

K 033/675

CURRICULUM FOR THE
BACHELOR'S PROGRAM IN
BIOINFORMATICS.



Joint Bachelor's Program
in cooperation with
Faculty of Science
University of South Bohemia in Budweis
Czech Republic
(in English)



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§ 1 Qualification Profile

The double degree bachelor study Bioinformatics is a joint study of the Johannes Kepler University (JKU), Linz, Austria and the University of South Bohemia (USB), České Budějovice, Czech Republic.

Bioinformatics was the key technology for one of the greatest scientific advances of the 20th century, the decoding of the human genome, and will remain a key technology of the 21st century. Bioinformatics is now established as an independent education and scientific discipline. Bioinformatics links computer science, mathematics and life sciences to reach its central goal, namely to understand the molecular biological processes. Bioinformatics develops and utilizes methods and techniques from computer science and mathematics in order to solve tasks from biology, chemistry, or medicine.

Bioinformatics is required in:

- Biology, to understand the processes and regulations within a cell, to obtain new insight into developmental processes, to construct the evolutionary tree of life. Focus is on molecular biology disciplines.
 - Medicine, to understand the pathogenesis and processes of diseases.
 - Pharmacology, to develop new drugs.
 - Ecology, to understand the interaction of organisms.
- Data from these life science disciplines are managed, visualized, analyzed, interpreted, compared to one another, and simulated using bioinformatics methods. A special challenge is posed by the rapidly growing amount of potentially noisy and high dimensional data from sequencing, microarrays, imaging, peptide and protein arrays.

Orientation / Focus

The Bachelor's program in Bioinformatics is practically orientated and its degree is a professional qualification. The study focuses on life science applications of computer science and educates the students in solving life science problems by means of computational tools. It contains current topics in life sciences and introduces state-of-the-art bioinformatics methods. The Bachelor's program in Bioinformatics is the basis for later Master's studies or other subsequent qualifications because it lays the theoretical foundations for basic research.

Qualifications

The Bachelor's program in Bioinformatics aims at developing competency in problem solving as preparation for a professional qualification. The bachelor of bioinformatics has knowledge and abilities in the following areas:

BASICS: Fundamental knowledge in bioinformatics, computer science, biology, chemistry, and mathematics.

CURRENT TOPICS: Specialized courses as introductions to current topics in bioinformatics, especially the bioinformatics tools used in current methods in biotechnology. The specialized courses are in bioinformatics, computer science, biology, chemistry, and mathematics.

STATE-OF-THE-ART METHODS: Theoretical and practical knowledge of the state-of-the-art methods of bioinformatics including analysis of problems, analytical problem solving, understanding and representation of complex dependencies and structures. The bachelor of bioinformatics knows how to use and how to apply the methods and techniques of bioinformatics and how to access and use the publicly available software and data base resources adapted to the problem at hand.

CONTINUING EDUCATION: Readiness and ability to independently learn further knowledge, especially new methods and techniques of bioinformatics. The ability to specialize in specific subjects and to follow new developments. The bachelor in bioinformatics is ready to start a Master's study program in a related field.

INTERNATIONALITY: English is a prerequisite of the study as it is a cross-border study between the Czech Republic and Austria. Students learn early to interact with foreign students and faculty staff and are able to work in teams that consist of members from different countries.

RESPONSIBILITY: Responsible use of the methods and techniques of bioinformatics regarding questions of ethics and of the social and environmental effects of new technologies.

SOCIAL COMPETENCE: Ability to work in a team, willingness and ability to cooperate, management capabilities, and expertise in presenting and moderating.

Competences

The skills that are gained during the Bachelor's studies include computer science approaches to life science problems. The bachelors in bioinformatics use their social competences to quickly comprehend the problems of life science experts and thereafter efficiently apply and adapt methods and techniques from computer science to solve those problems. Further, due to their interdisciplinary experiences they are able to combine computer science with areas which are not associated with life sciences. Furthermore bachelors of bioinformatics are educated in applying methods of computer science in a responsible and critical way and to challenge new developments.

Job Profiles

Various job profiles exist for bachelors in bioinformatics, all building the connection between life science and IT experts. On the one hand they may work in pharmacy, chemical, plant or food industry or in biotech companies, but on the other hand they may be employed in software companies producing the pharmaceutical software for experts in biology, medicine or chemistry. Hospitals now also need bioinformatics bachelors in pathology and diagnosis labs or for clinical studies. The scope of duties of bachelors in bioinformatics is manifold, e.g. they may be experts in databases, simulations, data mining, or in algorithm design.

§ 2 Structure and Outline

(1) In accordance with § 54 (1) UG the Bachelor's program in Bioinformatics belongs to the category of degrees in natural sciences.

(2) The Bachelor's program in Bioinformatics covers six semesters and consists of 180 ECTS points, which are distributed among the following subjects:

Subjects	ECTS
Mandatory Subjects/Modules	161
Bachelor's Thesis	6
Bachelor's Examination	4
Free Electives	9
Total	180

(3) For Free Electives students have to pass examinations corresponding to 9 ECTS points, which can be chosen from any recognized national or international post-secondary educational institution. The Free Electives shall provide additional skills beyond the Bachelor's program in Bioinformatics and can be taken anytime during the Bachelor's study.

(4) The recommended course of study is shown in the annex 1.

§ 3 Studies Introductory and Orientation Phase

(1) According to § 66 para. 1 UG the introductory and orientation phase consists of lectures which give an overview of the fundamental contents and structure of the corresponding curriculum of studies. The introductory and orientation phase of the Bachelor's program in Bioinformatics covers modules amounting to 9 ECTS points in total, which can be chosen out of the following list:

Code	Name	ECTS winter term	ECTS summer term
675MATHLIA13	Linear Algebra	3	
675COSCADS13	Algorithms and Data Structures	4	
663MOBIMAG12	Molecular Biology and Genetics	3	
675COSCPYB18	Python Basics	4	
675COSCAPR18	Applied Programming		3
675BIOLITG13	Introduction to Genomics		3
675CHEMGCH13	General Chemistry		3
675BINFINB13	Introduction to Bioinformatics		6

(2) Before completion of the introductory and orientation phase further modules to an extent of 22 ECTS points can be chosen out of the following list:

Code	Name	ECTS winter term	ECTS summer term
663BIOLBMI12	Biology of Microorganisms	5	
675MATHCA113	Calculus I	6	
663KOETAWC15	Academic Writing for Cross Border Studies		3
675SOSKETH13	Ethics	3	
675MATHCA213	Calculus II		5
675BIOLDOL13	Diversity of life		5
675MATHPM118	Probability and mathematical statistics I		3

§ 4 Mandatory Subjects/Modules

(1) All courses and modules of the Mandatory Subjects have to be completed successfully.

Code	Name	ECTS
675COSC16	Computer Science	30
675MATH18	Mathematics	22
675BINF18	Bioinformatics	32
675CHEM18	Chemistry	17,5
675BIOL13	Biology	22
675SOSK18	Soft Skills	12
675ARSP18	Area of Specialisation	25,5

(2) The subject Computer Science is subdivided into the listed subjects or modules:

Code	Name	ECTS
675COSCAPR18	Applied Programming	3
675COSCPYB18	Python Basics	4
675COSCADS13	Algorithms and Data Structures	4
675INSY18	Information Systems	12
675INTR13	Introduction to R	3
675COSCPAP13	Parallel Programming	4

(3) The subject Mathematics is subdivided into the listed subjects or modules:

Code	Name	ECTS
675MATHPM118	Probability and mathematical statistics I	3
675MATHCA113	Calculus I	6
675MATHLIA13	Linear Algebra	3
675MATHCA218	Calculus II	5
663BIOLBST12	Biostatistics	5

(4) The subject Bioinformatics is subdivided into the listed subjects or modules:

Code	Name	ECTS
675BINFINB13	Introduction to Bioinformatics	6
675GTSB16	Genome Analysis & Transcriptomics and Structural Bioinformatics	15
675MALE18	Machine Learning	3
675BINFBIP13	Bioinformatics Project	8

(5) The subject Biology is subdivided into the listed modules:

Code	Name	ECTS
663BIOLBMI18	Biology of Microorganisms	4
663BIOLICB18	Introduction to Cell Biology	1
663MOBIMAG12	Molecular Biology and Genetics	3
675BIOLDOL13	Diversity of life	5
675BIOLITG13	Introduction to Genomics	3
675BIOLMOP13	Molecular Phylogenetics	6

(6) The subject Chemistry is subdivided into the listed subjects or modules:

Code	Name	ECTS
675CHEMGCH13	General Chemistry	3
675BIAN13	Bioanalytics	4,5
675ORCH18	Organic Chemistry	6
675CHEMCCM17	Computational Chemistry and Molecular Modelling of Biomolecules	4

(7) The subject Soft Skills is subdivided into the listed subjects or modules:

Code	Name	ECTS
663GESKAWC18	Academic Writing for Cross Border Studies	3
675SOSKETH13	Ethics	3
675GEND13	Gender Studies	3
675ENSC18	English for Scientists	3

§ 5 Courses

(1) The names and the types of all courses of the Mandatory subjects, as well as their ECTS points, their duration in hours per week, their codes, their registration requirements, and their admission procedures (in case of limited availability of places) are described in the study handbook of JKU (studienhandbuch.jku.at).

(2) The possible types of courses as well as the examination regulations are described in §§ 13 and 14 of the JKU statute (Section "Studienrecht").

(3) For courses at the University of South Bohemia, the regulations of the University of South Bohemia apply.

§ 6 Bachelor's Thesis

(1) Students of the Bachelor's program in Bioinformatics must complete a Bachelor's Thesis according to § 80 UG in the course Bachelor's Seminar (675BAARBASS13) which is jointly supervised by a university teacher from Johannes Kepler University Linz and University of South Bohemia.

(2) The Bachelor's Thesis will be graded in combination with the Bachelor's Seminar by the teacher of this course.

(3) The Curricular Committee for Bioinformatics may specify guidelines for the formal structure of a Bachelor's Thesis.

(4) The topic of the Bachelor's Thesis has to be expressed in the certificate.

§ 7 Examination Regulations

(1) The regulations for subject examinations and course examinations are described in the study handbook of JKU (studienhandbuch.jku.at).

(2) Examination regulations of the University of South Bohemia apply for examinations at the University of South Bohemia.

(3) Students of this curriculum are eligible for examinations of courses at the partner university, even if they did not attend courses at this university during the current semester.

(4) The Bachelor's program in Bioinformatics is concluded by a Bachelor's Examination.

(5) The Bachelor's Examination consists of two parts: The first part of the Bachelor's Examination is the successful completion of mandatory subjects according to § 4.

(6) The second part of the Bachelor's Examination (4 ECTS points) is a final state exam at the University of South Bohemia according to its regulations there. Prior to the admission to the second part of the Bachelor's Examination, students must successfully complete the first part of the Bachelor's Examination, the Bachelor's Thesis, and the Free Electives.

(7) Following conversion is used to translate grades from the University of South Bohemia (USB):

Grades at USB	Grades at JKU
excellent 1	sehr gut 1
excellent minus 1–	sehr gut 1
very good 2	gut 2
very good minus 2–	befriedigend 3
good 3	genügend 4
unsatisfactory 4	nicht genügend 5
successful participation	mit Erfolg teilgenommen
unsuccessful participation	ohne Erfolg teilgenommen

(8) Following conversion is used to translate grades from the Johannes Kepler University Linz (JKU):

Grades at JKU	Grades at USB
sehr gut 1	excellent 1
gut 2	very good 2
befriedigend 3	very good minus 2–
genügend 4	good 3
nicht genügend 5	unsatisfactory 4
mit Erfolg teilgenommen	successful participation
ohne Erfolg teilgenommen	unsuccessful participation

(9) For the purpose of assigning grades in the certificate, above conversion of grades of the University of South Bohemia (para. 7) will be used for subjects completed at the University of South Bohemia (USB).

§ 8 Academic Degree

(1) Graduates of the Bachelor's program in Bioinformatics are awarded the academic degree „Bachelor of Science“, abbreviated „BSc“ oder „BSc (JKU)“ at the Johannes Kepler University Linz and the academic degree "Bachelor", abbreviated „Bc“ at University of South Bohemia.

(2) The certificate of the Austrian academic degree is issued in German and in English translation.

(3) The certificate has to express that the Bachelor's program in Bioinformatics is a joint study of the Johannes Kepler University and the University of South Bohemia.

§ 9 Legal Validity

(1) This curriculum comes into effect on October 1st, 2016.

(2) The curriculum of the Bachelor's program in Bioinformatics in the version published in the official newsletter of the Johannes Kepler University Linz on June 10th, 2015, 26th piece, item 204 expires by the end of September 30th, 2016.

(3) § 3 and annex 1 as published in the official newsletter of the Johannes Kepler University Linz on June 23th, 2017, 33th piece, item 250 will take effect on October 1st, 2017. Students, who have been admitted to this bachelor's program before the winter term 2017/18 and have not completed the introduction and orientation phase yet, are entitled to finish it until September 30th, 2018 according to the rules in force till September 30th, 2017.

(4) § 3 para. 1 and 2, § 4, § 5 para. 1, § 7 para. 1, § 10 para. 1 and 3 and annex 1 as published in the official newsletter of the Johannes Kepler University Linz on June 22nd, 2018, 26th piece, item 271 will take effect on October 1st, 2018.

§ 10 Transitional Arrangements

(1) For students who have passed examinations within the curriculum of the Bachelor's program in Bioinformatics in a previous version, the equivalences listed in the study handbook of JKU (studienhandbuch.jku.at) apply.

(2) In addition to the equivalences given in the study handbook of JKU, following equivalences are effective:

Table A: Equivalence of subject packages

Package of subjects in the Bachelor Bioinformatics version of 2015	equivalent package of subjects in the Bachelor Bioinformatics version of 2016
675COSC13: Computer Science (27 ECTS) 675MATH13: Mathematics (26 ECTS) 675BINF13: Bioinformatics (30,5 ECTS) 675CHEM13: Chemistry (20,1 ECTS) 675ARSP13: Area of Specialisation (21,6 ECTS)	675COSC16: Computer Science (30 ECTS) 675MATH16: Mathematics (20 ECTS) 675BINF16: Bioinformatics (33,5 ECTS) 675CHEM16: Chemistry (17,1 ECTS) 675ARSP16: Area of Specialisation (24,6 ECTS)

(3) In addition to the equivalences given in the study handbook of JKU, following equivalences are effective:

Table B: Equivalence of subject packages

Package of subjects in the Bachelor Bioinformatics version of 2017	equivalent package of subjects in the Bachelor Bioinformatics version of 2018
675CHEM16: Chemistry (17,1 ECTS) 675CHEM16: Mathematics (20 ECTS) 675BINF16: Bioinformatics (33,5 ECTS) 675SOSK13: Soft Skills (13,8 ECTS) 675ARSP16: Area of Specialisation (24,6 ECTS)	675CHEM18: Chemistry (17,5 ECTS) 675MATH18: Mathematics (22 ECTS) 675BINF18: Bioinformatics (32 ECTS) 675SOSK18: Soft Skills (12 ECTS) 675ARSP18: Area of Specialisation (25,5 ECTS)

Table C: Equivalence of lecture packages

Package of lectures in the Bachelor Bioinformatics version of 2017	equivalent package of lectures in the Bachelor Bioinformatics version of 2018
TM1PEKVINFO: KV Informationssysteme (3 ECTS) TM1PEKVSWE: KV Software Engineering (3 ECTS)	INBIPVOIFS1: VO Informationssysteme 1 (3 ECTS) INBIPUEIFS1: UE Informationssysteme 1 (3 ECTS)

Annex 1: Global map of study subjects - Bachelor's Program in Bioinformatics (2018)

1 st Semester (WS)		2 nd Semester (SS)		3 rd Semester (WS)		4 th Semester (SS)		5 th Semester (WS)		6 th Semester (SS)	
USB Budweis		USB Budweis		JKU Linz		JKU Linz		USB Budweis		JKU Linz	
Subject/Module	ECTS	Subject/Module	ECTS	Subject/Module	ECTS	Subject/Module	ECTS	Subject/Module	ECTS	Subject/Module	ECTS
Python Basics	4	Applied Programming	3	Information Systems	6	Introduction to R	3	Parallel Programming	4	Information Systems	6
Algorithms and Data Structures	4	Calculus II	5	Genome Analysis & Transcriptomics and Structural Bioinformatics	9	Genome Analysis & Transcriptomics and Structural Bioinformatics	6	Biostatistics	5	Bachelor's Thesis	6
Calculus I	6	Probability and mathematical statistics I	3	Machine Learning	3	Organic Chemistry	3	Bioinformatics Project	8	Area of Specialisation (USB/JKU)	9,5
Linear Algebra	3	Introduction to Bioinformatics	6	Bioanalytics	4,5	Gender Studies	3	Computational Chemistry and Molecular Modelling of Biomolecules	4	Bachelor's Examination (USB)	4
Biology of Microorganisms	5	Diversity of life	5	Organic Chemistry	3	Area of Specialisation	9	Molecular Phylogenetics	6	Free Electives	3
Molecular Biology and Genetics	3	Introduction to Genomics	3	English for Scientists	3	Free Electives	3	Area of Specialisation	3		
Ethics	3	General Chemistry	3	Area of Specialisation	4			Free Electives	3		
		Academic Writing for Cross Border Studies	3								
28		31		32,5		27		33		28,5	

Total: 180,00