POZNAN UNIVERSITY OF TECHNOLOGY

CURRICULUM OF STUDIES

1. **General characteristics of the programme**

2. **Name of the degree programme:**
   Bioinformatics
   Specialisations: none

3. **Level of studies:** second-cycle studies

4. **Level of the Polish Qualifications Framework:**
   Seventh

5. **Form of studies:** full-time studies

6. **Profile of studies:**
   general academic

7. **Professional title awarded to graduates:**
   Master of Science Engineer

8. **Field of science/arts and scientific/artistic discipline:**
   The studies are conducted at the Faculty of Computing and Telecommunications, Poznan University of Technology, in cooperation with the Faculty of Chemical Technology, Poznan University of Technology.

   Percentage distribution of fields and disciplines

Field of Science	Discipline	Percentage of ECTS credits (%)	Leading discipline
Engineering and technology	Technical computer science and telecommunications	60	YES
Natural sciences	Chemical sciences	40	

9. **ISCED classification:**
   0688 Interdisciplinary programmes and qualifications involving information and communication technologies

10. Number of semesters:

3

11. Number of ECTS credits required to obtain the qualification:

90

Number of ECTS credits required to obtain the qualification.

Allocation of ECTS credits	Number of ECTS credits	Percentage
In the programme required to obtain a qualification corresponding to the level of education.	90	100%
For classes requiring direct participation of academic teachers and students.	45	50%
Classes connected with research conducted in the field(s) of science relevant to the assessed programme of study, aimed at enabling students to acquire in-depth knowledge and research skills.	58	64,4%
Classes from the areas of humanities or social sciences (in the case of degree programmes assigned to fields other than, respectively, humanities or social sciences).	5	
Elective subjects.	31	34,4%
Professional internships (if included in the programme).	Not applicable	' ■
Using distance learning methods and techniques.	Not applicable	Not applicable

12. Language of instruction:

Polish

13. Total number of hours in the programme:

1,129 hours

14. Learning outcomes:

The learning outcomes for the Bioinformatics programme implement qualifications in accordance with the Regulation of the Minister of Science and Higher Education of 28 November 2018 on second-cycle characteristics of the Polish Qualifications Framework, typical for qualifications obtained in higher education after completing a full first-cycle qualification (Levels 6–8).

Table of programme learning outcomes.

PRK category	Symbol	Programme learning outcomes	Component code
Knowledge: the graduate knows and understands	K_W01	Knows and understands complex biological phenomena and processes, and bases their interpretation in research and practical activities on a rigorous and consistent approach using empirical data	P7S_WG
	K_W02	Knows and understands complex physicochemical and biochemical processes, including principles for appropriate selection of materials, raw materials, apparatus, and equipment for conducting and characterising these processes	P7S_WG
	K_W03	Knows and understands in depth issues in mathematics, statistics, optimisation, and artificial intelligence methods useful for modelling and analysing biological processes	P7S_WG

	K_W04	Knows and understands methods, techniques and tools used in solving complex bioinformatics tasks, primarily of an engineering nature	P7S_WG
	K_W05	Knows and understands the life cycle of information systems	P7S_WG
	K_W06	Knows and understands specialised technologies related to bioinformatics	P7S_WG
	K_W07	Knows and understands the fundamentals of using biocatalysts and biomaterials in biochemical processes	P7S_WG
	K_W08	Knows and understands detailed issues in genome-scale and population-level bioinformatics analysis based on sound theoretical foundations	P7S_WG
	K_W09	Knows and understands detailed issues in modelling and analysis of biological systems based on sound theoretical foundations	P7S_WG
	K_W10	Knows and understands detailed issues in structural bioinformatics based on sound theoretical foundations	P7S_WG
	K_W11	Knows and understands principles of planning bioinformatics research, including system-based approaches	P7S_WG
	K_W12	Knows and understands developmental trends in bioinformatics	P7S_WG
	K_W13	Knows and understands the social, economic and legal determinants of their activity and the need to take them into account in practice, including issues of intellectual and industrial property protection, as well as societal risks and ethical dilemmas	P7S_WK
	K_W14	Knows and understands principles of health and safety at work and ergonomics	P7S_WK
	K_W15	Knows and understands issues in management, including quality management, and conducting economic activity	P7S_WK
Skills: the graduate is able to	K_U01	Is able to proficiently use and integrate information obtained from literature and electronic sources, including descriptions of technical solutions in Polish and English, and to evaluate, critically analyse, synthesise and creatively interpret such information	P7S_UW
	K_U02	Is able to draw conclusions and clearly formulate and comprehensively justify opinions based on data from various sources	P7S_UW
	K_U03	Is able to plan and conduct advanced measurements and laboratory experiments, including computer simulations, and interpret their results	P7S_UW
	K_U04	Is able to apply advanced information technology techniques and tools to solve biological problems and assess their suitability	P7S_UW
	K_U05	Is able to apply knowledge of biochemistry and related sciences to solve bioinformatics problems	P7S_UW
	K_U06	Is able, under the supervision of an academic supervisor, to plan and carry out research tasks, including those of an engineering nature, using analytical, simulation and experimental methods	P7S_UW
	K_U07	Is able to apply mathematical (including statistical) methods and specialised information technology techniques and tools to describe processes and analyse biological data	P7S_UW
	K_U08	Is able to design and develop complex computer software – in accordance with a given specification that takes into account non-technical aspects – using appropriate methods, techniques and tools	P7S_UW
	K_U09	Is able to prepare presentations of research results in Polish and English and to discuss and debate them in both scientific and other environments	P7S_UK

	K_U10	Is able to prepare a written research report in Polish and a short scientific communication in English presenting the results of their own research	P7S_UK
	K_U11	Is able to use English at B2+ level in technical and scientific domains, particularly computing and biology	P7S_UK
	K_U12	Is able to apply a systems-based approach to solving bioinformatics tasks, taking into account non-technical aspects, including ethical considerations	P7S_UW
	K_U13	Is able to formulate and test hypotheses related to bioinformatics research problems	P7S_UW
	K_U14	Is able to assess the usefulness and applicability of new achievements, including innovative technical solutions, in bioinformatics and biochemistry	P7S_UW
	K_U15	Is able to propose improvements to solutions used in bioinformatics	P7S_UW
	K_U16	Is able to conduct a preliminary economic analysis of undertaken activities	P7S_UW
	K_U17	Is able to learn independently and plan their professional career, as well as guide others in this respect	P7S_UU
	K_U18	Is able to work in an enterprise, both individually and in a team, including in a leadership role, and to observe safety principles related to such work	P7S_UO
Competences: the graduate is prepared to	K_K01	Is prepared for lifelong learning, to inspire and organise the learning process of others, including seeking expert opinions and critically evaluating acquired information	P7S_KK P7S_KO
	K_K02	Is prepared to responsibly fulfil professional roles, uphold professional ethos and observe professional ethical principles, and act to ensure their observance	P7S_KR
	K_K03	Is prepared to set priorities for the implementation of tasks defined by themselves or others and to act in an entrepreneurial manner	P7S_KO P7S_KK
	K_K04	Is prepared to take responsibility for assessing risks arising from applied research techniques and for creating conditions of safe work	P7S_KO
	K_K05	Is prepared to demonstrate a creative attitude in professional and social life and to consciously fulfil the role of a higher education graduate, including caring for the public interest and initiating action in its favour	P7S_KR P7S_KO

15. Methods of verification and assessment of learning outcomes:

The principles for verifying and assessing the achievement of learning outcomes provided for during studies in the Bioinformatics programme are described in the REGULATIONS OF STUDIES for first- and second-cycle studies adopted by the Senate of Poznan University of Technology (Resolution No. 55/2024–2028 of 30 April 2025).

A detailed description of the methods for verifying learning outcomes for individual subjects is contained in the subject specification sheets. In order to pass a subject, it is necessary to achieve all the learning outcomes established for that subject. Methods for assessing learning outcomes have been developed with reference to all forms of instruction within the subject. In general, these methods include formative assessments, conducted during the semester, and summative assessments, conducted at the end of the semester.

Formative assessment is an assessment supporting the learning process and may include:

— point-based assessment of tests / quizzes,
— point-based assessment of tasks performed during laboratory classes and evaluation of ongoing progress in completing tasks,
— assessment of homework, including software projects,
— point-based assessment of participation in classes, oral responses, and in lectures – responses to questions concerning material covered in previous lectures.

The summative assessment of the achievement of learning outcomes takes into account formative assessments and may also be conducted through:
a) in the case of lectures
— assessment of knowledge and skills demonstrated in a written problem-based examination or in the form of a multiple-choice test or a credit examination,
— discussion of the results of the examination / credit test,
b) in the case of laboratories / exercises,
— assessment of the report from the completed project,
— assessment of the student's presentation of the project.

Additional points may be awarded for participation in classes, in particular for:
— discussion of additional aspects of the subject matter,
— effectiveness in applying acquired knowledge to solve a given problem,
— ability to work within a team,
— comments related to improving teaching materials.

For summative assessments, the grading scale used is consistent with the REGULATIONS OF STUDIES for first- and second-cycle studies of Poznan University of Technology: fail (2.0), pass (3.0), satisfactory plus (3.5), good (4.0), good plus (4.5), very good (5.0).

In the assessment process, teaching staff may, at their discretion, use the widely employed electronic platform eKursy of Poznan University of Technology.

The final method of verifying learning outcomes is the process of graduation and completion of the degree dissertation. The master's dissertation is primarily carried out during the final semester of studies, and the achievement of related learning outcomes is supervised by the dissertation supervisor. The degree examination constitutes an independent method of verifying these outcomes. The supporting subject for the dissertation process (Diploma Seminar) includes a description of the methods for verifying learning outcomes in its subject specification sheet.

16. **Professional internships:**
    Not applicable

17. **Foreign language:**
    The compulsory foreign language for the Bioinformatics programme is English. The staff of the specialised inter-faculty unit – the Centre for Languages and Communication – delivers two subjects at second-cycle studies leading to the achievement of level B2+.

Subjects incorporating learning outcomes in the area of foreign language proficiency (O – total, W – lecture, C – classes, L – laboratory, P – project, ECTS – number of ECTS credits).

Sem.	Subject name	Hours					ECTS
		O	W	C	L	P	
1	Communication in English	30		30			2

2	Scientific & Technical Writing	**30**		2
	Total	**60**		

18. Physical education classes:
Not applicable

18. Training:

Training (O – total, W – lecture, C – classes, L – laboratory, P – project, ECTS – number of ECTS credits).

Sem.	Subject name	Hours					ECTS
		O	W	C	L	P	
	Health and safety training – on safe and hygienic conditions of education	**4**	4				0
	Library training – on the use of library resources						
	E-learning training – on preparation for participation in classes using distance learning methods and techniques						
	Total	**4**					**0**

19. Elective subjects (courses of choice):

List of elective subjects (courses of choice) (O – total, W – lecture, C – classes, L – laboratory, P – project, ECTS – number of ECTS credits).

Sem.	Subject name	Hours					ECTS
		O	W	C	L	P	
2	Elective subject 1	**60**	30		30		4
	1A: Development of web and mobile applications						
	1B: Content management systems						
2	Elective subject 2	**30**	15		15		2
	2A: Combined techniques in bioactive compound analytics						
	2B: Hardware solutions in bioactive compound analytics						
2	Research and problem-based workshop	**45**				45	3
3	Elective subject 3	**60**	30		30		4
	3A: Genomic data analysis in the Bioconductor environment						
	3B Structural variation of genomes						
3	Humanities/social elective subject	**45**	30	15			3
	S1: Marketing and elements of managerial competences						
	S2: Innovation and creative thinking						
3	Preparation of the degree dissertation	**120**				120	15
	Total	**360**					**31**

The total amounts to 31 ECTS credits, which represents 34.4% of all ECTS credits.

20. **Engineering competences:**

Applicants for the three-semester second-cycle studies that are the subject of this proposal may apply if they hold the professional title of engineer. During second-cycle studies, they acquire additional engineering competences as specified below.

List of programme learning outcomes enabling the acquisition of engineering competences.

PRK category	Description and code of component	Programme learning outcomes	Symbol of programme outcome
Knowledge: the graduate knows and understands	basic processes occurring in the life cycle of devices, objects and technical systems (P7S_WG)	Knows and understands complex physicochemical and biochemical processes, including principles of appropriate selection of materials, raw materials, apparatus and equipment for their implementation and for characterising products	K_W02
		Knows and understands methods, techniques and tools used in solving complex bioinformatics tasks, primarily of an engineering nature	K_W04
		Knows and understands the life cycle of information	K_W05
		Knows and understands specialised technologies related to bioinformatics	K_W06
		Knows and understands the fundamentals of using biocatalysts and biomaterials in biochemical	K_W07
		Knows and understands developmental trends in bioinformatics	K_W12
	basic principles of creating and developing various forms of individual entrepreneurship (P7S_WK)	Knows and understands the social, economic and legal determinants of their activity and the need to take them into account in practice, including issues of intellectual and industrial property protection, as well as societal risks and ethical dilemmas	K_W13
		Knows and understands principles of health and safety at work and ergonomics	K_W14
		Knows and understands issues in management, including quality management and conducting economic activity	K_W15
Skills: the graduate is able to	plan and conduct experiments, including measurements and computer simulations, interpret results and draw conclusions (P7S_UW)	Is able to draw conclusions and clearly formulate and comprehensively justify opinions based on data from various sources	K_U02
		Is able to plan and conduct advanced measurements and laboratory experiments, including computer simulations, and interpret their results	K_U03
		Is able to formulate and test hypotheses related to bioinformatics research problems	K_U13
	when identifying and formulating specifications for engineering tasks and their solutions: - use analytical, simulation and experimental methods - recognise systemic and non-technical aspects, including ethical aspects - conduct a preliminary economic assessment of proposed solutions and engineering activities (P7S_UW)	Is able, under the supervision of an academic supervisor, to plan and carry out research tasks, including those of an engineering nature, using analytical, simulation and experimental methods	K_U06
		Is able to apply mathematical (including statistical) methods and specialised information technology techniques and tools to describe processes and analyse biological data	K_U07
		Is able to apply a systems-based approach to solving bioinformatics tasks, taking into account non-technical aspects, including ethical considerations	K_U12

		Is able to conduct a preliminary economic analysis of undertaken activities	K_U16
	critically analyse the functioning of existing technical solutions and evaluate these solutions (P7S_UW)	Is able to proficiently use and integrate information obtained from literature and electronic sources, including descriptions of technical solutions in Polish and English, and to evaluate, critically analyse, synthesise and creatively interpret such information	K_U01
		Is able to apply advanced information technology techniques and tools to solve biological problems and assess their suitability	K_U04
		Is able to assess the usefulness and applicability of new achievements, including innovative technical solutions, in bioinformatics and biochemistry	K_U14
	design – in accordance with a given specification – and develop simple devices, objects, systems typical for the field of study, or implement processes using appropriately selected methods, techniques, tools and materials (P7S_UW)	Is able to design and develop complex computer software – in accordance with a given specification that takes into account non-technical aspects – using appropriate methods, techniques and tools	K_U08
		Is able to propose improvements to solutions used in bioinformatics	K_U15

21. Classes in the field of humanities or social sciences:

List of subjects from the field of humanities or social sciences (O – total, W – lecture, C – classes, L – laboratory, P – project).

Sem.	Subject name	O	W	C	L	P	ECTS
1	Risk analysis in engineering tasks	**30**	15	15			2
3	Humanities/social elective subject	**45**	30	15			3
	S1: Marketing and elements of managerial competences						
	S2: Innovation and creative thinking						
	Total	**75**					**5**

22. Classes related to scientific activity conducted at the university:

Classes related to scientific activity conducted at the University.

Subject name	ECTS credits	Student participation in classes preparing for or involving research activity (YES/NO)	Description of research activity
Advanced optimisation methods	3	YES	Theoretical and practical solving of continuous and discrete optimisation problems
Advanced programming	5	YES	Development, implementation and testing of complex software for a bioinformatics problem
Structural bioinformatics of RNA	4	YES	Solving problems of RNA structural biology and analysis of RNA structural data

Informatics in medicine	4	YES	Analysis and processing of medical data, design of information technology solutions for medical applications
Population genomics	5	YES	Analysis of genomic data at the population level
Systems biology	5	YES	Application of systems-based approaches to modelling and analysing complex biological systems
Processing of next-generation sequencing (NGS) data	2	YES	Analysis and synthesis of data derived from next-generation sequencing
Phylogenetic analysis	2	YES	Construction of phylogenetic trees and statistical analysis in phylogenetics
Artificial intelligence in bioinformatics	3	YES	Solving bioinformatics problems using artificial intelligence methods
Systems approaches in biomedical research	3	YES	Use of systems methods in biomedical research
Design and physicochemistry of biomedical materials	2	YES	Design of biomedical materials
Diploma seminar, semester 2	1	YES	Application of principles for preparing a degree dissertation
Diploma seminar, semester 3	1	YES	Application of principles for presenting diploma results
Research and problem-based workshop	3	YES	Preliminary work related to the preparation of the diploma thesis
Preparation of the diploma thesis	15	YES	Completion of the diploma thesis
Total	58		

The 58 ECTS credits from the subjects listed above represent 64.4% of all ECTS credits in the study programme.

II. Supplementary information

1. Educational concept and alignment of learning outcomes with labour market needs

Bioinformatics is a rapidly developing branch of science that combines the latest approaches from biochemistry, biotechnology and molecular biology with advanced information technology methods and tools. Its importance is considerable in light of the rapidly growing resources of digital biological data, particularly molecular data obtained from genome sequencing of humans, animals, plants and microorganisms. The development of bioinformatics requires the education of new specialists who understand the problems arising in molecular biology and are able to apply computational methods and develop information technology tools to solve these problems. The development in Poland of a knowledge-based society and economy also requires specialists competent in biotechnology and bioinformatics, especially given the current stage of development of technologies used for identifying and analysing genomes and other needs related to molecular biology.

The Bioinformatics programme has been offered at Poznan University of Technology, currently at the Faculty of Computing and Telecommunications, since 2010. It was established as an inter-university programme under an agreement between Poznan University of Technology and Adam Mickiewicz University. The initiative was motivated by an analysis of labour market needs and the scientific challenges faced by contemporary biology and related sciences. Its establishment was made possible, among other factors, by a strong group of researchers specialising in bioinformatics employed at the Institute of Computing of Poznan University of Technology. The educational offer in bioinformatics continues to enjoy considerable interest and remains one of the relatively few programmes of this type in Poland. Students acquire knowledge of the latest achievements, methods

and technologies in bioinformatics and develop the skills necessary to use existing computational methods and tools, as well as to develop their own, to solve problems currently arising in molecular biology.

Cooperation with Adam Mickiewicz University has since ended, and a new Bioinformatics programme (first- and second-cycle studies) was launched in 2021 in cooperation with the Faculty of Chemical Technology of Poznan University of Technology. This faculty employs specialists in organic chemistry, biochemistry, cell biology and biotechnology. The academic staff of the Faculty of Chemical Technology, together with its laboratory facilities, ensure comprehensive delivery of the programme content related to these areas. In addition, the teaching of molecular biology, genomics and proteomics is supported by researchers from the Institute of Bioorganic Chemistry of the Polish Academy of Sciences in Poznan.

The learning outcomes included in the study programme will contribute to a favourable position of graduates on the labour market in sectors related to the subject area of the programme. Graduates will possess knowledge, skills and competences in biochemistry, molecular biology, computer science and bioinformatics, with particular emphasis on the technical aspects present in these areas. By understanding biological processes and phenomena and possessing extensive knowledge of computing, graduates will be particularly well prepared to undertake both research and applied activities at the intersection of these fields.

A large number of elective subjects in the curriculum enables students to choose a learning profile aligned with their individual interests. The selection of elective subjects is carried out by means of a survey distributed to students at the end of the summer semester and covering both semesters of the following academic year. From each pair of elective subjects, the one receiving the higher number of votes in the survey is offered. (Given the planned number of students in the programme, it is not possible to run both subjects forming a given pair while maintaining the minimum group sizes established by the resolution of the Senate of Poznan University of Technology.)

Graduates of second-cycle studies will possess theoretical and practical knowledge enabling them to analyse, describe and explain natural processes and phenomena, also using computational methods of data analysis and systems modelling. They will be able to creatively combine tools of biology and computing in order to design and conduct research experiments and perform comprehensive analyses of the results obtained. They will be able to assess the usefulness of available computational tools and adapt them to solve advanced biological problems. They will also acquire the ability to design and develop new computational tools for solving specific biological problems. Graduates will be prepared to work in teams of biologists or computer scientists and to coordinate work in groups composed of specialists from both fields. They may take up employment in companies using bioinformatics, biological and computational methods. They will also be prepared for independent research and analytical work in research institutions, research laboratories, control or diagnostic laboratories, as well as in administrative units in positions requiring biological or computing expertise. Graduates may also continue their education in doctoral programmes in the areas of knowledge studied.

The need to educate bioinformatics specialists is confirmed by the interest shown by biotechnology and pharmaceutical companies in our graduates (e.g. Roche, GSK). The biotechnology industry in Poland is developing and increasingly moving towards more advanced research activities, and companies recognise the need to employ highly qualified staff. For example, at genXone — the company that first detected the British variant of the SARS-CoV-2 virus in Poland — at least one graduate of our Bioinformatics programme is employed. Another Polish company, OncoArendi Therapeutics, has also expressed interest in employing bioinformatics graduates. In November 2020, this company concluded the largest biotechnology contract in the history of the Polish biotechnology sector (worth EUR 322 million) with one of the most important European companies in this field.

The University's strategy refers to the motto "Unity of goals and place – diversity of opportunities." The concept of the new programme fits perfectly within this objective. The faculties jointly delivering the programme share a location on the modern Warta campus, a research-oriented approach and openness to new ideas, as well as commitment to modern technologies and to educating graduates with a strong position on the labour market. The programme expands the offer of inter-faculty studies, allowing better use of the University's human and technical resources. The programme concept directly reflects a strategic objective: providing education that prepares graduates to work and function in a knowledge-based society. In recent years, both nationally and internationally, awareness of the importance and need for research in biotechnology and bioinformatics has increased. The experience gained from previous editions of the Bioinformatics programme has demonstrated strong labour market demand for our graduates and has proven to be a valuable contribution to building a competitive knowledge-based economy in Poland.

2. Description of actions aimed at improving the study programme and ensuring the quality of education

Oversight of the study plan and curriculum of the Bioinformatics programme, the content delivered within individual subjects, and the quality of education is exercised by an inter-faculty Programme Council composed of representatives of the Faculty of Computing and Telecommunications and the Faculty of Chemical Technology. The Council meets periodically to improve the educational process or adapt it to current regulations.

These activities are complemented by the faculty systems for quality assurance in education, implemented at both faculties, which include measures aimed at improving the quality of education in the programmes offered. As part of these systems, the Committee for Education Quality at the Faculty of Computing and Telecommunications and the Education Quality Assurance Team at the Faculty of Chemical Technology have been established. These bodies include faculty staff members as well as representatives of doctoral candidates and students. The teams monitor the educational process within the Bioinformatics programme and implement appropriate procedures defined in the faculty quality assurance systems. In addition, in order to assess the conditions under which teaching activities are conducted, periodic evaluations of the laboratory facilities of both faculties involved in delivering the programme are carried out.

Measures aimed at improving the quality of education and monitoring and enhancing the implementation of the curriculum include:
— university-wide student surveys conducted each semester to evaluate classes and teaching staff, together with systems for rewarding lecturers and classroom observation procedures,
— evaluation of the organisation and discipline of classes and consultation hours, where necessary in response to student complaints,
— optional short surveys conducted independently by academic staff,
— administration of the graduation process in accordance with clearly defined rules and procedures,
— taking into account the results of monitoring the professional careers of graduates when updating the curriculum.

3. Description of scientific activity conducted within the discipline(s)

Most academic staff teaching in the Bioinformatics programme conduct research activity in this or related areas and share their knowledge and experience with students during classes. Academic staff of Poznan University of Technology involved in teaching in the programme have declared their affiliation with one of the disciplines assigned to the programme.

Among the research topics in the field of bioinformatics pursued by the academic staff of Poznan

University of Technology, the following may be distinguished:

— Development of algorithms for problems related to the analysis and processing of nucleotide and amino acid sequences, including sequencing, assembly, DNA mapping, global, local and semiglobal sequence alignment, and motif searching in sequences.

— Development of algorithms for problems in structural bioinformatics and RNA biology, for example simulation of the RNA folding process, modelling and analysis of three-dimensional structures of biological molecules, and processing of structural and experimental data.

— Application of machine learning methods and visualisation techniques in modelling and quality assessment of protein spatial structures.

— Analysis of data derived from high-throughput technologies, including DNA microarrays, next-generation sequencing and mass spectrometry.

— Design of new types of DNA microarrays.

— Biological applications of databases.

— Imaging of microorganisms and viruses using atomic force microscopy.

— Application of computational approaches and tools, including those from the field of artificial intelligence, to the analysis of biomedical data and the design of new IT solutions for medical applications.

— Implementation of algorithms for bioinformatics problems using mechanisms of concurrency.

— Investigation of new classes of graphs, development of new graph models, and application of existing graph models and problems from graph theory to problems arising in molecular biology.

— Analysis of the computational complexity of bioinformatics problems.

— Modelling and analysis of complex biological systems, including through the use of Petri nets and their extensions as well as differential equations.

4. Description of competencies expected from candidates applying for admission to the programme

Applicants for second-cycle studies may be candidates whose first-cycle studies concluded with the award of the professional title of Engineer, and during which the candidate acquired the learning outcomes defined for the first-cycle Bioinformatics programme. Verification of the candidate's mastery of the required learning outcomes will be conducted through an admission interview held before an admissions committee composed of specialists in bioinformatics, computer science, biology and chemistry. The currently applicable detailed admission rules are specified in Resolution No. 185/2020–2024 of the Senate of Poznan University of Technology of 24 April 2024 on the conditions and procedure for admission to studies in the academic year 2025/2026.

5. Planned schedule for the implementation of the study programme in individual semesters of the study cycle.

Schedule of the study programme implementation
(O – total hours, W – lecture, C – classes, L – laboratory, P – project, ECTS – number of ECTS credits, E – examination).

No.	Subject name	Hours					ECTS	E
		O	W	C	L	P		
SEMESTER I								
1	Advanced optimisation methods	30	15	-	15	-	3	-
2	Advanced programming	60	30	-	30	-	5	-

#	Course							
3	Structural bioinformatics of RNA	45	15	-	30	-	4	X
4	Informatics in medicine	45	30	-	15	-	4	-
5	Biological database applications	60	30	-	30	-	5	-
6	Population genomics	60	30	-	30	-	5	X
7	Risk analysis in engineering tasks	30	15	15	-	-	2	-
8	Communication in English	30	-	30	-	-	2	-
9	Basic occupational health and safety training	4	4	-	-	-	0	-
	Total in semester I:	364	169	45	150	0	30	2
	SEMESTER II							
1	Systems biology	60	30	-	30	-	5	X
2	Processing of NGS data	30	15	-	15	-	2	-
3	Phylogenetic analysis	30	15	-	15	-	2	-
4	Artificial intelligence in bioinformatics	45	15	-	30	-	3	-
5	Medical aspects of microbiology	15	15	-	-	-	1	-
6	Molecular modelling of biomolecules	60	30	-	30	-	5	X
7	Elective subject 1	60	30	-	30	-	4	-
7a	*Web and mobile application development*							
7b	*Content management systems*							
8	Elective subject 2	30	15	-	15	-	2	-
8a	*Combined techniques in the analysis of bioactive compounds*							
8b	*Hardware solutions used in the analysis of bioactive compounds*							
9	Diploma seminar	15	-	-	-	15	1	-
10	Research and problem-based workshop	45	-	-	-	45	3	-
11	Scientific and Technical Writing	30	-	30	-	-	2	-
	Total in semester II:	420	165	30	165	60	30	2
	SEMESTER III							
1	Systems approaches in biomedical research	45	15	10	20	-	3	-
2	Design and physicochemistry of biomedical materials	30	15	-	15	-	2	-
3	Toxicology	30	30	-	-	-	2	-
4	Elective subject 3	60	30	-	30	-	4	-
4a	*Genomic data analysis in the Bioconductor environment*							
4b	*Structural variation of genomes*							
5	Humanities/social sciences elective subject	45	30	15	-	-	3	-
5a	*Marketing and elements of managerial competences*							
5b	*Innovation and creative thinking*							
6	Diploma seminar	15	-	-	-	15	1	-
7	Preparation of the diploma thesis	120	-	-	-	120	15	-
	Total in semester III:	345	120	25	65	135	30	0
	Total:	1129	454	100	380	195	90	4

6. Course description sheets (ECTS course cards) are published on the website of Poznan University of Technology.