research Planning and Management in Physical Sciences (Sem. 2) | L | 15 | 2 |
| D | Current Trends in Physical Sciences 2 (Sem. 2) | L | 15 | 2 |
| AD | Elective course from different discipline (second year) | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | “Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Food and Nutrition Technology**

1. Basic information

*Field: Agricultural Sciences*
*Discipline: Food and Nutrition Technology*
*Degree awarded: PhD in Agricultural Sciences in the discipline of Food and Nutrition Technology*

2. Training demand

The mission of the Interdisciplinary Doctoral School of Lodz University of Technology in the field of agricultural sciences in the discipline food and nutrition technology is to multiply and disseminate knowledge, aiming at educating highly qualified staff for the needs of the economy and administration. The primary goal is to educate graduates with interdisciplinary knowledge who can use it in both research and practice. Another goal is to teach graduates the ability to present and publish results of their research and to defend their research theories. The IDS TUL graduates after obtaining the degree of doctor of agricultural sciences in the discipline of food and nutrition technology, due to the interdisciplinary nature and multi-directional training program have extensive knowledge related not only to the basic discipline, but also broadly understood biotechnology and chemical engineering.

3. Detailed entry requirements

A formal requirement for candidates to IDS TUL is the completion of master's studies in food and nutrition technology or chemical engineering or other related fields. In addition, the candidates should demonstrate the ability to work independently, the ability to acquire and apply knowledge in various fields, as well as demonstrate predispositions for objective analysis and evaluation of collected observations and research results.

4. Teaching methods

Lectures, tutorials, laboratories, projects, research seminars.

5. Graduate’s profile

The graduates know and understand world scientific and creative achievements and practical implications resulting from them. They are able to analyze and creatively synthesize scientific and creative achievements in order to identify and solve research problems and issues related to innovative and creative activities as well as to contribute new elements to these achievements. The graduates can consciously and independently plan their development and inspire the development of other people and participate in the exchange of experiences and ideas in the national and international environment. They are ready to undertake independent studies enlarging the existing scientific and creative achievements, taking up challenges in the professional and public sphere, taking into account their ethical dimension and responsibility for their effects and shaping patterns of proper behavior in such situations. Graduates will find employment at domestic and foreign universities as well as in research and development centers as researchers and scientists. They will be highly qualified staff of modern enterprises that implement production processes using waste-free innovative technologies in areas such as biotechnology, agri-food, cosmetics and pharmaceutical industries. They can also modify, evaluate and consult new technological and

product solutions in terms of their efficiency, profitability and innovation – also in the wider context of a sustainable and low-carbon circular economy.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS TUL – organized by the Interdisciplinary Doctoral School of Lodz University of Technology
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/second half) | T | 15 | 2 |
| D | Modern Trends in Food Technology (Sem. 2) | L/LB | 15 | 2 |
| D | Advances in Fermented Food and Beverages (Sem. 2) | L/LB | 15 | 2 |
| D | Modern Microbiological Analysis in Food Industry (Sem. 2) | L | 15 | 2 |
| AD | Elective course from additional discipline | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | “Hot Topics in Science and Technology” (Sem. 2-6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |

**TRAINING PROGRAM IN DISCIPLINE:**
**Management and Quality Studies**

1. Basic information

*Field: Social sciences*
*Discipline: Management and Quality Studies*
*Degree awarded: PhD in Social Sciences in the discipline of Management and Quality Studies*

2. Training demand

The modern economy is undergoing profound technological, social and environmental transformation. The digitalization of business processes, the development of artificial intelligence and data analytics, the globalization of markets, regulatory pressure in the area of sustainable development, and stakeholders' growing expectations regarding organizational responsibility mean that management is becoming a field requiring advanced scientific knowledge and analytical skills. Organizations operate in conditions of high uncertainty and dynamic change, which increases the demand for specialists capable of conducting in-depth research into the mechanisms of business models, management processes and modern management tools. In these circumstances, the importance of training doctoral candidates in the discipline of management and quality studies, prepared to conduct independent theoretical and applied research, is growing. It is becoming particularly important to develop competencies in quantitative and qualitative methods, data analysis, the design of empirical research, and the transfer of knowledge to business practice. There is therefore a need for training in the discipline of management and quality studies focused on systematically introducing candidates to academic activity, enabling them to develop specialist knowledge and research competencies in line with current global trends.

3. Detailed entry requirements

The formal requirement for candidates to IDS TUL is to have a master's diploma or an equivalent diploma. In addition, the candidate should demonstrate the predisposition to scientific and research work, the ability to work independently, the ability to acquire and apply knowledge from various fields, as well as the predispositions for objective analysis and evaluation of the own observations and collected research results.

4. Teaching methods

Lectures, tutorials, laboratories, projects, research seminars.

5. Graduate's profile

Graduates of the Interdisciplinary Doctoral School in the discipline of management and quality studies are prepared to work in research and development units and higher education institutions, where they may hold research and research-teaching positions, as well as in the business sector and public administration, where they may perform expert and strategic roles. Graduates possess in-depth theoretical knowledge in the field of management and quality studies, as well as advanced methodological skills, enabling them to independently design and conduct research in accordance with international quality standards. They also possess the skills to diagnose and resolve complex organizational and managerial problems, as well as to design and implement modern management solutions. The implementation of research projects prepares young researchers for tasks related to establishing their own research teams, managing R&D departments in companies, forming international

consortia, developing products, processes and services, as well as establishing independent entities such as spin-offs or start-ups.

6. Training program (detailed description)

Format (Lecture – L, Tutorial – T, Laboratory – LB, Project – P, Seminar – S)
D – organized by the discipline
IDS – organized by the doctoral school
AD – elective course from the university offer from different discipline

| Unit | Semester | Format | No. of hrs | ECTS |
|---|---|---|---|---|
| IDS TUL | Entrepreneurship and the Elements of Law (Sem. 1/ second half) | L/T | 25 | 2 |
| D | Methodology of Scientific Research (Sem. 1/ Second half) | L/T | 15 | 2 |
| D | Management Concepts (Sem. 2) | L/T | 15 | 2 |
| D | Quantitative Methods in Social Sciences (Sem. 2) | L | 15 | 2 |
| D | Qualitative Methods in Social Sciences (Sem. 2) | L/T | 15 | 2 |
| AD | Elective course from additional discipline | L | 15 | 1 |
| D | Elective project 1 (second year) | P | 15 | 1 |
| D | Elective project 2 (second year) | P | 15 | 1 |
| D | Elective project 3 (second year) | P | 15 | 1 |
| D | „Hot Topics in Science and Technology" (Sem. 2-Sem. 6) | S | 10 | N/A |
| D | Research Seminar (Sem. 1-Sem. 8) | S | 40 | N/A |
| **Total** | | | **195** | **14** |