

Interdisciplinary Doctoral Programme

in

Biomedicine

2021

1. The programme.....	4
2. Basic programme goal and general competence.....	4
3. Application and enrolment in the Doctoral Programme in Biomedicine	5
4. Admission requirements and criteria for selection.....	5
4.1. Admission requirements	5
4.2. Criteria for selection of candidates.....	6
5. Recognition of knowledge and skills acquired before admission to the programme.....	6
6. Tuition Fee	6
6.1 Scholarship Opportunities.....	6
7. Mentoring	6
8. Programme	7
8.1 Schedules.....	8
9. Course presentation	8
9. 1. Core courses	8
9. 2. Short presentation of core courses	9
9. 3. Elective courses	16
9. 3. 1. Elective theoretical courses	17
9. 3. 2. Elective individual research courses	19
10. Key to course codes	24
11. Requirements for progression through the programme.....	27
12. Grading system	27
13. Conditions for completing the programme and doctoral diploma.....	27
13. 1. Conditions for completing the programme.....	27
13. 2. Doctoral thesis.....	27
13. 3. Doctoral diploma.....	28
14. Transfer between study programmes	28
15. Career Prospects.....	28
16. International exchanges	29
17. Programme Council.....	29
18. Field coordinators	29
19. Additional Information.....	30
20. Organisation.....	31

INTRODUCTION

The field of biomedicine encompasses knowledge from the areas of basic medicine, biochemistry and molecular biology, clinical biochemistry and laboratory biomedicine, clinical medicine, genetics, medical microbiology, neuroscience, pharmacy, public health, toxicology and veterinary medicine. The need for a high-quality and up-to-date doctoral programme to acquire suitable knowledge in these areas is dictated by rapid and extensive development in these various scientific fields, as well as their impact on the quality of life. Due to previous good experiences and the advantages of an interdisciplinary approach to existing postgraduate studies, the doctoral study of biomedicine is organised at university level. The field of biomedicine is very broad and is being developed at the first two educational levels by various faculty members at the University of Ljubljana. It seems reasonable to link the third educational level (doctoral studies) in terms of organization and content. This approach also enables the collaboration of teachers and researchers from separate scientific fields, thus forming a broader interdisciplinary field. The connections of university research with research institutes are also achieved.

The primary emphasis of doctoral study is on research, interdisciplinarity and collaboration between internationally renowned local and foreign experts. Based on recommendations of the European University Association (EUA), international student exchange is also encouraged. As the end result of the research work, the publishing of at least one scientific article is expected. Special emphasis is placed on a productive relation between the doctoral candidates and their mentors. Students can choose mentors from amongst internationally recognised and established experts in compliance with the rules of the University of Ljubljana and collaborating faculties.

1. The programme

The duration of the Interdisciplinary Doctoral Programme in Biomedicine is four years (240 ECTS credits), and according to the Bologna guidelines this represents the third cycle of the educational scheme. The programme was formed in agreement with all the requirements and legislation of the Republic of Slovenia and meets all criteria for doctoral study established by the EUA. In this way, the direct inclusion of programme components in an international exchange with universities from other countries using the ECTS system is rendered possible.

The programme consists of organised classes (60 credits) and individual research work for the doctoral thesis, public presentation of the results, writing of the scientific article and public dissertation and public defence (180 credits).

The programme leads to the degree of doktor/doktorica znanosti (level of qualification: SQF level 10, EQF level 8, EQ-EHEA level Third cycle) in the following fields:

- Basic Medicine
- Biochemistry and Molecular Biology
- Clinical Biochemistry and Laboratory Biomedicine
- Clinical Medicine
- Genetics
- Medical Microbiology
- Neuroscience
- Pharmacy
- Public Health
- Toxicology
- Veterinary Medicine

The programme is organised by the University of Ljubljana through its faculties and three Slovene research institutes.

- **Biotechnical Faculty**, Jamnikarjeva ulica 101, Ljubljana
- **Faculty of Pharmacy**, Aškerčeva cesta 7, Ljubljana
- **Faculty of Chemistry and Chemical Technology**, Večna pot 113, Ljubljana
- **Faculty of Medicine**, Vrazov trg 2, Ljubljana
- **Veterinary Faculty**, Gerbičeva ulica 60, Ljubljana
- **The Jožef Stefan Institute**, Jamova cesta 39, Ljubljana
- **The National Institute of Chemistry**, Hajdrihova 19, Ljubljana
- **The National Institute of Biology**, Večna pot 111, Ljubljana

The research institutes contribute teachers who take part in organised courses, mentors and the research infrastructure for executing the experimental part of doctoral work.

2. Basic programme goals and general competences

The basic goal of the Interdisciplinary Doctoral Programme in Biomedicine is to further educate highly qualified experts in the scientific fields that constitute the area of biomedicine. The programme is interdisciplinary and encompasses biochemistry and molecular biology, pharmacy, genetics, clinical biochemistry and laboratory biomedicine, clinical and basic medicine, medical microbiology, neuroscience, public health, toxicology and veterinary medicine.

The graduates of the doctoral programme in Biomedicine will acquire the ability of understanding, critically judging and solving complex scientific-research issues. They will be qualified for creative and independent research, for the critical assessment of research results, the development of new research methods and the transfer of new research methods and knowledge into practice.

3. Application and enrolment in the Doctoral Programme in Biomedicine

Call for enrolment is published on the UL web page (<https://www.uni-lj.si/eng/>) no later than 6 months prior to the start of the academic year. Applicants for admission to the programme can apply according to the instructions in the call for enrolment.

Candidates will receive information regarding the success of their application in September. Enrolment in year 1 of the Biomedicine doctoral study programme takes place at the providing faculties. Enrolment dates will be published on the webpage <https://www.uni-lj.si/study/doctoral/biomedicine/>.

Enrolment and all other procedures required to obtain the scientific title are carried out by providing faculties coordinating the relevant scientific field. Enrolment in the scientific fields Biochemistry and Molecular Biology, Clinical Medicine, Basic Medicine, Neuroscience, Medical Microbiology and Public Health is held at the Faculty of Medicine, enrolment in the scientific fields Pharmacy, Clinical Biochemistry and Laboratory Biomedicine and Toxicology is held at the Faculty of Pharmacy, enrolment in the scientific field of Genetics is held at the Biotechnical Faculty and enrolment in the scientific field of Veterinary Medicine is held at the Veterinary Faculty.

Upon enrolment, the doctoral student and the University of Ljubljana sign a contract on education.

4. Admission requirements and criteria for selection

4.1. Admission requirements

For admission to the Interdisciplinary Doctoral Programme in Biomedicine, graduates of the following programmes can apply:

- Second cycle study programmes;
- Study programmes providing education for occupations regulated by Directives of the European Union (93/16/EEC for doctors, 78/1027/EEC for veterinarians, 78/687/EEC for dentists and 85/432/EEC for pharmacists) evaluated with at least 300 credits;
- Study programmes leading to specialisation, if candidates have previously completed a higher education professional study programme. The Biomedicine Programme Council will specify additional entry requirements for candidates in individual areas amounting from 30 to 60 ECTS;
- Study programmes leading to a master of science or to specialization after completing an academic study programme. 60 credits of study obligations will be recognised to such candidates;
- Academic study programmes.

Candidates with foreign qualifications are required to apply for recognition of their entry qualifications. The procedure starts with the candidate's application for study in the Republic of Slovenia, which is submitted in electronic form on the eVŠ web portal. The procedure is run by the authorised person at the University Member (academy or faculty).

4.2. Criteria for selection of candidates

The selection of candidates is an issue when the number of candidates significantly exceeds the number of places offered. Selection will be primarily based on the candidate's level of achievement in previous studies.

The main criteria for selection are based upon:

- achievement in previous studies (achived grades and graduation work (diploma));
- elective exam where the following is rated:
 1. research article(s);
 2. student scientific awards and awards at international competitions;
 3. professional specialisation or degrees from other high level programmes;
 4. other criteria.

Rating is determined by rhe Programme Council.

5. Recognition of knowledge and skills acquired before admission to the programme

Knowledge and skills acquired through formal and informal learning, and experience before entry will be recognised and evaluated by the Programme Council.

In recognising respective knowledge and skills, the following is considered:

- professional specialisation;
- a second degree from an undergraduate programme;
- previous scientific research work;
- published scientific work;
- previous professional experience.

6. Tuition Fee

The tuition fee is paid individually for each study year or for each year that the student enrolls in.

The tuition fees are published in the price list adopted by the UL Governing Board: <https://www.uni-lj.si/study/doctoral/tuition-fees>.

6.1 Scholarship Opportunities

For information about scholarship opportunities, please visit <https://www.uni-lj.si/study/doctoral/funding>, <https://www.uni-lj.si/study/information/scholarships/> and <http://www.sklad-kadri.si/>.

7. Mentoring

Prior to enrolment, candidates are required to choose a mentor and submit the mentor's written acceptance of mentorship upon enrolment at the latest. The mentor or co-mentor is a university teacher (assistant professor, associate professor, full professor) or researcher (research associate, senior researcher or higher research associate) with a relevant scientific bibliography in the field of the doctoral dissertation topic.

The mentor's role is to guide the student and to provide conditions for work. The mentor must ensure that appropriate research capacities and research infrastructure are available. A foreign expert with a title comparable to a Slovenian title can be a mentor.

The list of potential mentors is available at <https://www.uni-lj.si/study/doctoral/biomedicine/mentor/>.

8. Programme

The programme consists of organised forms of teaching and research. Organised teaching comprises of 60 credits; the remaining 180 credits are intended for individual research work (IRW) for the doctoral thesis.

Each faculty is responsible for the organization and implementation of the doctoral programme in the respective field. In cooperation with the mentor, the faculty provides a suitable research environment for the student.

Content and structure of the programme (by year)

The structure of the programme is designed to emphasise organized study in the first year and beginning of second year, while later the emphasis is on research and the preparation of the doctoral thesis.

YEAR 1	
Core courses	30 CREDITS
Individual research work 1	30 CREDITS
YEAR 2	
Elective course 1	5 CREDITS
Elective course 2	5 CREDITS
Elective course 3	5 CREDITS
Presentation of the doctoral dissertation topic	5 CREDITS
Individual research work 2	40 CREDITS
YEAR 3	
Individual research work 3	60 CREDITS
YEAR 4	
Individual research work 4	50 CREDITS
Presentation of the results of research work	5 CREDITS
Completed doctoral dissertation and public defence	5 CREDITS

In the first year of study, doctoral students, within the framework of core courses obtain fundamental theoretical knowledge and expertise of scientific work. 20 ECTS has to be from the core course of scientific field they are enrolled in. In agreement with the mentor and co-ordinator, 10 ECTS can be chosen from other core courses. In the second year of study, students fulfil their obligations arising from the elective courses (15 ECTS). The selected courses according to student's research work must be approved by the mentor.

The core of the third year is research work, and preparation of the doctoral dissertation.

In the fourth year, the focus is on individual research work, publication of the scientific article and preparation of the doctoral dissertation. Students also present the results of their research work and defend their doctoral dissertation publicly.

Registration of topic

Students should register the topic of doctoral thesis no later than in the beginning of the second semester of the second year of studies.

Registration of topic of doctoral thesis as well as evaluation of each doctoral thesis are in the domain of the faculty senate responsible for a given scientific field. The Senate of the University of Ljubljana has to consent to the doctoral dissertation topic and the proposed mentor.

Mobility

Students can select 10 ECTS from elective courses from other doctoral programmes at the University of Ljubljana and comparable programmes of foreign universities. The selected courses must be approved by the mentor and the coordinator of the specific scientific field. Elective credits can be selected also from the university pool of generic skills courses, listed at the web site of the University of Ljubljana.

8.1 Schedules

The core course schedules are published at <https://www.uni-lj.si/study/doctoral/biomedicine/curriculum/schedules-of-courses/> in early September each year. Schedules for elective courses are designed individually.

9. Course presentation

The programme is composed of three types of courses:

- core courses
- elective theoretical courses
- elective individual research courses

The doctoral students, together with their mentors and the field coordinators, design individual study programmes by selecting courses from core and both types of elective course pools. The core courses are modular. For each scientific field a choice of at least 20 credits is needed from the core modules proposed by the respective scientific fields, while the remaining 10 credits can be chosen from modules of other core courses. Remaining credits can be obtained from the selection of various elective courses. Elective credits can also be selected from the university pool of generic skills courses, listed at the web page of the University of Ljubljana.

9. 1. Core courses

Core courses are designed for each specific scientific field. The content of courses is chosen on the basis of the research work of the professors.

Each scientific field ensures one core course, which is usually constructed from modules. The selection of modules is made in agreement with the mentor and the field coordinator.

Core courses

Code	Scientific field	Course title
J-1-400	Basic Medicine	Medical Cell Biology
B-1-100	Biochemistry and Molecular Biology	Selected advanced topics in Biochemistry and Molecular biology
L-1-300	Clinical Biochemistry and Laboratory	Algorithms of clinical biochemical

	Biomedicine	diagnostics
K-1-500	Clinical Medicine	Research in clinical medicine
G-1-600	Genetics	Genetics
M-1-410	Medical Microbiology	Selected Topics in Medical Microbiology
N-1-540	Neuroscience	Neuroscience
F-1-200	Pharmacy	Pharmaceutical sciences
S-1-420	Public health	Research aspects of public health
T-1-340	Toxicology	Toxicology
V-1-700	Veterinary Medicine	Regulation processes in healthy and diseased animals

9. 2. Short presentation of core courses

Code: J-1-400

Course title: Medical Cell Biology

Lecturers:

Rok Romih, Irma Virant Klun, Gregor Serša, Tadej Battelino, Damjana Rozman, Peter Veranič, Mateja Erdani Kreft, Maja Čemažar, Katarina Trebušak Podkrajšek, Borut Peterlin, Danijel Petrovič, Vita Dolžan, Alojz Ihan, Janez Žgajnar, Marko Goličnik, Maruša Debeljak

Contents:

The course Medical Cell Biology enables in depth study of cell structures and functions, their alterations during pathological processes at molecular level, and upgrading of that knowledge in some important areas of medicine. The course consists of the obligatory module Fundamentals of medical cell biology and four elective modules: Cell biology in human reproduction, Biology of malignant cells and translational oncology, Cell biology in clinical genetics and System medicine of multifactorial disorders such as human reproductive biology, Oncology, genetics and multifactorial disorders. The course is composed of a core module (Module 1) and four elective modules.

Module 1: Fundamentals of medical cell biology

The basic module focuses on cell and molecular mechanisms of normal and abnormal cell cycle, cell death, the role of cell junctions in development, differentiation and diseases, the role of cell compartments of biosynthetic and endocytotic pathway in normal and transformed cells, the role of peroxisomes and mitochondria and on the structure and function of cytoskeleton during cell differentiation and their role in various diseases.

Module 2: Reproductive biology *in vivo* and *in vitro*

The module deals with the development of gonads, oogenesis, folliculogenesis, spermatogenesis, fertilization, embryogenesis. Students get knowledge on assisted reproduction and stem cells.

Module 3: Biology of malignant cells and translational oncology

Students acquire knowledge on fundamentals of cancer biology, carcinogenesis, principles and targets for cancer treatment, new treatment approaches and advances in translational oncology.

Module 4: Cell biology in clinical genetics

The module covers genetic defects in different areas of the cell function and their impact on the disease development. Such knowledge is crucial for adequate treatment decisions, follow-up of the patients and prognosis, as well as for genetic counselling.

Module 5: System medicine of multifactorial disorders

The module 5 consists of work on the project, which is based on the most recent scientific discoveries and research interests of the study group. The study focuses on the systems

approaches of the post-genome era, the computation with large datasets, statistics, data modelling and on the role of global genome studies for the predictive personalized medicine.

Code: B-1-100

Course title: Selected advanced topics in Biochemistry and Molecular biology

Lecturers:

Ana Plemenitaš, Vita Dolžan, Kristina Sepčić, Peter Dovč, Roman Jerala, Marko Dolinar, Marjeta Podobnik, Radovan Komel, Simon Horvat, Gregor Anderluh, Blaž Zupan, Sergej Pirkmajer

Contents:

Core course entitled »Selected advanced topics in Biochemistry and Molecular biology« is divided into three independent modules, each equivalent to 10 ECTS:

Module 1: Selected biochemical processes with regulatory mechanisms

Included are topics on metabolism of xenobiotics and ROS, mitochondrial biogenesis, growth, ontogenetic development in mammals, structure and functional asymmetry of biological membranes, membrane microdomains, protein interaction with lipid membranes, and mechanisms of signal transduction in regulating cellular processes.

Module 2: Structure and function of biological molecules and designed biological systems

Included are topics in molecular immunology and proteolysis. Techniques of protein engineering and molecular modelling of proteins for prediction of their function will be presented.

Module 3: Functional genomics and proteomics

Included are topics on genome structure, organization and regulation, comparative genomics and principles of global genome analysis. Theoretical principles and experimental approaches of transgenetics, transcriptomics, proteomics, metabolomics, interactomics and bioinformatics will be presented.

Students can sign in all three modules (30 ECTS) or at least two of them while the remaining 10 credits can be selected from modules offered in other core courses.

Code: L-1-300

Course title: Algorithms of clinical biochemical diagnostics

Lecturers:

Janja Marc, Borut Božič, Darko Černe, Janko Kos, Irena Mlinarič-Raščan, Matjaž Jeras, Barbara Ostanek

Contents:

Course is organized into three modules consisting of eight independent blocks (each 5 ECTS). Student can select any combination of blocks. Each block is independently evaluated by separate score. For this research field each student has to elect 4 to 6 blocks.

Module 1: Laboratory biomedicine consists of two blocks.

Block 1: Scientific approaches in laboratory medicine, where students will learn the inductive and deductive approaches to problem solving in laboratory medicine. Using model cases, the students will critically evaluate their hypotheses, the credibility of the obtained results and the methodology used.

Block 2: Stepwise approach to clinical and biochemical diagnostics with interpretation will introduce students to the use of various mental pathways and stepwise approach in the

laboratory diagnostics of common disorders. Based on this knowledge the student will be able to make evidence-based proposals for guidelines patients management.

Module 2: Molecular markers of diseases consists of three blocks.

Block 1: Common genetic diseases. Students will learn the screening (prenatal and postnatal diagnosis, family and population studies) and confirmatory tests of accumulating or missing metabolites and the correlation of laboratory results with the clinical symptoms of model diseases.

Block 2: Immune diseases. Students will learn the laboratory approaches to the diagnosis of immune-mediated diseases and hypersensitivity states using the analytes and tests in primary and targeted search for immune system disorders.

Block 3: Malignant disorders. Students will learn the use of biological molecules in the screening tests, tumor markers, extracellular tumor DNA, use of DNA / RNA tests, immunological tests, biosensors and microarrays, preparation of monoclonal antibodies, aptamers, siRNA, RNA / DNA probes and recombinant proteins in the diagnosis of malignancy.

Module 3: Translational Biomedicine consists of three blocks.

Block 1: Pharmacogenomic diagnostics. Students will learn the approaches to pharmacogenomic diagnostics and individualized therapy, pharmacogenomics of metabolic enzymes, receptors, transporters, miRNA and the direct and reverse pharmacogenomics in drug design, target identification and in preclinical and clinical studies.

Block 2. Cellular and Tissue Engineering. Students will understand different approaches in the preparation of complex cell and tissue cultures intended for advanced treatments or as system for testing artificial substances and materials in vitro.

Block 3: “Omic” Technologies and Tools (advanced technologies and tools in translational biomedicine). Students will learn about the advanced technologies in the areas of genomics, transcriptomics, proteomics and metabolomics and their implementation to laboratory practice and biomedicine.

Code: K-1-500

Course title: Research in clinical medicine

Lecturers:

Matej Podbregar, Žarko Finderle (nosilca), Lovro Stanovnik, Mirta Koželj, Mitja Košnik, Vladimir Smrkolj, Vito Starc, Alojz Ihan, Vita Dolžan, Juš Kšela, Mitja Lainščak, Tomaž Marš, Tadeja Pintar, Sergej Pirkmajer, Damjana Rozman, Janez Stare, Mišo Šabovič, Dušan Štajer, Katarina Šurlan Popovič, Igor Švab, Aleš Tomažič, Samo Zver

Contents:

The subject is divided in three thematic modules (each brings 10 ECTS). Module 3 is divided into several thematic submodules, which take place simultaneously. The doctoral student chooses two thematic submodules.

Module 1: Fundamentals in medical research

This module deals with ethics in research work, presentation of research and performance, evidence-based medicine, project preparation, intellectual property protection, research funding, writing and analysis of articles, characteristics of clinical research, cell and animal models.

Module 2: Methods in clinical research

Data collection, bias, representativeness, qualitative methods, conducting surveys, modern statistical methods, information methods.

Module 3: Achievements in clinical research

The module consists of individual thematic blocks (5 ECTS each), doctoral student chooses two of the blocks, or instead one module (10 credits) from the scientific fields of medicine - basic orientation, biochemistry, microbiology or neuroscience.

Thematic blocks are: Imaging methods, Genetic methods, Immunology and allergology, Physiology of the cardiovascular system, Physiology of respiration, Physiology and biomechanics of the locomotor system, Basic and clinical pharmacology, Cardiovascular medical sciences, Emergency and intensive medicine, Hematology and oncology, Medical sciences of operative disciplines, Hyperbaric medicine. Thematic blocks are: Imaging methods, Genetic methods, Immunology and allergology, Physiology of the cardiovascular system, Physiology of respiration, Physiology and biomechanics of the locomotor system, Basic and clinical pharmacology, Cardiovascular medical sciences, Emergency and intensive medicine, Hematology and oncology, Medical sciences of operative disciplines, Hyperbaric medicine.

Code: G-1-600

Course title: Genetics

Lecturers:

Simon Horvat, Branka Javornik, Peter Dovč, Borut Peterlin, Darja Žgur-Bertok, Jernej Jakše, Gregor Gorjanc, Roman Jerala, Tanja Kunej, Uroš Petrovič, Peter Trontelj

Contents:

The »Genetics« core course is intended to provide students with solid foundations in transmission (Mendelian), microbial, molecular genetics, cytogenetics, population, quantitative, evolutionary genetics, epigenetics, genomics, and in use of bioinformatics tools in genetic analyses. Students in the Genetics PhD programme are required to complete modules 1 and 2, whereas the third module can be from module 3 (Bioinformatics tools) or any module offered in other obligatory core PhD courses. Students from other PhD programmes may enrol any of the three GENETICS modules though enrolling module 2 requires prerequisite knowledge in basic genetics covered in module 1.

Module 1: Genetic concepts I covers various basic genetic concepts and fields of biological systems from microbes to mammals.

Module 2: Genetic concepts II provides an advanced course on theoretical and applied genetics as well as contemporary genomics. Emphasis is on analyses of genome structure or variation and applications in biomedicine and biotechnology.

Module 3: Bioinformatics tools is aimed at teaching students how to efficiently use some of the main bioinformatics tools and databases for genetic, genomic and protein analyses. Emphasis of the module is on practical problem-based projects. In summary, contents covered in the three modules of the genetics core course should provide students with the necessary skills and knowledge of contemporary concepts and scientific approaches used in classical and genomic analyses. Students should be able to apply this knowledge and expertise to tackle their projects on model organisms, microbes, domestic animals, plants, wildlife or humans.

Code: M-1-410

Course title: Selected Topics in Medical Microbiology

Lecturers:

Mario Poljak, Tatjana Avšič Županc, Bojana Beović, Alojz Ihan, Srečko Koren, Tatjana Lejko Zupanc, Mojca Matičič, Polona Maver Vodičar, Miroslav Petrovec, Mateja Pirš, Katja Seme, Franc Strle, Janez Tomažič

Contents:

The subject »Selected Topics in Microbiology« deals with complex relationships between microorganisms and between microorganisms and their hosts. It explains the physiological

and pathological circumstances that enable the understanding of mechanisms that underlay the development of infectious diseases.

The subject is divided into three modules each evaluated with 10 credits (ECTS). The students inscribe the subject (30 ECTS) as a combination of three or selection of at least two modules.

Module 1: Basic medical microbiology

Virulent factors and pathogenetic mechanisms of the microbes, fundamentals of antimicrobial chemotherapy and vaccination, fundamentals of laboratory diagnostics of the microbes, molecular epidemiology, emerging microorganisms and prions will be discussed within this module.

Module 2: Clinical microbiology

Diagnostic algorithms in clinical microbiology, their comparison with other similar algorithms in medicine, critical interpretation of the results of microbiological testing, ways of resolving complex diagnostic complications, most frequent errors made when ordering microbiological tests and their medical and economic consequences and problems with communication between the laboratory and clinicians will be discussed.

Module 3: Infectious diseases

All aspects of the most important infectious diseases affecting humans will be explored in details: their epidemiology, pathogenesis, diagnostic procedures (clinical and laboratory) and algorithms, differential diagnosis, therapy, prevention and control and vaccination.

Code: N-1-540

Course title: Neuroscience

Lecturers:

Zvezdan Pirtošek, Mara Bresjanac, Fajko Bajrović, Roman Bošnjak, Leja Dolenc Grošelj, Alojz Ihan, Marko Kreft, Mojca Kržan, Gregor Majdič, David Neubauer, Peter Pregelj, Borut Prestor, Janja Pretnar Oblak, Simon Podnar, Zoran Rodi, Uroš Rot, Saša Šega, Dušan Šuput, Janez Zidar, Robert Zorec, Marko Živin, Jurij Bon, Ivan Bratko, Dejan Georgiev, Milica Gregorič Kramberger, Maja Kojović, Urban Kordeš, Blaž Koritnik, Christina Manoulidiou, Tomaž Marš, Grega Repovš, Boris Rogelj, Maja Trošt

Contents:

The course »Neuroscience« reviews updated knowledge and research in neurobiology at molecular, cellular and systemic levels, anatomy and histology of central and peripheral nervous systems, development and plasticity of the nervous system in physiological and pathological conditions, function of sensory and motor systems, regulation of physiological functions, neuropharmacology, behavioural and cognitive neuroscience, neurological, neurosurgical and psychiatric diseases including ethical considerations.

The course is divided into two independent modules, each equivalent to 10 ECTS. Students can choose both modules (20 ECTS).

Module 1: Basic neuroscience

Module 2: Clinical neuroscience, which consists of three thematic sections: Neurology, Psychiatry and Psychology.

Code: F-1-200

Course title: Pharmaceutical sciences

Lecturers:

Danijel Kikelj (nosilec), Pegi Ahlin Grabnar, Marko Anderluh, Aleš Belič, Marija Bogataj, Tomaž Bratkovič, Zdenko Časar, Bojan Doljak, Rok Dreu, Mirjana Gašperlin, Stanislav

Gobec, Simona Golič Gradolnik, Iztok Grabnar, Janez Ilaš, Damjan Janeš, Matjaž Jeras, Mojca Kerec Kos, Petra Kocbek, Nina Kočevnar, Janko Kos, Mitja Kos, Samo Kreft, Albin Kristl, Julijana Kristl, Jurij Lah, Igor Locatelli, Mojca Lunder, Janez Mravljak, Aleš Mrhar, Aleš Obreza, Slavko Pečar, Andrej Perdih, Lucija Peterlin Mašič, Odon Planinšek, Valentina Prevolnik Rupel, Boris Rogelj, Marija Sollner Dolenc, Izidor Sosič, Stane Srčič, Tomaž Šolmajer, Borut Štrukelj, Tihomir Tomšič, Jurij Trontelj, Uroš Urleb, Tomaž Vovk, Franc Vrečer, Anamarija Zega, Alenka Zvonar Pobirk, Simon Žakelj, Nejc Horvat, Janez Plavec, Žiga Jakopin, Nace Zidar, Gregor Gunčar, Izidor Sosič, Ilija German Ilić, Špela Zupančič, Biljana Jankovič, Lea Knez

Contents:

The core course "Pharmaceutical sciences" deals with scientific principles of medicinal chemistry, pharmaceutical biology, pharmaceutical technological operations, delivery systems and pharmaceutical nanotechnology, molecular biopharmacy and health economics, social pharmacy, pharmacoconomics and pharmacoepidemiology.

The core course comprises 15 independent modules, each equivalent to 15 ECTS. The students can select a combination of modules (10 ECTS each) depending on their research topic.

Modules: Module 1.1.: Drug structure and their properties

Module 1.2.: Drug targets and interactions

Module 1.3.: Drug design methodologies

Module 2.1.: Biomolecules as targets for diagnosis and therapy

Module 2.2.: Biological and gene medical products

Module 2.3.: Herbal medicines

Module 3.1.: Pharmacokinetics and its role in drug discovery and development

Module 3.2.: Biopharmaceutical analysis of LADME processes

Module 3.3.: Pharmacokinetic-pharmacodynamic analysis

Module 4.1.: Pharmaceutical manufacturing processes

Module 4.2.: Drug delivery systems

Module 4.3.: Pharmaceutical nanotechnology and nanomedicines

Module 5.1.: Social pharmacy

Module 5.2.: Health economics

Module 5.3.: Pharmacoepidemiology

Short presentations of modules of the core course "Pharmaceutical sciences" are available at <https://www.uni-lj.si/study/doctoral/biomedicine/curriculum/course-presentation/>.

Code: S-1-420

Course title: Research aspects of public health

Lecturers:

Lijana Zaletel Kragelj, Marjan Bilban, Helena Burger, Barbara Domajnko, Petra Došenović Bonča, Ivan Eržen, Miroljub Jakovljević, Matic Kavčič, Irena Klavs, Žalika Klemenc Ketiš, Marko Kolšek, Mitja Kos, Andreja Kukec, Andreja Kvas, Nejc Mekiš, Ruža Pandel Mikuš, Marija Petek Šter, Antonija Poplas Susič, Danica Rotar Pavlič, Darja Rugelj, Polona Selič, Maja Sočan, Andrej Starc, Igor Švab, Vesna Švab, Vesna Zadnik, Janez Žibert

Contents:

The course consists of two modules, 10 ECTS each.

Module 1: Determinants of health and disease

Biological background of health problems, determinants of health (lifestyle, work environment), selected health problems (mainly cancer and mental health), groups at risk, research methodology.

Module 2: Methodology of public health interventions

Health systems and health policy, quality of care, health promotion, nursing, prevention (vaccination, screening, epidemiological monitoring), primary care, rehabilitation, research methodology.

Code: T-1-340

Course title: Toxicology

Lecturers:

Marija Sollner Dolenc, Emanuela Corsini, Damjana Drobne, Metka Filipič, Žiga Jakopin, Domen Leštan, Janez Mavri, Irena Mlinarič Raščan, Lucija Peterlin Mašič

Contents:

Understanding the mechanisms how chemicals disrupt biological targets is increasingly important in deciding on the safe use of chemical in the workplace and in everyday life.

The course attempts to introduce on the selected cases: mechanisms of transport of compounds across the cell membrane and toxic effects of compounds on it; the role of metabolism in the formation of reactive metabolites that covalently interact with macromolecules of cells; the role of radicals and substances capable of redox reactions to generate oxidative stress in cells; mechanisms of necrotic and apoptotic cell death induced by compounds; specific/nonspecific activation of enzymes and receptors caused by xenobiotics; toxic effects of compounds on mitochondria and peroxisomes, and energy state of cells; specific and nonspecific interactions (covalent /noncovalent) of substances with macromolecules in relation to the toxic effects of compounds (genotoxicity, immunotoxicity, etc.); mechanisms of toxic action of various groups of xenobiotics, which occur in the environment in different groups of organisms (bacteria, animals, plants, fungi); the application of biosensors and biomarkers for evaluation of the toxicity of compounds in conjunction with the corrupting effects on individual organisms, populations, community and ecosystem.

The course is divided into three independent modules, each equivalent to 10 ECTS. Students can sign in all three modules (30 ECTS) or at least two of them while the remaining 10 credits can be selected from modules offered in other core courses.

Module 1: Relationship between structure and toxicity

Covalent and noncovalent interactions of xenobiotics with macromolecules in living cells will be presented and formation of reactive oxygen compounds will be discussed in relation with genotoxic and immunotoxic effects of the compounds. Biotransformation reactions of the substance (functionalisation and conjugation) will be explained, and the consequences of the presence of their products in different tissues will be discussed. The role of radicals in the cell will be presented and the groups of substances that allow their formation will be discussed. We will also present some of the xenobiotics that non-specifically or specifically interact with cell macromolecules. Basic understanding of toxicological tests, including the quantum mechanic methods and bimolecular simulations that allow toxicity prediction of substances will be presented.

Module 2: Influence of toxic compounds on processes within cell

The effects of substances on the transport across membranes will be discussed, and the mechanisms of necrotic and apoptotic cell death induced by xenobiotics will be explained. The toxicity of a substance caused by the activation / suppression of cytokine and nuclear receptors will be described. The examples of xenobiotics that interfere with the processes of energy and interact with mitochondria and peroxisomes, immune system and genetic material will be presented.

Module 3: Influence of toxic compounds on environment and ecosystems

This module presents: effects of xenobiotic on suborganism, organism, population and ecosystem level; extrapolation of toxicological data from molecular and physiological levels

to higher levels of biological organization; bioavailability of xenobiotics and other harmful substances in soil and water; biotransformation way of some important groups of xenobiotics and other harmful substances in soil and water; path intake of residues of drugs and their metabolites in the environment, their behavior (adsorption/desorption, distribution, decomposition) and their toxic effects in the environment; the possibility of bio-accumulation and toxic effects of residues of substances in aquatic and terrestrial organisms in the environment.

Code: V-1-700

Course title: Regulation processes in healthy and diseased animals

Lecturers:

Milka Vrecl Fazarinc, Gregor Majdič, Nina Čebulj-Kadunc, Jelka Zabavnik Piano, Robert Frangež, Breda Jakovac Strajn, Polona Juntas, Martina Klinkon Ogrinec, Andrej Kirbiš, Urška Jamnikar Ciglencečki, Petra Zrimšek in Mitja Gombač

Contents:

Module 1: Regulation of basic processes in animals

Module 1 deals with morphological and functional characteristics of animal cell, cell as hereditary carrier, transfer of hereditary information on offspring, regulation of gene expression and cell signaling. It also covers biochemical and physiological processes and their neuroendocrine regulation crucial for maintenance of homeostasis and responsiveness of the organism to various environmental influences. It also enables students to expand their knowledge of progenesis, fertilization and early embryonic development in domestic animals, and to become acquainted with modern research methods.

Module 2: Disruption of homeostasis and disease processes

Module 2 deals in depth with main causes for disturbances and basic pathophysiological processes in organisms, important in developing and understanding of the mechanisms of disease and establishing clinical diagnosis and disease therapy. It enables recognition of organism dysfunction through morphological alterations in organs, tissues and cells and contribute to better understanding of organism response to the impact of harmful factors in disease processes. It also deals with the interconnection between changes in the biochemical parameters and the function of organ systems, mineral and electrolyte metabolism disturbances and the assessment of acid-bases balance and changes associated with the alimentary intoxications.

Module 3: Food safety

In module 3, students gain knowledge and understanding of positive and negative effect of interaction between human and animals, with an emphasis on consuming products of animal origin, using epidemiological and statistical tools to estimate the risk, gain new knowledge in the technology of meat and dairy processing industries, as well as fish processing industry, clams, crabs, frogs, eggs, honey and products from these commodities.

9. 3. Elective courses

The various scientific fields offer a great variety of elective courses. The student can choose between elective theoretical courses and elective individual research courses evaluated with 5 credits. The courses are offered by professors who are also leading scientists in their respective scientific fields. Elective individual research courses are offered by researchers who can accept doctoral students in their laboratories, where they can acquire up-to-date scientific technologies and approaches to experimental work. A total of 10 elective credits can be selected from the university pool of generic skills courses, listed at the web page of University of Ljubljana (http://bit.ly/doktorski_studij).

9. 3. 1. Elective theoretical courses

	Course	Lecturer	Code
1	Analysis of drugs and metabolites in biosystems	Albin Kristl	F-2-202
2	Autoimmunity	Borut Božič	L-2-301
3	Biophysics of macromolecules and membrane	Janez Štrancar	F-2-923
4	Biogenic medicines	Nina Kočever Glavač	F-2-203
5	Biochemistry of biological membranes	Igor Križaj	B-2-903
6	The biology of stress	Damjana Drobne	T-2-344
7	Biological drugs on the basis of monoclonal antibodies	Vladka Čurin Šerbec	B-2-110
8	Biomolecular thermodynamics	Jurij Lah	B-2-800
9	Cell physiology	Robert Zorec	B-2-105
10	Cell and tissue engineering in advanced therapies	Matjaž Jeras	F-2-204
11	Electroporation based technologies and treatments	Damijan Miklavčič	J-2-441
12	Ethology and reserach methods in animal behaviour	Martin Dobeic	V-2-704
13	Pharmaceutical biotechnology	Borut Štrukelj	F-2-205
14	Communicology in pharmacy	Nejc Horvat	F-2-206
15	Pharmaceutical packaging	Stane Srčič	F-2-234
16	Veterinary dosage forms	Stane Srčič	F-2-207
17	Pharmacoeconomics	Igor Locatelli	F-2-208
18	Pharmacogenetics and personalized medicine	Vita Dolžan	B-2-104
19	Pharmacogenomics in pharmaceutical practice	Irena Mlinarič – Raščan	F-2-209
20	Pharmacometrics	Igor Locatelli	F-2-210
21	Pharmacotherapy	Mojca Kerec Kos	F-2-201
22	Industrial medicinal chemistry	Stanislav Gobec	F-2-237
23	Industrial development of dosage forms	Janez Kerč	F-2-215
24	Interactions of drug delivery systems in biosystems	Marija Bogataj	F-2-216
25	Chosen chapters from drug analysis	Aleš Obreza	F-2-217
26	Topics from physical pharmacy	Stane Srčič	F-2-218
27	Clinical biochemistry – selected topics	Janja Marc	L-2-302
28	Cosmetology – selected topics	Mirjana Gašperlin	F-2-219
29	Selected topics in drug synthesis	Danijel Kikelj	F-2-220
30	Selected topics from oromaxillofacial field	Nataša Ihan Hren	K-2-535
31	Quality of medicaments	Aleš Krbavčič	F-2-224
32	Clinical pharmacokinetics	Iztok Grabnar	F-2-225

33	Macromolecular crystallography	Dušan Turk	F-2-920
34	Medical biophysics	Jure Derganc	J-2-442
35	Medical virology	Mario Poljak	M-2-413
36	Methods of structure and properties determination of drugs and their targets	Andrej Perdih	F-2-921
37	Methods for determination of phenomena at interfaces	Odon Planinšek	F-2-226
38	The methodology of scientific research	Jelka Zabavnik Piano	V-2-705
39	Microbiology of the gut	Gorazd Avguštin	M-2-616
40	Molecular bioinformatics	Roman Jerala	B-2-901
41	Molecular biology in veterinary medicine	Jelka Zabavnik Piano	V-2-706
42	Molecular mechanisms of cancer	Gregor Serša	B-2-107
43	Mutagenesis and genetic toxicology	Metka Filipič	T-2-940
44	Design of biodiagnostics and biosensors	Janko Kos	L-2-303
45	Design and analysis of clinical and epidemiological research	Lara Lusa	J-2-466
46	Design and synthesis of enzyme inhibitors	Stanislav Gobec	F-2-227
47	Quality assurance and validations in pharmaceutical production	Stane Srčič	F-2-214
48	Drug design	Danijel Kikelj	F-2-230
49	Advanced molecular genetics	Jože Pungerčar	B-2-902
50	Advanced drug delivery systems	Julijana Kristl	F-2-229
51	High resolution optical microscopy – confocal microscopy	Marko Kreft	J-2-440
52	Perinatology	Ksenija Geršak	K-2-536
53	Entrepreneurship in medicine	Mateja Drnovšek	B-2-108
54	Quality of care assessment research methods	Marija Petek Šter	S-2-423
55	Reactive metabolites of xenobiotics	Lucija Peterlin Mašič	T-2-345
56	Synthesis and analysis of chiral drugs	Danijel Kikelj	F-2-239
57	Social pharmacy with pharmacoepidemiology	Mitja Kos	F-2-238
58	Drug stability	Robert Roškar	F-2-235
59	Steroid hormones and hormone dependent diseases	Tea Lanišnik Rižner	B-2-109
60	Light and electron microscopy	Rok Romih	J-2-465
61	Transport and metabolism of drugs in biosystems	Albin Kristl	F-2-236
62	Compounds with multiple mode of action	Janez Ilaš	F-2-240
63	Thermal analysis of pharmaceuticals	Stane Srčič	F-2-228
64	Introduction to data mining	Blaž Zupan	B-2-126
65	Veterinary ecology and biosecurity	Martin Dobeic	V-2-707
66	Protein folding and aggregation	Eva Žerovnik	B-2-905
67	Animals in experiment	Mitja Gombač	V-2-708

9. 3. 2. Elective individual research courses

	Course	Lecturer	Code
1	Allergology	Mitja Košnik	K-3-501
2	Genome and transcriptome analyses	Damjana Rozman	B-3-119
3	Analysis of non-coding RNAs	Tanja Kunej	G-3-614
4	Skeletal muscle analysis	Vika Smerdu	J-3-452
5	Genomewide association and functional analysis in human	Uroš Potočnik	G-3-610
6	Development of biomarkers and their clinical application	Joško Osredkar	L-3-317
7	Biology and diseases of honeybee society	Vlasta Jenčič	V-3-709
8	Tumor biology	Gregor Serša	J-3-444
9	Biological implications of protein misfolding and aggregation	Eva Žerovnik	B-3-911
10	Biotechnological processes in pharmacy	Borut Štrukelj	F-3-245
11	Diseases and fish health management	Vlasta Jenčič	V-3-710
12	Diseases of birds, small mammals and reptiles	Joško Račnik	V-3-711
13	Cell electrophysiological methods	Robert Zorec	N-3-546
14	Cell cultures in research studies and regenerative medicine	Mateja Erdani Kreft	J-3-463
15	Cellular models of stress	Irina Milisav Ribarič	J-3-453
16	Hereditary disorders of the skin – molecular techniques for disease diagnosis and research	Mirjana Liovic	B-3-118
17	Work with isolated organs	Katarina Černe	J-3-462
18	Dermatology of dogs and cats	Tina Kotnik	V-3-712
19	Detection and localisation of molecules in cells	Peter Veranič	J-3-457
20	Diagnostic and experimental cytology	Margareta Strojjan Fležar	J-3-456
21	Diagnostic microbiology	Mario Poljak	M-3-414
22	Diagnostics and intensive therapy of neurological diseases in newborn	David Neubauer	N-3-547
23	Determination of specific protein expression in skeletal muscle cells with western blot	Sergej Pirkmajer	J-3-448
24	Echocardiography	Mirta Koželj	K-3-502
25	Experimental epigenetics	Alja Videtič Paska	B-3-115
26	Experimental immunology	Alojz Ihan	K-3-504
27	Experimental neuroendocrinology	Gregor Majdič	V-3-713
28	Experimental rheological analysis	Mirjana Gašperlin	F-3-249
29	Experimental virology	Tatjana Avšič-Županc	M-3-415
30	Experimental methods in biophysics	Janez Štrancar	F-3-924
31	Experimental methods in pharmacogenomics	Vita Dolžan	B-3-110
32	Experimental methods in laboratory medicine	Darko Černe	L-3-309
33	Experimental methods in innate immunity	Roman Jerala	B-3-908
34	Experimental methods in studies of nucleic acid structure	Janez Plavec	B-3-116

35	Experimental techniques in dental prosthodontics	Peter Jevnikar	K-3-529
36	Experimental methods for studying biochemistry of steroid hormones	Tea Lanišnik Rižner	B-3-122
37	Experimental methods for the research of brain disease	Marko Živin	N-3-545
38	Experimental approaches in molecular epidemiology	Alenka Franko	B-3-131
39	High resolution electrocardiography	Vito Starc	K-3-503
40	Enzyme catalysis	Jure Stojan	B-3-124
41	Evolutionary genomics	Dušan Kordiš	B-3-909
42	Pharmacoeconomics	Igor Locatelli	F-3-256
43	Pharmacology and toxicology	Tomaž Snoj	V-3-714
44	Pharmacological and toxicological testing of drugs	Metoda Lipnik–Štangelj	K-3-505
45	Pharmacotherapy	Mojca Kerec Kos	F-3-255
46	Functional MRI	Dušan Šuput	N-3-557
47	Gastroenterologic surgery	Mirko Omejc	K-3-506
48	Gastrointestinal problems in horses	Peter Kruljc	V-3-715
49	Yeast genetics, functional geomics and systems biology	Uroš Petrovič	G-3-930
50	Genome analysis of complex traits	Gregor Gorjanc	G-3-606
51	Protein glycosylation	Gregor Gunčar	B-3-805
52	Breeding and health care of wild animals	Gorazd Vengušt	V-3-716
53	Hemostasis	Mojca Božič Mijovski	K-3-526
54	Hyperbaric Medicine	Žarko Finderle	K-3-545
55	Human cytogenetics	Nadja Kokalj Vokač	G-3-608
56	Immunohistochemistry	Mija Meznarič	J-3-451
57	Veterinary immunology methods	Tadej Malovrh	V-3-717
58	Immune reaction in research and diagnostics	Saša Čučnik	L-3-306
59	Intensive care	Matej Podbregar	K-3-547
60	Problems in ruminant medicine or surgery	Jože Starič	V-3-718
61	Interventional radiology	Dimitrij Kuhelj	K-3-531
62	Selected topics from drug analysis	Aleš Obreza	F-3-250
63	Haematology – selected topics	Helena Podgornik	L-3-304
64	Selected immunological methods	Alojz Ihan	K-3-508
65	Selected methods in pharmacokinetics	Mojca Kržan	K-3-507
66	Selected methods applied in sports medicine	Helena Lenasi	K-3-528
67	Clinical biochemistry – selected contents	Janja Marc	L-3-313
68	Selected cases in human genetics	Damjan Glavač	G-3-605
69	Selected cases in medical genetics	Damjan Glavač	B-3-125
70	Nuclear magnetic resonance in studies of biological macromolecules	Janez Plavec	B-3-907
71	Characterization and identification of microfungi	Nina Gunde–Cimerman	M-3-621
72	Cardiovascular dynamics	Borut Kim	K-3-509
73	Cardiovascular surgery	Juš Kšela	K-3-548

74	Surgery and ophtalmology principles, methods and approaches	Vladimira Erjavec	V-3-719
75	Clinical arrhythmology	Matjaž Šinkovec	K-3-549
76	Clinical cardiac electrophysiology	Peter Rakovec	K-3-512
77	Clinical nutrition	Nada Rotovnik	K-3-550
78	Clinical neurophysiological methods for assessment of muscles and the nervous system	Blaž Koritnik	N-3-548
79	Clinical neurosonology methods for cerebrovascular blood flow study	Bojana Žvan	N-3-549
80	Clinical researches of face and oral cavity	Nataša Ihan Hren	K-3-551
81	Clinical aspects of human reproduction	Bojana Pinter	K-3-511
82	Concepts of genomic data integration	Tanja Kunej	G-3-609
83	Blood	Samo Zver	K-3-552
84	Cryomethods for electron microscopy	Rok Romih	J-3-443
85	Qualitative methods on health behaviour research	Marko Kolšek	S-3-424
86	Qualitative research through interviews	Danica Rotar Pavlič	S-3-425
87	Macromolecular interactions	Gregor Anderluh	B-3-906
88	Stem cells: from research to cell therapies	Uroš Rajčević	J-3-467
89	Regulation of gene expression of prokaryotes	Matej Butala	G-3-612
90	Methods for determination of reactive metabolites of xenobiotics	Marija Sollner Dolenc	T-3-348
91	Methods and models in cell-based assays	Irena Mlinarič Raščan	L-3-305
92	Advanced neuromonitoring methods following traumatic brain injury	Primož Gradišek	K-3-553
93	Methods in single cell physiology	Robert Zorec	J-3-445
94	Techniques for studying membrane proteins and assesing the membrane integrity on the model of mitochondrial biogenesis	Irina Milisav Ribarič	J-3-454
95	Methods to study metabolism in tissue and in single cells	Nina Vardjan	J-3-468
96	Methods for determination of antithrombotic efficiency of agents	Mojca Božič Mijovski	F-3-247
97	Treatment methods of cancer in veterinary medicine	Nataša Tozon	V-3-720
98	Microbiology	Andrej Pengov	V-3-721
99	Microbiology techniques	Matjaž Ocepek	V-3-722
100	Single cell micromanipulation	Jure Derganc	J-3-459
101	Mammary gland: a model for genetic, developmental and cell biology studies	Peter Dovč	G-3-604
102	Molecular analysis and suicidal behavior	Alja Videtič Paska	B-3-114
103	Molecular diagnostics	Damjan Glavač	J-3-461
104	Molecular diagnostics in laboratory biomedicine	Barbara Ostanek	L-3-316
105	Molecular genetics of hormone in metabolic disorders	Tadej Battelino	B-3-123
106	Molecular methods in pharmacology	Metoda Lipnik-Štangelj	K-3-513

107	Monoclonal antibodies – the overview and their use in research, diagnostics and therapy	Vladka Čurin Šerbec	B-3-126
108	Morphology and function of peripheral nerves	Simon Podnar	N-3-550
109	Morphometric analysis of cells and tissues	Milka Vrecl	V-3-723
110	Sleep–related breathing disorders and sleep disorders during development	David Neubauer	N-3-551
111	Evidence based health care and inter-professional collaboration	Brigita Skela Savič	S-3-429
112	Principles and techniques in biochemistry and molecular biology	Miha Pavšič	B-3-802
113	Design and experimental research of cancer diseases	Petra Hudler	B-3-113
114	Quality design and quality assurance in medical laboratories	Joško Osredkar	L-3-307
115	Rational design of peptidomimetics	Marija Sollner Dolenc	F-3-248
116	Food safety	Andrej Kirbiš	V-3-724
117	Advanced Treatment Strategies in Heart Failure	Bojan Vrtovec	K-3-554
118	Electrophysiologic study of the visual system	Maja Šuštar	N-3-552
119	Neurochemical methods	Tomaž Marš	N-3-553
120	Neurology and neurophysiology during early developmental age	David Neubauer	N-3-554
121	Neuroophthalmology – optic neuropathies and retinal dystrophies	Martina Jarc-Vidmar	N-3-564
122	Novel methods in abdominal surgery and organ transplantation	Blaž Trotovšek	K-3-555
123	Novelties in perinatal medicine	Miha Lučovnik	K-3-556
124	Numerical modeling of processes in biophysics	Bojan Božič	J-3-460
125	Hygiene and pathology of animal nutrition	Breda Jakovac Strajn	V-3-725
126	Nutrigenomics	Nataša Karas Kuželički	L-3-315
127	Surgical oncology	Nikola Bešič	K-3-514
128	High resolution optical microscopy – confocal microscopy	Marko Kreft	J-3-446
129	Basic of molecular virology	Ivan Toplak	V-3-726
130	Osteosynthesis	Vladimir Smrkolj	K-3-515
131	Pathobiochemical mechanisms and models	Samo Ribarič	L-3-308
132	Perioperative treatment of the patient	Maja Šoštarič	K-3-557
133	Prenatal screening and diagnostic tests for detection of fetal anomalies	Nataša Tul Mandić	K-3-558
134	Screening tests for Down syndrome	Joško Osredkar	J-3-447
135	Comparative genomics	Jernej Jakše	G-3-613
136	Comparative odontology and periodontal medicine	Ana Nemeč	V-3-727
137	Recommendations on the implementation of point–of–care tests	Joško Osredkar	K-3-527
138	Preparation of skeletal muscle cell culture	Tomaž Marš	J-3-449
139	Development of protocols for enzyme activity determination and quatification of molecular	Aljoša Bavec	B-3-130

	interactions		
140	Congenital heart disease	Mirta Koželj	K-3-516
141	Experimental approaches in molecular genetics diagnostic of inborn disorders	Katarina Trebušak Podkrajšek	G-3-611
142	Plant toxins and poisonous plants	Samo Kreft	T-3-349
143	Research approach to diagnostics and therapy of cerebrovascular disease	Janja Pretnar Oblak	N-3-556
144	Research in physiological reproductive period	Ana Polona Mivšek	S-4-433
145	Research in the field of gerontology and aging processes	Borut Poljšak	S-4-431
146	Research in the field of posture and balance control	Darja Rugelj	S-3-430
147	Research in the field of optimization of radiographical procedures	Nejc Mekiš	S-4-432
148	Research designs in health promotion	Lijana Zaletel – Kragelj	S-3-426
149	Reactive oxygen and nitrogen species in biological systems	Janez Mravljak	F-3-244
150	Regenerative orthopedics	Matej Drobnič	K-3-559
151	Recombinant proteins	Marko Dolinar	B-3-803
152	Reproduction and obsterics	Marjan Kosec	V-3-728
153	Electronic analog circuitry for physiological and pathophysiological studies	Samo Ribarič	K-3-517
154	Community care	Vesna Švab	S-3-427
155	Monitoring of DNA amplification in real time	Kristina Gruden	G-3-607
156	Sleep medicine and polysomnographic recordings for evaluation of sleep disorders	Leja Dolenc Grošelj	N-3-555
157	Special veterinary pathology	Polona Juntjes	V-3-730
158	Cardiovascular rehabilitation	Borut Jug	K-3-560
159	Drug stability	Robert Roškar	F-3-254
160	Stereology and quantitative image analysis	Andrej Čör	J-3-450
161	Stigma of mental disorders	Vesna Švab	S-3-428
162	Protein structure	Gregor Gunčar	B-3-804
163	Study of drug effects on human microcirculation	Ksenija Cankar	K-3-518
164	Toxicokinetics	Iztok Grabnar	T-3-346
165	Toxicology on molecular scale	Janez Mavri	T-3-941
166	Toxicological testing of new drugs	Marija Sollner Dolenc	T-3-347
167	Three–dimensional diagnostics in jaw and dental orthopedics	Maja Ovsenik	K-3-561
168	Small animal ultrasonography	Aleksandra Domanjko Petrič	V-3-731
169	Regulation of gene expression – experimental approaches	Damjana Rozman	B-3-121
170	Genome editing and regulating gene expression using TALEs and CRISPR/Cas9	Roman Jerala	G-3-931
171	Small animal emergency medicine	Alenka Seliškar	V-3-729
172	Urogynecology	Adolf Lukanovič	K-3-519
173	Oral medicine and periodontology	Boris Gašpirc	K-3-562

174	Silencing of specific genes using sirna approach	Katarina Miš	J-3-455
175	Gene immunotherapy	Uroš Rajčević	J-3-469
176	Veterinary anaesthesiology	Alenka Seliškar	V-3-732
177	Veterinary diagnostic cytopathology	Polona Juntos	V-3-733
178	Veterinary cardiology	Aleksandra Domanjko Petrič	V-3-734
179	Veterinary laboratory medicine – clinical pathology	Martina Klinkon Ogrinec	V-3-735
180	Veterinary radiology	Aleksandra Domanjko Petrič	V-3-736
181	Evidence–based laboratory medicine	Janja Marc	L-3-314
182	Poultry health and protection	Olga Zorman Rojs	V-3-738
183	Health care of pigs	Marina Štrukelj	V-3-739
184	Health care of ruminants	Jožica Ježek	V-3-740
185	Intracellular signalling mediated by receptor and non–receptor protein kinases	Sergej Pirkmajer	J-3-458
186	Dental diseases	Janja Jan	K-3-563
187	Extracellular vesicles - biological relevance and clinical potential	Metka Lenassi	B-3-127

10. Key to course codes

The courses are coded with a capital letter and two numbers. The capital letter indicates the scientific field or a combination of fields. The first number indicates the type of the course and the second one consists of three digits, the first indicating the location and the last two the consecutive number of the course.

Scientific fields:

B - Biochemistry and Molecular Biology
F - Pharmacy
G - Genetics
J - Basic Medical Science
K - Clinical Medicine
L - Clinical Biochemistry and Laboratory Biomedicine
M – Medical Microbiology
N - Neuroscience
S - Public Health
T - Toxicology
V - Veterinary Medicine

Types of courses:

1 – core courses
2 – elective theoretical courses
3 – elective individual research courses

Course locations:

1 – Faculty of Medicine - Biochemistry and Molecular Biology
2 – Faculty of Pharmacy – Pharmacy
3 – Faculty of Pharmacy - Clinical Biochemistry and Laboratory Biomedicine, Toxicology

- 4 – Faculty of Medicine – Basic Medical Science, Public Health, Microbiology
- 5 – Faculty of Medicine, University Medical Centre Ljubljana, Institut of Oncology Ljubljana, University Psychiatric Hospital Ljubljana – Clinical Medicine, Neuroscience
- 6 – Biotechnical Faculty - Microbiology, Genetics
- 7 – Veterinary Faculty – Veterinary Medicine
- 8 – Faculty of Chemistry and Chemical Technology
- 9 – research institutes: Josef Stefan Institute, National Institute of Chemistry, National Institute of Biology

Hence, the course bearing the code B-2-940 belongs in the area of biochemistry and molecular biology (B), is an elective theoretical course (2) and is carried out at a research institute (9).

CORE COURSES:

- | | |
|---------|--|
| B-1-100 | Selected advanced topics in Biochemistry and Molecular biology |
| B-1-101 | 1 Selected biochemical processes with regulatory mechanisms |
| B-1-102 | 2 Structure and function of biological molecules and designed biological |
| B-1-103 | 3 Functional genomics and proteomics |
| | |
| F-1-200 | Pharmaceutical sciences |
| F-1-211 | 1. 1 Drug structure and their properties |
| F-1-212 | 1. 2 Drug targets and interactions |
| F-1-213 | 1. 3 Drug design methodologies |
| F-1-221 | 2. 1 Biomolecules as targets for diagnosis and therapy |
| F-1-222 | 2. 2 Biological and gene medical products |
| F-1-223 | 2. 3 Herbal medicines |
| F-1-231 | 3. 1 Pharmacokinetics and its role in drug discovery and development |
| F-1-232 | 3. 2 Biopharmaceutical analysis of LADME processes |
| F-1-233 | 3. 3 Pharmacokinetic-pharmacodynamic analysis |
| F-1-241 | 4. 1 Pharmaceutical manufacturing proceses |
| F-1-242 | 4. 2 Drug delivery systems |
| F-1-243 | 4. 3 Pharmaceutical nanotechnology and nanomedicines |
| F-1-251 | 5. 1 Social pharmacy |
| F-1-252 | 5. 2 Health economics |
| F-1-253 | 5. 3 Pharmacoepidemiology |
| | |
| L-1-300 | Algorithms of clinical biochemical diagnostics |
| L-1-310 | 1. Laboratory biomedicine |
| L-1-311 | 1. 1 Scientific approaches in laboratory medicine |
| L-1-312 | 1. 2 Stepwise approach to clinical and biochemical diagnostics with interpretation |
| L-1-320 | 2. Molecular markers of diseases |
| L-1-321 | 2. 1 Common genetic diseases |
| L-1-322 | 2. 2 Immune diseases |
| L-1-323 | 2. 3 Malignant disorders |
| L-1-330 | 3. Translational Biomedicine |

L-1-331	3. 1 Pharmacogenomic diagnostics
L-1-332	3. 2 Cellular and Tissue Engineering
L-1-333	3. 3 Omic” Technologies and Tools (advanced technologies and tools in translational biomedicine)
T-1-340	Toxicology
T-1-341	1. Relationship between structure and toxicity
T-1-342	2. Influence of toxic compounds on processes within cell
T-1-343	3. Influence of toxic compounds on environment and ecosystems
J-1-400	Medical Cell Biology
J-1-401	1. Fundamentals of medical cell biology
J-1-402	2. Reproductive biology <i>in vivo</i> and <i>in vitro</i>
J-1-403	3. Biology of Malignant Cells and Translational Oncology
J-1-404	4. Cell biology in clinical genetics
J-1-405	5. Systems medicine of multifactorial disorders
M-1-410	Selected Topics in Medical Microbiology
M-1-411	1. Basic medical microbiology
M-1-412	2. Clinical microbiology
M-1-615	3. Infectious diseases
S-1-420	Research aspects of public health
S-1-421	1. Determinants of health and disease
S-1-422	2. Methodology of public health interventions
K-1-500	Research in clinical medicine
K-1-510	1. Fundamentals in medical research
K-1-520	2. Methods in medical research
K-1-530	3. Achievements in clinical research
K-1-531	3. 1 Cardiovascular medical science
K-1-532	3. 2 Medical science of surgical disciplines
K-1-533	3. 3 Emergency and intensive medicine
K-1-534	3. 4 Hematology and oncology
K-1-535	3. 5 Hyperbaric medicine
K-1-536	3. 6 Immunology and allergology
K-1-537	3. 7 Imaging methods
K-1-538	3. 8 Genetic methods
K-1-539	3. 9 Physiology of the cardiovascular system
K-1-531	3. 10 Physiology of respiration
K-1-531	3. 11 Physiology and biomechanics of the locomotor system
K-1-531	3. 12 Basic and clinical pharmacology and drug development

N-1-540	Neuroscience
N-1-541	1. Basic neuroscience
N-1-542	2. Clinical Neuroscience
G-1-600	Genetics
G-1-601	1. Genetic concepts I
G-1-602	2. Genetic concepts II
G-1-603	3. Bioinformatics tools
V-1-700	Regulation processes in healthy and diseased animals
V-1-701	1. <i>Regulation of basic processes in animals</i>
V-1-702	2. <i>Disruption of homeostasis and disease processes</i>
V-1-703	3. <i>Food safety</i>

11. Requirements for progression through the programme

To progress from the 1st to the 2nd year, successful completion of at least 45 credits, of which at least 20 credits must derive from core courses, is required.

Students who have completed all organized study requirements in the first and second year and have the confirmation of the positive assessment of the doctoral dissertation topic by their guidance committee from the senate of the Faculty at which the student is enrolled, may progress to the third year of doctoral study.

Students who have completed all obligations from the first three years of study and obtained the confirmation of the proposed doctoral dissertation topic by the University Senate may advance to the fourth year of doctoral study.

It is also possible to repeat the year. The requirements for repeating the first year is completion of at least 10 credits from the core course and 20 from individual research work.

If the student wishes to repeat the second year, he/she must fulfil all study obligations of the first year.

The requirement for repeating the third year is completion of all study obligations of the first and second year of study.

12. Grading system

According to the programme, exams are written and oral. In accordance with the Statute of the University of Ljubljana examination results are graded from 5 to 10, pass grades range from 6 to 10. Preparation and oral presentations of seminars are also graded. The examinations in doctoral programmes may also be graded as not passed, passed and passed with honors.

13. Conditions for completing the programme and doctoral diploma

13. 1. Conditions for completing the programme

The condition for completing the programme of study and acquiring a doctoral degree is the successful completion of all study obligations defined by the programme and the successful defence of the doctoral thesis. The doctoral student must publish at least one scientific article based on the research presented in the doctoral thesis in a scientific journal indexed by the SCI or SSCI. The article with the student's name listed as first author must be published or

accepted for publication before the candidate hands in the doctoral dissertation for assessment.

13. 2. Doctoral thesis

A doctoral thesis is a written final study assignment that represents an independent and original contribution to the scientific field covered by the doctoral dissertation topic. As a rule, the doctoral thesis shall be written in Slovene. It may be written exceptionally in a foreign language in accordance with the Rules on Doctoral Study at the UL.

After the public defense of the doctoral thesis and following a nomination by the UL member faculty, where the student has successfully defended the doctoral dissertation, the Rector performs the promotion for the doctoral graduate.

13. 3. Doctoral diploma

After completing the programme, the doctoral diploma jointly signed by the Rector of the University of Ljubljana and the dean of the responsible faculty, is awarded to the students. Doctoral diploma is awarded by the Rector of the University of Ljubljana. Graduates of the Interdisciplinary Doctoral Programme in Biomedicine receive the title doktor/doktorica znanosti (level of qualification: SQF level 10, EQF level 8, EQ-EHEA level Third cycle).

14. Transfer between study programmes

Transfer between programmes is possible if candidates fulfil the access requirements of the programme. Applications for transfer of such candidates to Interdisciplinary Doctoral Programme in Biomedicine will be treated individually by the Programme Council in accordance with the University Statute.

15. Career Prospects

The possibilities for employment of graduates from the Interdisciplinary Doctoral Programme in Biomedicine are diverse. They will present an important pool of experts at Slovene universities and other educational or research institutions. They can also work in health institutions as well as in other institutions that perform research. They will also be employable in the pharmaceutical industry and in government administration. Employment in other institutions that employ experts with the highest educational level is also possible.

16. International exchanges

The Interdisciplinary Doctoral Programme in Biomedicine is both horizontally and vertically linked to other study programmes at the University of Ljubljana. Horizontal exchange enables students to fulfill their elective course requirements from other graduate study programmes at the University of Ljubljana in agreement with their mentors and course lecturers. The vertical link is inherent in the very design of the study programme through its syllabus and the possibilities of choosing different courses. Furthermore, it is possible to exchange study courses with other comparable programmes taught at other universities. The quality and comparability of courses must be evaluated by the Programme Council. International exchange takes place on the basis of international contracts and bilateral agreements.

International exchange is also possible through collaboration in mobility programmes for students and professors (ERASMUS, SOCRATES, CEEPUS etc.). The programme is also open to foreign students.

17. Programme Council

The Programme Council consists of members of each faculty and research institute. Representatives are proposed by the faculty senates and confirmed by University Senate for a period of four years. The Council is chaired by the chairman, who has a deputy. The president's mandate is four years and can be repeated. The seat of the Programme Council is at the University of Ljubljana.

At the proposal of the UL Student Council, the twelfth member, a student representative, may also join the Programme Council -.

18. Field coordinators

Biochemistry and Molecular Biology:

Prof Dr Ana PLEMENITAŠ, phone: +386 1 543 76 71

e-mail: ana.plemenitas@mf.uni-lj.si

Deputy: Prof Dr Vita DOLŽAN, phone: +386 1 543 76 70

e-mail: vita.dolzan@mf.uni-lj.si

Pharmacy:

Prof Dr Mirjana GAŠPERLIN, phone: +386 1 476 96 34

e-mail: mirjana.gasperlin@ffa.uni-lj.si

Deputy: Assoc Prof Tomaž VOVK, phone: +386 1 476 95 50

e-mail: tomaz.vovk@ffa.uni-lj.si

Genetics:

Prof Dr Simon HORVAT, phone: +386 1 320 39 17

e-mail: simon.horvat@bf.uni-lj.si

Deputy: Prof Dr Jernej JAKŠE, phone: +386 1 320 32 80

e-mail: jernej.jakse@bf.uni-lj.si

Public Health:

Prof Dr Lijana ZALETEL KRAGELJ, phone: +386 1 543 75 42

e-mail: lijana.kragelj@mf.uni-lj.si

Deputy: Prof Dr Marija PETEK ŠTER,

e-mail: marija.petek-ster@mf.uni-lj.si

Clinical Biochemistry and Laboratory Biomedicine:

Prof Dr Janja MARC, phone: +386 1 476 96 00

e-mail: janja.marc@ffa.uni-lj.si
Deputy: Prof Dr Darko ČERNE, phone: +386 1 476 96 44
e-mail: darko.cerne@ffa.uni-lj.si

Clinical Medicine:

Prof Dr Žarko FINDERLE, phone: +386 1 543 75 12
e-mail: finderle@mf.uni-lj.si
Deputy: Prof Dr. Matej PODBREGAR, phone: +386 40 215 960
e-mail: matej.podbregar@guest.arnes.si, podbregar.matej@gmail.com

Basic Medicine:

Prof Dr Rok ROMIH, phone: +386 1 543 76 83
e-mail: rok.romih@mf.uni-lj.si
Deputy: Prof Dr Tadej BATTELINO, phone: +386 1 522 92 26
e-mail: tadej.battelino@mf.uni-lj.si

Microbiology (the last generation enrolled in this field in the academic year 2020/2021):

Prof dr Gorazd AVGUŠTIN, phone: 01 721-78-27
e-mail: gorazd.avgustin@bf.uni-lj.si

Medical Microbiology:

Prof Dr Mario POLJAK, phone: +386 1 543 74 53
e-mail: mario.poljak@mf.uni-lj.si
Deputy: Prof Dr Janez TOMAŽIČ, phone: +386 1 522 81 17
e-mail: janez.tomazic@mf.uni-lj.si

Neuroscience:

Prof Dr Marko ŽIVIN, phone: +386 1 543 70 58
e-mail: marko.zivin@mf.uni-lj.si
Deputy: Asst Prof Blaž KORITNIK, phone: +386 1 522 15 01
e-mail: blaz.koritnik@mf.uni-lj.si

Toxicology:

Prof Dr Marija SOLLNER DOLENC, phone: +386 1 476 95 72
e-mail: marija.sollner@ffa.uni-lj.si
Deputy: Prof Dr Damjana DROBNE, phone: +386 1 320 33 75
e-mail: damjana.drobne@bf.uni-lj.si

Veterinary Medicine:

Prof Dr Robert FRANGEŽ, phone: +386 1 477 91 31
e-mail: robert.frangez@vf.uni-lj.si
Deputy: Prof Dr Milka VRECL FAZARINC,
phone: +386 1 477 91 18,
e-mail: milka.vreclfazarinc@vf.uni-lj.si

19. Additional Information

Webpage:

<https://www.uni-lj.si/study/doctoral/biomedicine/>

Postgraduate studies offices at the University members coordinating individual scientific fields

Biotechnical Faculty, Jamnikarjeva 101, Ljubljana www.bf.uni-lj.si	Fields	Contact	Phone	E-mail
	Genetics	Vesna Ješe Janežič	+386 1 320 30 27	vesna.iesejaneczic@bf.uni-lj.si
Faculty of Medicine, Vrazov trg 2, Ljubljana www.mf.uni-lj.si	Biochemistry and Molecular Biology	Stela Kuželj Maruša Vukelič	+386 1 543 77 24 +386 1 543 7819	stela.kuzelj@mf.uni-lj.si marusa.vukelic@mf.uni-lj.si
	Clinical Medicine			
	Basic Medicine			
	Public Health			
	Neuroscience			
	Medical Microbiology			
Faculty of Pharmacy, Aškerčeva cesta 7, Ljubljana www.ffa.uni-lj.si	Pharmacy	Mateja Terčič	+386 1 476 95 14	mateja.tercic@ffa.uni-lj.si
	Clinical Biochemistry and Laboratory Biomedicine			
	Toxicology			
Veterinary Faculty, Gerbičeva ulica 60, Ljubljana www.vf.uni-lj.si	Veterinary Medicine	Biljana Grubišič	+386 1 477 91 47	biljana.grubisic@vf.uni-lj.si

University Office for Doctoral Study (University of Ljubljana, Kongresni trg 12, Ljubljana, Slovenia)
doktorski.studij@uni-lj.si

20. Organisation

A cooperation agreement of the interdisciplinary doctoral programme Biomedicine will be published by the beginning of the academic year on the programme website. Programme Council membership is described in the part »Programme Council«.

Programme Council's responsibilities are:

- Review of applications, selection of candidates.
- Notification of responsible faculty as to the names of selected candidates.
- Reports on study programme implementation.

- Coordination of procedures for introduction of new courses and changes in the existing programme.
- Analysis of efficiency in meeting the planned study programme goals.
- Decision-making with regard to individual candidate applications and questions concerning the doctoral programme.
- Facilitation of co-operation among lecturers.
- Decision-making on expert issues.
- Confirmation of Rules and Regulations concerning financial management of the programme.

Field co-ordinators have the following responsibilities:

- Facilitation of regular study process. On-time schedule preparation.
- Coordination of work among students, mentors and lecturers.
- On-time replacement of absent lecturers (in cooperation with relevant participating institutions).
- Responsibility for improvement and updating of scientific field courses in agreement with the Programme Council (in the process, co-ordinators play an advisory role).
- Approves student's selection of courses.
- Collaborates in preparation of year reports of implementation of the programme.

Rules about procedures for obtaining the scientific title of *doktor/doktorica znanosti* (level of qualification: SQF level 10, EQF level 8, EQ-EHEA level Third cycle) in the interdisciplinary doctoral programme in Biomedicine are published at <https://www.uni-lj.si/study/doctoral/biomedicine/rules-forms/rules-title-adquisition/>.