

## PROSPECTUS

### UNIVERSITY PROGRAMME LABORATORY BIOMEDICINE UNIVERSITY OF LJUBLJANA, FACULTY OF PHARMACY

#### Presentation of the study programme:

##### 1. Information on the study programme:

University study programme *Laboratory Biomedicine* - 1<sup>st</sup> cycle; lasts 3 years (6 semesters) and comprises 180 credit points (ECTS).

The academic title awarded to the students is diplomirani inženir / diplomirana inženirka laboratorijske biomedicine - dipl. ing. lab. biomed. (Bachelor of Engineering in Laboratory Biomedicine).

##### 2. Fundamental objectives of the programme and general competences

The main objective of the three-year university study programme Laboratory Biomedicine is to train skilled professionals for jobs in medical laboratories of different specific fields within laboratory medicine, in research institutions and in laboratory medicine related fields of activity. The programme provides the basics for further studies at master's and/or specialist level, and for lifelong technical and scientific training.

General competences:

- ability of analysing, critically evaluating, searching for solutions and solving relevant professional laboratory problems arising in different working environments;
- appropriate qualifications for autonomous implementation of professional work and analysis of subject-specific problems;
- capacity to perform individual professional and research work, to work in a team, and knowledge needed for communication and publication of results;
- proper skills for understanding, introduction, application and evaluation of modern techniques and methods for the use in the professional and research fields of laboratory medicine;
- competence for assurance of quality procedures;
- appropriate ethically shaped professional personality for work with patients and human biological material, and for work in biomedical researches.

##### 3. Enrolment requirements and selection criteria in case of restricted enrolment

University study programme Laboratory Biomedicine is intended for the candidates:

- a) who have completed matura;
- b) who have passed vocational matura examination in any high school programme, and biology, chemistry, physics or biotechnology exam within the matura examination. Subject selected for matura examination must be different from that of vocational matura.
- c) who completed any four-year secondary programme prior to June 1<sup>st</sup> 1995.

In case of restricted enrolment,

candidates under points a) and c) will be selected based on:

-general success in the matura or final school 60% of points

examination

-general success in years 3 and 4 40% of points

candidates under point b) will be selected based on:

-general success in the vocational matura examination 50% of points

-general success in years 3 and 4 40% of points

-success in matura subject 10% of points

#### **4. Criteria for recognition of knowledge and skills acquired prior to the enrolment in the programme**

Upon the candidate's request, the Academic Affairs Commission may submit to the FFA Senate a proposal for recognition of knowledge and skills acquired by the candidate prior to entering the study programme, which can be recognised within the study programme Laboratory Biomedicine as part of study obligations and are evaluated with the proper number of credit points. Passed foreign language exam, for example, may therefore be recognised within the general optional courses in the third year, and medical laboratory work experience may be taken into account in the third year course Laboratory Work in Practice.

#### **5. Requirements for advancement within the programme**

- Requirements for advancement from one year to another:

Students may enrol in the next year of study if they complete by the end of the year all the obligations determined in the curriculum for the enrolment in the next year.

To be able to advance to the second year, students must meet all academic requirements laid down in the curriculum and first year course schemes, in the amount of at least 51 ECTS credits, provided that the course Cellular Biology and Genetics is not one of the missing obligations.

To be able to advance to the third year, students must meet all academic requirements laid down in the curriculum and course schemes, in the amount of 60 ECTS credits for the first, and 60 ECTS credits for the second year.

- Requirements for the repetition of the year:

During their studies, students are allowed to repeat a year once, provided they have met half of the requirements for the attending year, which amounts to no less than 30 ECTS credits.

During their studies, students are entitled to one exceptional enrolment in the next year. This is decided upon by the FFA Academic Affairs Commission which can, according to the UL Statute and the FFA Academic Regulations, allow exceptional advancement when it determines the student has failed to fulfil required conditions due to substantial and verified reasons.

#### **6. Requirements for completion of study**

To complete the study programme and gain the title diplomirani inženir / diplomirana inženirka laboratorijske biomedicine (UN) (Bachelor of Engineering in Laboratory Biomedicine), candidate must successfully meet all the obligations laid down in the curriculum, in total amount of 180 ECTS credits.

## 7. Transfers between study programmes

- Transfers between the university education study programmes within the UL  
Direct transfers of the students from other UL member university study programmes are not envisaged.
- Transfers between the professional high education study programmes within the UL  
Direct transfers of the students from UL member high education study programmes are not envisaged.
- Transfers between the study programmes of other universities  
To be able to transfer to the second or higher year of the university study programme Laboratory Biomedicine, one has to be a student of the university or professional high education study programme Laboratory Biomedicine or a related programme at some other university, provided they meet the requirements for the enrolment in the next year that apply to the study programme they are enrolled in. The FFA Senate approves the advancement on a proposal from the FFA Academic Affairs Commission that also determines a year a student may enrol in, potential bridge exams or other obligations.
- Transfer between the FFA programmes  
Provided they have gathered the required 51 ECTS credits in their current study programme, students of the uniform master's pharmacy programme may transfer to the 2<sup>nd</sup> year of the university programme Laboratory Biomedicine. Academic Affairs Commission determines missing obligations for the 1<sup>st</sup> year of the university study programme Laboratory Biomedicine.
- Current - new programme transfer  
UL - FFA planned to introduce the university programme Laboratory Biomedicine in the academic year 2008/2009.  
In case the students enrolled in the old high education study programme Laboratory Biomedicine continue their studies in the new university study programme Laboratory Biomedicine, they may enrol in the higher year of the new university study programme when they fulfil all obligations for the old programme, and when the Academic Affairs Commission determines potential missing or additional study obligations and the deadlines to fulfil them.

## 8. Assessment schemes

Each course has its own assessment scheme which is set in the course curriculum. Assessment schemes include oral and written exams, partial exams, seminar papers, etc. The assessment scale ranges from 6 – 10 (positive) and 1 – 5 (negative). Assessment is subject to the provisions laid down in the Statute of the University of Ljubljana and FFA Academic Regulations.

**9. Programme curriculum:**

First year		Contact hours				ECTS
		L	S	P	O	
<b>Semester 1</b>		<b>210</b>	<b>30</b>	<b>150</b>	<b>0</b>	<b>30</b>
1.	<u>Mathematics with Statistics</u>	45	0	30	0	5
2.	<u>Physics</u>	45	0	30	0	5
3.	<u>Anatomy and Histology</u>	30	0	30	0	5
4.	<u>Work with Biological Samples</u>	30	0	30	0	5
5.	<u>Introduction to Biomedical Analysis</u>	30	0	30	0	5
6.	<u>General and Organic Chemistry</u>	30	30	0	0	5
<b>Semester 2</b>		<b>240</b>	<b>75</b>	<b>75</b>	<b>0</b>	<b>30</b>
6.	<u>General and Organic Chemistry</u>	45	30	0	0	6
7.	<u>Cellular Biology and Genetics</u>	90	0	30	0	9
8.	<u>Field-Specific English</u>	30	30	0	0	4
9.	<u>Biomedical Informatics</u>	30	15	15	0	5
10.	<u>Analytical Chemistry</u>	45	0	30	0	6
<b>Total</b>		<b>450</b>	<b>105</b>	<b>225</b>	<b>0</b>	<b>60</b>

L - lectures; S - seminar; P - practice; O - other forms of direct pedagogical work (especially project work); ECTS - European Credit Transfer System (1 credit point equals to 30 hours of student workload)

Second year		Contact hours				ECTS
		L	S	P	O	
<b>Semester 3</b>		<b>195</b>	<b>45</b>	<b>135</b>	<b>0</b>	<b>30</b>
11.	<u>Biochemistry</u>	45	0	30	0	6
12.	<u>Physical Chemistry</u>	30	15	15	0	5
13.	<u>Physiology</u>	30	15	15	0	5
14.	<u>Immunology with Immunochemistry</u>	30	15	15	0	5
15.	<u>Biomedical Analysis</u>	30	0	30	0	5
17.	<u>Clinical Biochemistry I</u>	30	0	30	0	4
<b>Semester 4</b>		<b>165</b>	<b>60</b>	<b>120</b>	<b>0</b>	<b>30</b>
15.	<u>Biomedical Analysis</u>	45	0	45	0	7
16.	<u>Microbiology and Parasitology</u>	45	15	30	0	8
17.	<u>Clinical Biochemistry I</u>	45	30	30	0	10
18.	<u>Laboratory Histopathological Methods</u>	30	15	15	0	5
<b>Total</b>		<b>360</b>	<b>105</b>	<b>255</b>	<b>0</b>	<b>60</b>

Third year	Contact hours				ECTS
	L	S	P	O	
<b>Semester 5</b>	<b>165</b>	<b>105</b>	<b>105</b>	<b>0</b>	<b>30</b>
19. Clinical Haematology	45	0	45	0	7
21. Molecular Biology Techniques in Medicine	30	30	0	0	5
22. Clinical Biochemistry II	45	0	60	0	9
Laboratory Work in Practice (Sem.)	0	15	0	0	1
24. Legislation and Ethics in Biomedicine	15	30	0	0	3
Optional Course I	30	30	0	0	5
<b>Semester 6</b>	<b>135</b>	<b>135</b>	<b>15</b>	<b>105</b>	<b>30</b>
20. Basics of Transfusion Medicine and Transplantation	15	0	15	0	3
23. Laboratory Work in Practice	0	15	0	105	7
Optional Course II	30	30	0	0	5
Optional Course III	30	30	0	0	5
Optional Course IV	30	30	0	0	5
Optional Course V	30	30	0	0	5
<b>Total</b>	<b>300</b>	<b>240</b>	<b>105</b>	<b>105</b>	<b>60</b>

Optional Courses	Contact hours				ECTS
	L	S	P	O	
25. Biomedical Genetics	30	30	0	0	5
26. Haemostasis	30	30	0	0	5
27. Proteomics	30	30	0	0	5
28. Emergency Laboratory Diagnostics	30	30	0	0	5
29. Toxicology	30	30	0	0	5
30. <u>Cytogenetic and Molecular Biological Tests in Haematology</u>	30	30	0	0	5
31. Biomedical Informatics II	30	30	0	0	5
32. <u>Psychotropic substances and Abuse of Medicinal Products</u>	30	30	0	0	5
33. Techniques in Diagnostic Virology	30	30	0	0	5
34. Cellular and Tissue Cultures	30	30	0	0	5
35. Project Work	0	0	0	60	5
<b>Total</b>	<b>300</b>	<b>300</b>	<b>0</b>	<b>60</b>	<b>55</b>

## 10. Information on available optional courses and mobility

Optional courses offer in-depth knowledge from 11 specialised fields with respect to students' interest and desired profession. Students select five optional courses in the third year. The conditions for the admission into a certain course are provided in individual curricula. Their percentage in the programme amounts to 25/180 ECTS or 13.9%.

According to point 6 of *Criteria for credit evaluation of study programmes*, students can transfer no less than 10 ECTS credits gathered within programme obligations or optional units from one study programme to another. A part of study obligations can be fulfilled within international student exchange programmes.

## 11. Presentation of individual courses

### 1. *Mathematics with Statistics (5 ECTS credits):*

Functions. Derivative, geometric and physical meaning of the derivative, function extremes, use of the derivative and differential, high derivatives. Multivariable functions, partial derivatives, regression. Indefinite and definite integral, numerical integration. Events, definition of probability, sequences of independent experiments, random variables, discrete and continuous distributions, normal distribution, average value, standard deviation, correlation. Introduction to statistics, population and pattern, presentation of statistical data, evaluation of parameters.

### 2. *Physics (5 ECTS credits):*

Kinematics. Dynamics: force and mass. Newton's laws, energy, work, elasticity, torque. Fluid mechanics: hydrostatics, buoyancy, surface tension, compressibility, hydrodynamics, viscosity, resistance. Oscillation and waves: amplitude, frequency and period of oscillation, waves. Heat: temperature stretching of bodies, ideal gas, phase changes. Electricity and magnetism: electric field and electric current, condenser, electrostatic induction, resistance, direct and alternating current, measuring electric current and voltage, static magnetic field, magnetic moment, electromagnetic induction, generator and electric motor, transformer. Light: electromagnetic oscillation and waves, reflection, refraction and interference of light. Geometrical optics: mirrors and lenses, optical devices: eye, magnifying glass and microscope. Modern physics: photoelectric effect, diffraction pattern of the electron beam, de Broglie wavelength.

### 3. *Anatomy and Histology (5 ECTS credits):*

Anatomy of musculoskeletal apparatus, nervous system, cardiovascular system, respiratory tract, digestive tract, urinary tract, male and female genital organs. Histology: epithelia, connective tissue, cartilaginous tissue, bone tissue, muscular tissue, nerve tissue, skin, cardiovascular system, blood, lymphatic system, respiratory system, digestive tract, urinary tract, male and female genital organs, endocrine system, senses, development and growth of an organism.

### 4. *Work with Biological Samples (5 ECTS credits)*

Types and composition of biological samples in a medical laboratory: blood, serum, plasma, blood cells, urine, faeces, cerebrospinal fluid, amniotic fluid, pleural, peritoneal and synovial fluid, various tissues, neoplasms, hair, nails, swabs. Endogenous and exogenous effects on the results of biological sample analysis, collection, transport and storage of biological samples, dangers related to biological samples and safety precautions, control systems and quality assurance of laboratory work.

*5. Introduction to Biomedical Analysis (5 ECTS credits)*

Introduction to laboratory work, dealing with hazardous materials, basic laboratory procedures, separation techniques, laboratory calculations, basics of chemical analysis, sample preparation for analysis, evaluation of results, introduction to spectroscopic methods, UV-VIS, IR and atomic absorption spectroscopy, emission methods and fluorescence.

*6. General and Organic Chemistry (11 ECTS credits)*

General chemistry: basic chemical terms and laws, structure of atoms and molecules, disperse systems, proteolytic balances in aqueous solutions, redox processes, biologically relevant elements and their compounds. Organic chemistry: structural characteristics of organic compounds, organic reactions, tautomerism, conversions of organic compounds (alkanes, alkenes and alkynes, alkyl halides and alcohols, aldehydes and ketones, carboxylic acids and derivatives, aromatic compounds, heterocyclic compounds), organic compounds of biological significance (carbohydrates, amino acids, peptides and proteins, nucleic acids, vitamins and coenzymes, lipids).

*7. Cellular Biology and Genetics (9 ECTS credits)*

Composition and function of cell, cell division, differentiation and intercellular communication, principle and role of cell death. Nucleus: chromatin, chromosome, gene, allele, genetic polymorphism; cellular biological foundations of Mendelian genetics, types of inheritance, genealogy, basics of molecular genetics and cytogenetics. Mitochondria and mitochondrial diseases in humans. Synthetic and selective pathway in a cell: endoplasmic reticulum, Golgi apparatus, lysosome and exocytosis. Endocytosis pathway in a cell: plasmalemma, endosomes, autophagy and heterophagy. Cytosol disintegration of a substance in a cell. Peroxisomes and peroxisomal diseases. Cell cycle, mitosis, meiosis. Cell proliferation, apoptosis and necrosis. Embryonic stem cell; cell potency and differentiation. Cellular diagnostics. In vitro cellular models.

*8. Field-Specific English (4 ECTS credits)*

Introduction to professional and technical text discourse, use of dictionaries and other sources of information, reading and translation of professional texts related to laboratory work, technical language specifics, writing of articles and reports, procedure/process descriptions, pronunciation of technical terms, business communication, taking part in discussions, presentations in English language.

*9. Biomedical Informatics I (5 ECTS credits):*

Descriptive statistics: population, sample, types of variables, mean values and measures of dispersion, rank type, rank, classes, empirical and mathematical classifications of data and their graphic presentation. Sampling, statistical methods and explanation of statistical analysis results, correlation and regression, statistical software packages (SPSS), databases and information systems.

*10. Analytical Chemistry (6 ECTS credits):*

Definitions in analytical chemistry, aspects of correct and complete expression of analytical results, evaluation methods, ensuring quality and traceability of results. Basic validation parameters of analytical procedure: responsiveness, accuracy, limit of detection, limit of quantification, dynamic area, selectivity. Chemical balances. Classical analytical methods: gravimetry and neutralization, precipitation, complexometric and oxidation-reduction titrations. Instrumental analytical methods: potentiometry, UV-VIS molecular absorption spectroscopy, molecular fluorescence spectroscopy, atomic emission and absorption spectroscopy. Separation procedures, chromatography, automation in analytical chemistry.

*11. Biochemistry (6 ECTS credits):*

Biomolecules: water, amino acids, peptides, proteins and enzymes, carbohydrates, lipids, hormones, nucleic acids. Metabolism: catabolism and anabolism, metabolism of

carbohydrates, amino acids, fatty acids and lipids. Storage and transfer of genetic information: structure of chromosomes and genes, DNA replication and transcription, RNA, the genetic code, protein synthesis and synthesis regulation, recombinant DNA.

*12. Physical Chemistry (5 ECTS credits):*

Physical quantities and dimensions. Systems. Gases. Thermodynamics: work, heat, internal energy, thermodynamic laws, enthalpy, calorimetry, entropy, Gibbs and Helmholtz free energy. Chemical potential, phase rule, Clapeyron and Clausius-Clapeyron equation. Phase diagrams of one-component systems. Solutions: Raoult's law and Henry's law, colligative properties. Chemical balance. Electrochemistry of solutions: strong and weak electrolytes, electrical conductivity, electrochemical cells and use of Galvanic cells.

*13. Physiology (5 ECTS credits):*

Physiological principles: homeostasis, transport phenomena, membrane potential, skeletal and smooth muscle. Blood circulation: heart, circulatory system, microcirculation, pressure regulation. Respiration: ventilation, respiratory mechanics, diffusion, pulmonary blood circulation, gas transport in the blood. Kidneys and electrolyte trafficking in the body: glomerular filtration and tubular transport, water balance in the body, kidney function tests. Nervous system physiology: synaptic transfer, somatosensory system, physiology of pain, sight, hearing, vegetative nervous system, integrative functions of the brain stem, brain hemisphere specialization. Digestion: characteristics of digestive tract movement, secretion of saliva, secretion in the stomach, exocrine pancreas, digestive function of the liver, secretion of bile. Endocrinology: regulation of hormone secretion, systems, adeno- and neurohypophysis hormones, thyroid hormones, adrenal hormones and sex hormones. Metabolism: transformations of substances and energy in the body, metabolic functions of the liver, *regulation of blood glucose concentration, basal metabolism*, regulation of body temperature.

*14. Immunology with Immunochemistry (5 ECTS credits)*

Composition and function of the immune system, innate, acquired, humoral and cellular immune response, antigens, antibodies, immunoglobulin gene rearrangement and expression, the main system of tissue compatibility, T lymphocytes and T-cell receptor, interactions between T and B lymphocytes, immune cell maturation, formation of the immune repertoire, cytokines, complement system, phagocytic cell characteristics, autoimmunity, transplantation immunology, immunological techniques.

*15. Biomedical Analysis (12 ECTS credits)*

Spectroscopic methods: UV-VIS, IR, NMR and MS spectroscopy, fluorescence, polarimetry and refractometry, turbidimetry and nephelometry, luminometry. Separation methods: planar chromatography, high resolution liquid chromatography, gas chromatography, electrophoresis, coupled techniques, isotopic techniques, immunochemical techniques, nucleic acid analysis techniques, dry chemistry, haematology analyzer principles, automation of biomedical laboratory analyses, errors, units, laboratory information systems.

*16. Microbiology and Parasitology (8 ECTS credits)*

Bacteria: composition, bacteria size and form, routes of infection and host response, bacterial taxonomy, bacterial genetics, antibiotic resistance mechanisms, overview of relevant pathogenic bacteria. Viruses: taxonomy, biological properties, reproduction, genetics, pathogenesis. DNA genome viruses, RNA genome viruses, antiviral agents. Pathogenic fungi: fungi characteristics, dermatophytes, systemic mycoses pathogens, opportunistic fungi, antimycotics. Parasites: one-celled and multi-celled parasites, arthropods, anti-parasite chemotherapeutic agents.

*17. Clinical Biochemistry I (14 ECTS credits)*



Development of clinical biochemistry, chemical and biochemical parameters, reference values, quality control, ethical handling with the examinee samples and examination results. Relevant groups of analytes in different biological samples: emergence in physiological and pathological states, selection of a proper biological sample, determination methods, significance of determination and specific features: water and electrolytes, basic urine examinations, acid-base balance, gas analysis, non-protein nitrogen compounds, iron and trace elements, carbohydrates, amino acids, proteins and enzymes, lipids and lipoproteins.

*18. Laboratory Histopathological Methods (5 ECTS credits):*

Cytologic and histologic techniques, collection and preparation of a biological sample, production and dyeing of a preparation, immunohistochemistry, in situ hybridization, polymerase chain reaction, enzyme reactions, electron microscopy, pathology basics of cell and extracellular structures, basics of general pathology.

*19. Clinical Haematology (7 ECTS credits):*

Composition of blood and bone marrow: stem cells, red cell line, granulocyte, lymphocyte and monocyte-macrophage cell line, megakaryocytes and thrombocytes. Tests in clinical haematology. Haematopoietic stem cell diseases: aplastic and congenital dyserythropoietic anaemias. Red blood cell diseases: megaloblastic and haemolytic anaemias, anaemia of chronic diseases, anaemias resulting from a disturbed globin synthesis. White blood cell diseases: acute leukemia, myelodysplastic syndromes, chronic myeloproliferative diseases, lymphocyte cell line diseases, malignant lymphoma, Hodgkin's disease, malignant immunoproliferative diseases, monocyte-macrophage cell line diseases. Haemostasis: haemorrhages, thrombocytopenia and disturbed thrombotic function, vascular disorders of primary haemostasis, coagulation disorders.

*20. Basics of Transfusion Medicine and Transplantation (3 ECTS credits)*

Treatment with blood, cells and transplantation of blood-producing and other tissues. Laboratory tests supporting transfusion, transplantation, cell therapies and tissue engineering. Histocompatibility and transplantation of organs, tissues and cells. Laboratory tests for assurance of tissue compatibility.

*21. Molecular Biology Techniques in Medicine (5 ECTS credits):*

Central dogma of molecular biology, organization of the human genome, polymorphism and mutations in the human genome, examples of the most common genetic diseases. Isolation, analysis, separation, multiplication and hybridization of nucleic acids and determination of nucleotide sequence. Applicability of techniques in prenatal diagnostics and bacterial and viral infection diagnostics and in forensic medicine. Basics of gene therapy.

*22. Clinical Biochemistry II (9 ECTS credits)*

Relevant groups of analytes in different biological samples: nucleic acids, haemoglobins, porphyrins, bilirubins, hormones (thyroid and parathyroid hormones, adrenal hormones, reproductive hormones), tumor markers. Kidney, liver and pancreas function tests. Biochemistry of particular conditions: increased physical activity, newborns and children, elderly people, pregnancy, neuropsychiatric conditions, starvation. Drug level and toxin presence monitoring. Effects on the results of analyses.

*23. Laboratory Work in Practice (8 ECTS credits)*

Organization of laboratory work, instrumental equipment and direct performance of laboratory examinations. Collection of blood from veins and capillaries. Laboratory tests in a real medical laboratory environment: general biochemical laboratory, urine laboratory, hormone laboratory, haematological laboratory and immunological laboratory.

*24. Legislation and Ethics in Biomedicine (3 ECTS credits)*

Historical, philosophical and biological basics of bioethics. Bioethics and the future of humankind: prenatal diagnostics, genetic information management, genetic treatment, embryonic stem cells, tissue stem cells. Deontology in laboratory medicine. Legislation that defines laboratory medicine as part of the healthcare system and relation between legal acts and ethical codes. Bioethics and animals. Bioethics and the environment. Recognition of ethical. Legal and ethical dilemmas.

*25. Biomedical Genetics (5 ECTS credits)*

Molecular, Mendelian, population and human genetics. Cause and effect relationship between Mendel's laws and Hardy-Weinberg principles and the action at molecular and cellular levels. Application of knowledge in practical examples from human genetics: Down's syndrome, phenylketonuria, cystic fibrosis, haemophilia, etc.

*26. Haemostasis (5 ECTS credits)*

Physiology and biochemistry of haemostasis, haemorrhages and thrombosis, anticoagulant agents, collection, preparation and storage of biological samples, devices and measurement principles, methods for determination of thrombotic disorders, coagulation examinations, fibrinolysis examinations, monitoring of anticoagulation and fibrinolytic therapies with laboratory methods, good laboratory practice.

*27. Proteomics (5 ECTS credits):*

Historical view of protein analysis and modern approaches: separation strategies, protein identifications and quantifications, protein families and sequences, structural proteomics and interprotein interactions, protein modifications and significance for health/disease, protein microarrays. Laboratory and virtual methods of protein activity researches, localizations of protein modifications and complex interactions.

*28. Emergency Laboratory Diagnostics (5 ECTS credits):*

Definition of "emergency examination in laboratory medicine", list of emergency laboratory examinations, target times and the most appropriate biological samples of the laboratory analysis of emergency laboratory examinations, the most appropriate analytical methods, instrumental techniques, analyzers and other emergency laboratory equipment. Laboratory bedside examinations. Communication between the performers of the emergency laboratory examinations and the clients. Price of emergency laboratory examinations.

*29. Toxicology (5 ECTS credits):*

Definition, structure, classification and functioning of toxic substances. Effect of metabolism on substance toxicity. Genotoxic, carcinogenic and co-carcinogenic substances. Immunotoxic substances. Toxic gases: carbon monoxide, hydrogen cyanide, hydrogensulphide, sulphur dioxide, singlet oxygen, ozone, nitrogen oxides. Heavy metal toxicity. Organic solvents: aliphates, aromatics, halogenated hydrocarbons, alcohols, ethers, aldehydes, ketones and esters. Pesticides: insecticides, herbicides, fungicides and rodenticides. Carbamic acid organophosphates and derivatives. Chemical weapons, protection. Addiction causing substances and illegal narcotics. Biological, instrumental and chemical analysis of toxic substances.

*30. Cytogenetic and Molecular Biological Tests in Haematology (5 ECTS credits)*

Clonality, malignant transformation of myeloid and lymphatic cells, epigenetic factors, acquired chromosomal abnormalities and mutations, the role of special examinations in diagnostics, prognosis assessment and therapy monitoring. Special examinations in the diagnostics of haematological malignancies: polymerase chain reaction, standard cytogenetic examination, fluorescent in situ hybridization, comparative genomic hybridization. Cytogenetic in haematological diseases: preparation of cytogenetic preparations, types of chromosome banding, karyotype analysis and use of different FISH probes. Molecular

genetic examinations in haematological diseases: methods for determining minimal residual disease, methods of identifying tendency to haemorrhages and thrombosis.

*31. Biomedical Informatics II (5 ECTS credits):*

Inferential statistics: estimation of population parameters, confidence intervals, risk, hypothesis testing, type I and type II errors, parametric and nonparametric tests, correlation and regression; working with the SPSS statistical software package.

*32. Psychotropic substances and Abuse of Medicinal Products (5 ECTS credits):*

Narcotics, anabolic steroid hormones, stimulants, diuretics, analgesics, local anaesthetics, anxiolytics, antidepressants, hypnotics, peptides and glycoprotein hormones. Mechanisms of action and symptoms of overdosing, tolerance, addiction, abstinence syndrome. Detoxification methods and antidotes. Identification and determination of substances causing the overdose. Legislation regarding illegal narcotics and the use of medicinal products for non-therapeutic purposes.

*33. Techniques in Diagnostic Virology (5 ECTS):*

Viruses and clinical diagnostic laboratory, immunoserological reactions and molecular techniques, isolation of viruses in normal cell cultures, virus antigen detection, serological diagnosis of viral diseases, virus diagnostic laboratory equipment, quality control and biological safety, the latest diagnostic methods in virology.

*34. Cellular and Tissue Cultures (5 ECTS credits)*

Cell culture types, techniques of cell and tissue cultivation in cultures: laboratory equipment, isolation, selection, maintenance and transformation of cells. Quantification and characterisation of cells: cell differentiation status, cell proliferation ability, cytotoxicity and genotoxicity tests. Applicability of cell models in researches. Legislation and standardization.

*35. Project Work (5 ECTS credits)*

Definition of the scientific – professional question, purposes, approaches, methods, presentations. Use and overview of available bibliography data. Basic approaches, methods and experimental techniques. Independent experimental work with recording. Analysis of results, making partial decisions and their testing. Research as a creative interdisciplinary teamwork. Written submission and oral presentation of the scientific work. (All habilitated professors who participate in the university programme Laboratory Biomedicine.)