University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy	
Course title: Introduction to Pharmacy	
Teachers: Krajnović M. Dušanka, Lakić M. Dragana, Mirić M. Milica	
Course status: mandatory	
Semester: I	**Year of studies: I**
ECTS points: 1	**Course code:**
Requirements: none	

Course aims:

Understanding of the significance and role of Pharmacy in the healthcare system, role of medicinal products in the society, importance of the Faculty of Pharmacy in education of pharmacists, and importance and diversity of the future profession. Gathering of basic knowledge on development of Pharmacy and scope of the pharmaceutical practice, and social responsibility of pharmacists in the health protection, prevention and treatment of illness. Basics of the communication skills.

Course outcomes:

Student is aware of the historical and cultural foundations for the development of Pharmacy (both scientific and professional); understands the professional and the social role of the pharmaceutical practice; understands the purpose and the necessity for the continuous professional self-development; applies various communication skills in the Pharmacy and in the general society.

Course contents:

Lectures

Professional development of Pharmacy. Development of Pharmacy as a scientific discipline. The most significant discoveries for the development of Pharmacy. Short review of the medicinal product development through time. Professional orientation in Pharmacy. Motives for choosing pharmacist profession. Concept of health and illness. Behavioral aspects of pharmaceutical care. Behavior of ill person. Health, economic and social aspect of the pharmaceutical care. Communication with colleagues and beneficiaries of health services. Methods and types of communication. Rules of good communication.

Recommended literature:

1. Krajnović D. Nerecenzirana skripta za predmet Uvod u farmaciju, 2012.
2. Tasić LJ, Parojčić D, Bogavac-Stanojević N, Ilić K, Jović S, Kocić-Pešić V. Promocija zdravlja i prevencija bolesti žena u farmaceutskoj praksi. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2007.
3. Tasić LJ, Krajnović D, Jocić D, Jović S. Komunikacija u farmaceutskoj praksi. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2011.
4. Smith MC, Wertheimer AI. Social and Behavioural Aspects of Pharmaceutical Care. New York: Pharmaceutical Press; 1996.
5. Anderson S. Making Medicines - A brief History of pharmacy and pharmaceuticals. 1st ed. New York: Pharmaceutical Press; 2005.

The total of active learning classes	
Lectures: 15	**Practical classes:** 0
Teaching methods: lectures, discussions	
Grading system: descriptive	

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	30	Practical	
Practical classes		Written	70
Colloquia		Oral	
Seminars			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Biology with human genetics

Teachers: Biljana M. Potparević, Lada P. Živković

Course status: mandatory

Semester: I	**Year of studies: I**
ECTS points: 5	**Course code:**

Requirements: none

Course aims: Introduction of students to the basic principles of the structure and function of cells, with the special emphasis on the importance of genetic parameters in its functioning. Furthermore, students are introduced to the basic changes in genetic material, and related consequences on the carrier and offspring.

Course outcomes: Upon completion of the course, students are able to:

- Use the techniques of microscoping
- Describe and explain the structure and function of cells
- Understand and explain the mechanisms of the occurrence of genetic material mutations, as well as to correlate these changes to the appropriate phenotype
- Apply the obtained knowledge on other biomedical courses during studies

Course contents:

Lectures

Basic properties of prokaryote and eukaryote cells, chemical composition of cells, plasma membrane, transport mechanisms through the membrane, cytoplasm organelles: nucleus and nucleolus, endoplasmic reticulum, the Golgi apparatus, lysosomes, peroxisomes, mitochondria, ribosomes, cytoskeleton elements: microtubules, actine filaments and intermediary filaments. Nucleic acids: DNA and RNA – structure and biological role, genetic code, DNA molecule replication, transcription, translation, genes activity regulation for prokaryotes and eukaryotes. Mendel's rules, genes, genotype and phenotype, monohybrid, dihybrid, intermediary and codominant crossing. Cell cycle, human chromosomes, mitosis, meiosis, gametogenesis, fertilization and early embryonic growth. Chromosome aberrations: numerical and structural, Robertson translocation, genes mutations, genealogical trees, monogenic diseases and inheritance of monogenic diseases, genetic methods of prenatal diagnostics, reparation mechanisms.

Practical classes

Types of microscopes, light microscope and microscoping; size and shape of cell and nucleuses; plasma membrane, cytoplasm organelles, cell cycle, mitosis, gametogenesis, replication, transcription and translation, chromosome aberrations: numerical and structural; structure and function of various types of cells: cells of epithelial, connective, muscle and nervous tissues.

Recommended literature:

1. Potparević B, Živković L. Praktikum iz biologije sa humanom genetikom. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2011.
2. Đelić N, Stanimirović Z. Principi genetike. Beograd: Elit-Medika; 2004.
3. Matić G, Savić Pavićević D. Molekularna biologija 1. Beograd: NNK Internatinal; 2011.
4. Brajušković G. Molekularna biologija 2. Beograd: Savremena administracija; 2012.
5. Papović R, Luković LJ, Novaković. Humana genetika. Beograd: Univerzitet u Beogradu - Medicinski fakultet; 2007.

The total of active learning classes

Lectures: 45	**Practical classes**: 30

Teaching methods:

lectures, video presentations, interactive lectures, consultations; individual microscoping using the light microscope, observation, analysis and sketching of preparations, assignments on genetics			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	2	Practical	
Practical classes	8	Written	70
Colloquia	20	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Human functional morphology

Teachers: Teofilovski-Parapid Č. Gordana, Trpinac P. Dušan

Course status: mandatory

Semester: I	**Year of studies:** I
ECTS points: 5	**Course code:**

Requirements: Biology with human genetics

Course aims:

For student will be to achieve basic knowledge about macroscopic, that is, anatomical and microscopic, that is, histological structures of human body. Also to gain perspective about interactions between structure and function and to be familiar with basic medical terminology and clinical cases.

Course outcomes:

Student will be train to gain additional knowledge about function of organic systems in health and sickness, and also keeping in mind complexity of structure and function of human organism as much as there interaction.

Course contents:

Lectures

ANATOMY. Introduction to anatomy, anatomical terminology and topographic regions of human body. Functional morphology of human organ systems: System for locomotion (osteology, arthrology, miology), chest (walls, distribution and content of chest interior), respiratory system, cardiovascular and lymphatic system, abdomen (walls, peritoneum, distribution and content of abdomen), gastrointestinal system, pelvis (walls and content), genitourinary system, endocrine system, central and peripheral nervous system and sense organs.

HISTOLOGY. Introduction to histology and basic microscopic methodology. General characteristics of structure and functional organization of the cell. General histological characteristics and tissue types. Epithelium, connective tissue, muscle and nerve tissue. Hematopoietic organs and blood. Lymphopoietic (lymphatic) organs. Cardiovascular system. Respiratory system. Digestive system. Urinary system. Male and female reproductive system. Central and peripheral nervous system. Endocrine system, Skin and sense organs.

Practical classes

ANATOMY. Practical exercises on anatomical models enables unique way for understanding of humar orgn systems in context of his morphology.

HISTOLOGY. Analysis of histological preparations and their relationship with theoretical knowledge.

Recommended literature:

1. Teofilovski-Parapid G, Maliković A. Anatomija čoveka. Beograd: Autorsko izdanje; 2009.
2.Moore KL, Dalley AF, Agur AMR. Clinically Oriented Anatomy. 6th ed. Baltimore: Lippincott Williams & Wilkins; 2009.
3. Trpinac D. Histologija za studente farmacije. Beograd: Kuća štampe; 2001.
4. Trpinac D, Obradović M. Repetitorijum histologije i embriologije. 2 izdanje. Beograd: Univerzitet u Beogradu - Medicinski fakultet; 2009.
5. Trpinac D. Praktikum za histološke vežbe za studente farmacije. Beograd: Autorsko izdanje; 2000.

The total of active learning classes

Lectures: 45	**Practical classes: 30**

Teaching methods:

Classes are performed during one semester using the following methods: lectures and practical exercises with anatomical preparations and demonstration exercises with slides of histological preparations.

Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	3	Practical	
Practical classes	27	Written	70
Colloquia		Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: General and Inorganic Chemistry

Teachers: Tatijana S. Jovanović, Čakar M. Mira, Popović V. Gordana, Tanasković B. Slađana

Course status: mandatory

Semester: I	**Year of studies:** I
ECTS points: 5	**Course code:**

Prerequisite for attending course: none

Course aims: Acquisition of modern knowledge in the field of chemistry which is necessary for understanding of structure and characteristics of simple and complex biopharmaceutical compounds, as well as mechanisms of chemical processes in which these compounds are involved in. Acquisition of practical and computational knowledge which is necessary for successful studying of other chemical and pharmaceutical courses, as well as in pharmaceutical practice.

Course outcomes: After successful mastering the course General and Inorganic Chemistry, a student is expected to:

- implement obtained knowledge for characteristic evaluation of chemical compounds
- predict and analyze the course of chemical reactions
- plan and organize safe work in laboratory
- develop analytical thinking in problem solving

Course contents:

Lectures

Chemical bonds: chemical bond theories, types of chemical bonds, hybridization. Intermolecular interactions: types of interactions; states of matter. Solutions: quantitative composition of solutions; colligate properties of solutions; ion activity; ionic force of the solution. Speed of the chemical reaction. Catalysts and inhibitors. Chemical balances and constants of balances. Balances and pH in acid, alkali and salt solutions. Buffers: composition; pH; buffer capacity. Balances in heterogeneous systems; solubility; solubility product constants, relation between solubility and solubility product; precipitation and solubility. Oxido-reduction. Electrochemical cells and reduction potential. Prediction of strength of oxidative and reductive properties, as well as direction of redox reactions. Coordination compounds: bonds in coordination compounds, balances in aqueous solutions; isomerism; nomenclature. Stoichiometric calculations. Periodicity properties of elements and inorganic compounds. Chemical properties of elements and inorganic compounds meaningful to biosystems, ecosystem and pharmacy.

Practical training

Chemical laboratory, function and equipment; safety in chemical laboratory and basic laboratory techniques. Solutions: properties; preparing of solutions which have determined quantitative composition. Calculation and measuring of pH value in aqueous solutions of electrolytes. Buffers: selection and preparation. Reactivity examination of biopharmaceutical significant elements and inorganic compounds.

Recommended literature:

1. Whitten KW, Davis RE, Peck ML. General Chemistry. 9th ed. Saunders college publishing; 2010.
2. Kotz J, Treichel P. Chemistry and chemical reactivity. 8th ed. Saunders college publishing; 2012.
3. Čakar M, Popović G. Opšta hemija I. Šesto izdanje. Beograd: Farmaceutski fakultet; 2010.
4. Dragojević M, Popović M, Stević S, Šćepanović V. Opšta hemija, I deo. Beograd: Tehnološko-metalurški fakultet; 2003.
5. Filipović I, Lipanović S. Opća i anorganska kemija. IX izdanje. Zagreb: Školska knjiga; 1995.

The total of active learning classes

Lectures: 60		**Practical training:** 30	
Teaching methods: oral lectures, practical training, discussions, problem solving			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical training	5	Written	70
Colloquia	25	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Organic Chemistry 1

Teachers: Tokić-Vujošević, N. Zorana

Course status: mandatory

Semester: I	**Year of studies:** I
ECTS points: 5	**Course code:**

Prerequisite for attending course: none

Course aims:

- Knowledge acquisition about the construction of the chemical bond, types of hybridization and electron effects in organic compounds
- Introduction to basic classes of organic compounds (systematical naming, structure and reactivity)
- Introduction to types and mechanisms of ionic and radical reactions which are characteristic for organic compounds.

Course outcomes:

- Knowledge acquisition about the structure and reactivity of organic molecules
- Understanding of the organic reactions mechanism
- Creating elementary logic framework for linkage of structure to function of organic molecules

Course contents:

Lectures

Types of chemical bonds, orbital hybridization, structure and isomerism of organic compounds. Electronic effects (resonance and inductive effect and its influence on polarization of molecules and reactivity). Reactive particles (nucleophile and electrophile) and basic chemical reactions types within organic molecules.

Saturated aliphatic carbohydrates (alkanes, cycloalkanes, radical substitution mechanism)

Unsaturated carbohydrates (alkenes, alkynes, electrophilic addition)

Conjugated alkadienes (1,2 and 1,4 adition)

Aromatic compounds (structure-activity relationship, electrophilic substitution mechanism)

Some classes of important aromatic compounds

Alkyl-, akenyl- and aryl-halogen (structure-reactivity relationship, S_N reaction mechanism)

Alcohols (structure-reactivity relationship, amphotericity)

Phenols and hinones (reactivity, factors which have influence on acidity of phenols)

Carbonyl compounds (structure-reactivity relationship). Nucleophilic addition mechanism within adehydes and ketones (reactions of protecting group)

Keto-enol equilibria, enolic ions in C-C bond forming; α,β-unsaturated carbonyl compounds (structure-reactivity relationship).

Carboxylic acids (factors influencing on increasing acidity of carboxyl group within differently substituted aliphatic and aromatic acids). Nucleophilic acyl substitution mechanism. Carboxylic acid derivatives (reactions). Alpha-halogen and apha-hydroxy carboxylic acids (reactions). Beta-dicarbonyl compounds (active methyl compounds-reactivity)

Amines (structure-reactivity relationship, alkalinity of aliphatic and aromatic amines).

Recommended literature:

1. K. P. C. Vollhard, N. E. Šor: Organska hemija struktura i funkcija, četvrto izdanje, Data status, Nauka 2004, 1330 str. (K.P. Vollhardt, N. E. Shore: Organic Chemistry: structure and function, W. H.Freeman & co)
2. Francis A.Carey Organic chemistry, IV edition, 2000, McGraw-Hill, 1108 p

The total of active learning classes			
Lectures: 60		**Practical training:**	
Teaching methods: lectures, consultations, tests			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical training		Written	50
Colloquia	45	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Physics

Teachers: Todorović-Vasović D. Neli Kristina

Course status: mandatory

Semester: I	**Year of studies:** I
ECTS points: 3	**Course code:**

Prerequisite for attending course: none

Course aims:

Introduction to basic principles of physics which are required for understanding of physical systems. Connecting physical and bio-physical systems. Connecting of modern flows in physics to newfound phenomenon in science. Basic theoretical and practical physics knowledge acquisition which is necessary for easier adoption of the contents in the professional courses related to pharmacy.

Course outcomes:

Student will have the opportunity to understand content of chemical and biological courses and possibility to notice relationship between physics and other sciences. Understanding of basic biological systems. Interdisciplinary connection of adopted physics knowledge. Implementation of knowledge in research work.

Course contents:

Lectures

Fundamental physics laws concerning mechanics, thermodynamics, electrodynamics and atomic and subatomic physic. Kinematics and dynamics of material point (average speed and acceleration, current speed and acceleration, Newton's laws). Work and energy (work and energy by conservative forces. Examples of energy preservation in nature. Gravity. Example of nonconservative force). Oscillations and waves. Basics of thermodynamics including dynamic of liquids. Electrostatics (Coulomb's law). Electricity (ac/dc electrical current-basic terms. Current density as vector value). Electric and magnetic field (definition of electric field. Definition of magnetic field. The Lorentz force). Electromagnetic field. Optics (Basic optic laws). Basics of atomic and subatomic physics. Solving computational tasks related to lectures.

Practical training

Basic physics measurement. Result processing. Computer application for processing results and for animations in laboratory work. Practical tasks: Spectral analysis. Spectrometer and spectroscope. Gama radiation. NMR. Absorption spectrophotometry. Reflex spectrophotometry. Determination of relative density using picknometer. Determination of EMF and electrical circuit inside resistance. Relative density of solids. Anemometers. Gas laws. Fluid flow trough pipe of unequal cross section. Photoelectric effect.

Recommended literature:

1. Young HD , Freedman RA, Ford AL. Sears and Zemansky`s University Physics. 12-th ed. San Francisco:Pearson Addison-Wesley; 2007.
2. Todorović-Vasović NK, Jesenko Roković A. Praktikum za eksperimentalne vežbe iz fizike. Farmaceutski fakultet; 2012.
3. Todorović-Vasović NK, Poglavlja iz fizike [internet]. Univerzitet u Beogradu, Farmaceutski fakultet, Katedra za fiziku i matematiku, 2012. http://supa.pharmacy.bg.ac.rs/courses/48/posts
4. Vučić V , Ivanović D, Fizika I, dvadesetdrugo izdanje, Beograd: Naučna Knjiga ;1990.
5. Stanković D , Osmokrović P. Praktikum laboratorijskih vežbi iz fizike, Zavod za fiziku tehničkih fakulteta Univerziteta u Beogradu; 2004.

The total of active learning classes

Lectures: 30	**Practical training:** 15

Teaching methods: lectures containing animations of physical phenomenon. Interactive teaching containing demonstrations related to physical systems. Characteristic computational tasks. Consultations.			
Grading system: maximal number of points 100			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical training	12	Written	70
Colloquia	9	Oral	
Seminars	9		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Organic Chemistry Practicum

Teachers: Tokić-Vujošević, N. Zorana

Course status: elective

Semester: I	**Year of studies:** I
ECTS points: 2	**Course code:**

Prerequisite for attending course: none

Course aims:

- Throughout independent solving problems and practicing mechanisms which were lectured in the course Organic Chemistry 1, and with consulting help of assistants, students have the opportunity to advance and to well systematize their knowledge about mentioned course. This will also make them passing exam in Organic Chemistry 1.

Course outcomes:

- Advancement of knowledge and systematization of the most important terms in organic chemistry in order to easier undertake scientific-professional and professional-application courses
- Introduction to and application of organic reactions mechanisms on biological substrate and in medicinal chemistry

Course contents:

Practical training:

Student seminar papers about the topics lectured in mandatory course Organic Chemistry 1: functional groups systematic and trivial nomenclature of organic compounds; formal charge, polarity of organic compounds, and electron effects (inductive, resonance; influence of inductive and resonant effect on reactivity of functional groups); reactive particles (nucleophiles and electrophiles; basic types of organic reactions (ionic, radical, electrophile-nucleophile, addition-substitution-elimination; nucleophilic substitution S_N 1, S_N2 mechanism (examples of biosynthesis of therpens, glutathione as biogenic nucleophile; nucleophilic addition-carboxylic groups to nitrogen nucleophile, thiols and alcohols reactions; reactivity of alkenes and conjugated dienes (polymer chemistry; electrophilic substitution; free radical reactions; aromaticity and and electrophilic aromatic substitution; phenols and quinone (oxido-reductive reactions); carboxylic acids and derivatives; amines; acid-alkali equilibria (influence of resonance and inductive effect on alkalinity and acidity of organic compounds); protection of functional groups and hydrolysis reactions; elimination reactions (dehydratation, decarboxylation, desamination).

Recommended literature:

1. K. P. C. Vollhard, N. E. Šor: Organska hemija struktura i funkcija, četvrto izdanje, Data status, Nauka 2004, 1330 str. (K.P. Vollhardt, N. E. Shore: Organic Chemistry: structure and function, W. H.Freeman & co)
2. Francis A.Carey Organic chemistry, IV edition, 2000, McGraw-Hill, 1108 p

The total of active learning classes

Lectures:	**Practical training:** 30

Teaching methods: seminar papers, solving of concrete problems, mini tests

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	
Practical training	70	Written	30
Colloquia		Oral	
Seminars			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Introduction to Laboratory Experiments

Teachers: Kapetanović P. Vera, Jelikić-Stankov D. Milena, Karljiković-Rajić D. Katarina, Ražić S. Slavica, Uskoković-Marković M. Snežana, Odović V. Jadranka

Course status: elective

Semester: I	**Year of studies:** I
ECTS points: 2	**Course code:**

Prerequisite for attending course: none

Course aims:

The aim is student to master work techniques in analytical laboratory. Student is introduced to basic laboratory dishes, equipment, as well as basic operations that are necessary for work in qualitative and quantitative chemical analysis.

Course outcomes:

Student gained necessary experimental experience for independent laboratory work for qualitative and quantitative chemical analysis important to professional courses. Student learned to use basic laboratory dishes and equipment and is obtained with selected work techniques in analytical laboratory.

Course contents:

Practical training

Precautions and safety in laboratory. Classification of chemicals. Distilled and deionized water. Washing and maintenance of laboratory dishes and working area. Methods of performance of chemical reactions. Performing reactions in wet or dry conditions in semimicroqualitative chemical analysis. Performing colored reactions. Reactions of flame coloring. Performing of reactions in digester.

Using of water bath, centrifuge (separation solution from precipitate), ultrasonic bath (dissolution of hardly soluble compounds). Filtration techniques. Magnetic stirrer.

Weighing on technical and analytical scales. Mass stabilization by drying laboratory dishes for quantitative analysis. Quantitative transfer of solution for analysis. Volume measurement for quantitative analysis. Burrete, volume reading. Preparation of primary and secondary solutions. Preparation of series of working solutions-dilution. Preparation of solutions of specific pH values. Titration examples.

Recommended literature:

1. Uputsva za laboratorijski rad, Katedra za analitičku hemiju
2. Skoog DA, West DM, Holler FJ. Fundaments of Analytical Chemistry. 7th ed. Philadelphia: Saunders College Publishing; 1996.
3. Christian GD. Analytical Chemistry. 6th ed. New York: John Wiley & Sons, INC; 2004.
4. Vogel AI. Qualitative Inorganic Analysis. 7th ed. London: Longman; 1996.

The total of active learning classes

Lectures: 0	**Practical training:** 30

Teaching methods: laboratory practice, work in small groups, interactive teaching

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	30
Practical training	70	Written	
Colloquia		Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Mathematics

Teachers: Nikčević Simić Ž. Stana, Ranković D. Dragana

Course status: mandatory

Semester: I	**Year of studies: I**
ECTS points: 4	**Course code:**

Requirements: none

Course aims:

Elementary mathematical literacy in the field of linear algebra, integral and differential calculus. Introduction to selected methods of applied mathematics.

Course outcomes:

Understanding and analysis of information related to physical, chemical and pharmaceutical sciences.

Course contents:

Lectures

Linear algebra: matrix calculus, determinants, systems of linear equations (Kramer formulas, Gaussian algorithm and matrix method), and vector calculus. Functions. Summary of known facts: definitions and properties of elementary functions (power, exponential, logarithmic, trigonometric and inverse functions). Operations with functions, limits, and asymptotic continuity. Differential calculus: the concept of derivative, derivative tables and operations. Roll's, Lagrange and Taylor's theorem applied to functions testing (monotonicity, extreme values, convexity and concavity). Partial derivatives of functions of several variables (method of least squares). Integral calculus. Indefinite integral. Review of the known facts, integrals of rational, some irrational functions (differential stage, Euler shifts) and trigonometric functions. Definite integral. Newton-Leibniz's theorem. Uncharacteristic integrals. Application of definite integrals to calculate lengths, areas and volumes. Approximate calculation of integrals: a method of rectangles and trapezoids. Differential equations. First order differential equations: separate variables, homogeneous, and the derived from them, linear, Bernoulli's equation and the total differential equations. Second order differential equations: the ones reducible to the first order differential equations, the method of variation of constants, determining homogeneous solutions of second order differential equation if one solution is known, homogeneous and inhomogeneous linear differential equation of second order with constant coefficients. Applications. The optimization method. The method of least squares. Linear programming.

Practical classes

Examples and problems related to the content presented in lectures.

Recommended literature:

1. Kečkić J, Nikčević S. Matematika. Jednogodišnji kurs. Beograd: Nauka; 2005.

The total of active learning classes

Lectures: 30	**Practical classes:** 30

Teaching methods: lectures, practical classes

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	
Practical classes		Written	30
Colloquia	30	Oral	40
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Organic Chemistry 2

Teachers: Savić M. Vladimir

Course status: mandatory

Semester: II	**Year of studies:** I
ECTS points: 7	**Course code:**

Prerequisite for attending course:

Course aims:

Lectures

Knowledge acquisition about the stereochemical properties of molecules; understanding stereochemical characteristic of organic reactions; knowledge acquisition about structure an general properties oh heterocyclic compound; elementary knowledge acquisition about biomolecules (carbohydrates, peptides, nucleic acids, lipids).

Practical training

Introduction to experimental techniques used in organic compounds synthesis and purification; developing of ability to select, presentation and discussion of scientific information throughout seminar paper; implementation of acquired knowledge in more efficient learning process and in solving tasks in organic chemistry.

Course outcomes:

Lectures: understanding and recognition of stereochemic properties of organic compounds and chemical transformations, understanding of the structural characteristics, reactivity and properities of heterocyclic compounds and biomolecules.

Practical training: skills in experimental techniques used in organic compounds synthesis and purification; ability to present and implement obtained knowledge.

Course contents:

Lectures

Stereochemistry. Stereoisomerism, symmetry elements, chirality, nomenclature, enantiomers, optical activity, configuration, compounds with multiple chiral C-atoms, racemic forms, derivation and separation of racemate, acyclic compounds, stereochemistry of cyclic compounds, conformations of unsubstituted and substituted six-member rings, structure and chirality of allenes and biphenyl, stereoselective and stereospecific reactiuons, asymmetric synthesis. Chemistry of heterocyclic compounds. Nomenclature, some general characteristics of heterocyclic compounds: aromaticity, heteroatom effect on reactivity, acidity, alkalinity, five-member heterocyclic compounds containing one, two or more heteroatoms-structure, properties, derivatives, condensed polycyclic derivatives, six-member heterocyclic compounds containing one, two or more heteroatoms-structure, properties, derivatives, condensed polycyclic derivatives, condensed systems containing multiple heteroatoms. Carbohydrates. Definition, nomenclature, classification, reaction. Elongation and abbreviation of string. Cyclic structure of monosaccharides. Mutarotation, anomeric effect. Derivatives: glycosides, esters, ethers. Disaccharides, polysaccharides. Peptides. Peptide bond, polypeptide synthesis, glycoside synthesis, synthesis on solid phase. Primary and secondary structure, primary structure determination. Nucleic acids. Structure and properties of nucleosides and nucleotides, synthesis, properties of nucleic acids. Lipids, structure and properties.

Practical training

Practical training consists of six experimental tasks, one theoretical task from the field of stereochemistry and one seminar paper. Within seminar paper which is written individually or in smaller groups, students are solving problems related to the topic of the seminar paper.

Recommended literature:

1. Mihailović M. Lj. Osnovi teorijske organske hemije i stereohemije. Beograd: Građevinska knjiga; 1975.
2. Stojanović G. Organska stereohemija. Niš: Prirodno matematički fakultet; 2007.
3. Savić V. Hemija heterocikličnih jedinjenja. Beograd: Farmaceutski fakultet. 2011.
4. Pine S. H., Hendrickson J. B., Cram D. J., Hammond G. S. Organska hemija. Zagreb: Školska knjiga; 1982.
5. Vollhardt K. P. C. Schore N.E. (prevod) Organska hemija. Beograd: Data Status; 2004.
6. Niketić V. Principi strukture i aktivnosti proteina. Beograd: Hemijski fakultet; 1995.
7. Savić V., Simić M., Petković M., Tokić Z. Tasić G., Dilber S. Praktikum iz organske hemije. Beograd: Farmaceutski fakultet; 2011.

The total of active learning classes: 105

Lectures: 60	**Practical training:** 45

Teaching methods: lectures, practical training, consultations

Grading system:

Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	3	Practical	
Practical training		Written	60
Colloquia	37	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Physical Chemistry

Teachers: Aleksić M. Mara, Kuntić S. Vesna, Blagojević M. Slavica

Course status: mandatory

Semester: II	**Year of studies:** I
ECTS points: 5	**Course code:**

Prerequisite for attending course: no

Course aims: Acquisition of fundamental knowledge in the selected field of physical chemistry which is necessary for understanding physicochemical processes that are important for education of a pharmacist or a pharmacist-medical biochemist. Aim is to enable student to implement acquisitioned knowledge in studying other courses which for are physicochemical principles necessary.

Course outcomes: Acquisition of knowledge about thermodynamic parameters, liquid and solid phase matter properties, solutions and phase transitions, phenomena at the interface, colloid systems, chemical kinetics and basics of radiochemistry. Knowing and understanding physicochemical processes which are important to pharmacy and biochemistry. Enabling students to follow courses in senior years of study.

Course contents:

Lectures:

Chemical thermodynamics: lows of thermodynamics, functions of states of system, thermo-chemistry, process spontaneity, chemical potential, equilibrium in homogenous systems. Liquid state of matter: vapor pressure, capillary phenomenon, surface tension, viscosity, determination methods of these values. Solid state of matter: crystal and amorphous state. Solutions: solid and gas phase dissolution in liquid phase, colligate properties, osmosis and osmotic pressure determination, dissolution of liquids (completely miscible, partly or completely immiscible). Phase equilibriums and transformations: Gibbs` phase rule, thermal analysis. Phenomena at the interface: adsorption on liquid or solid phase surface, adsorption isotherms. Chromatography basics (elution mechanisms, plateau theory, physicochemical principles of chromatography separation (adsorption, dissolution, ion exchange), separation mixture components methods. Basics of colloidal chemistry: colloidal systems, colloidal particle structure, kinetically, optical and electrical properties, stability and coagulation of colloids. Chemical kinetics: mechanism of complex chemical reactions (parallel, consecutive, equilibrium reactions), speed and catalysis, speed and order of reaction, order of reaction determination methods. Catalysis: properties of catalyst, homogenous and heterogeneous catalysis, mechanism of catalytically effects. Basics of radiochemistry: natural and artificial radioactivity, ionizing radiation, radiation doses.

Practical training:

Chemical thermodynamics: determination of basic thermodynamics values, heat of dissolution determination. Liquid state of matter: coefficient of viscosity determination and coefficient of tension determination. Chemical kinetics: determination of basic kinetic values. Phenomena at the interface: determination of Gibbs` adsorption isotherm, separation of components using adsorption and partitioning chromatography.

Recommended literature:

1. Malešev D. Odabrana poglavlja fizičke hemije. Beograd: izdavač Malešev D.; 2003.
2. Kuntić V, Aleksić M, Pejić Nm Blagojević S. Praktikum iz fizičke hemije. Beograd: Farmaceutski fakultet, Univerzitet u Beogradu; 2010.
3. Kuntić V, Aleksić M, Pavun L, Pejić N. Zbirka zadataka iz fizičke hemije. Beograd: izdavač: Pavun L.; 2003.
4. Medenica M, Malešev D. Eksperimentalna fizička hemija. Beograd: izdavač Medenica M.; 2002.
5. Atkins PW. Physical Chemistry. Oxford: Oxford University Press; 2002.

The total of active learning classes			
Lectures: 45		**Practical training:** 15	
Teaching methods: lectures, consultations, practical laboratory training			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical training	15	Written	40
Colloquia	40	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Physiology 1

Teachers: Plećaš-Solarović A. Bosiljka, Pešić R. Vesna, Nedeljković S. Miodrag

Course status: mandatory

Semester: II	**Year of studies: I**
ECTS points: 5	**Course code:**

Requirements: Biology with human genetics, Human functional morphology

Course aims:

Provision of important knowledge from physiology of cell, tissue, organ systems and human body as whole, relevant to pharmaceutical practice. Provision of theoretical basis relevant for other courses (pathophysiology, pharmacology, medical biochemistry, pharmacognosy, pharmacotherapy, clinical pharmacy, pharmacotherapy, toxicology, bromatology).

Course outcomes:

After finishing this course student will be trained to:

- properly use medical terminology
- be familiar with function of individual organs, understand integrated function of organs and control mechanisms related to them.
- understand interconnections of regulatory systems, which is important for organism adaptation to inner and outer environmental changes in everyday basis.

Course contents:

Theoretical lectures

Introduction to physiology. General physiology and physiology of the cell. Physiology of nervous system. Neurons and neuroglial cells; synaptic transmission, neurotransmitters, reflexes, functional organization of nervous system; neurobiology of sleep; Sensory function of nervous system; Motor function of nervous system; autonomic nervous system; metabolism of the brain; protective apparatus of central nervous system. Physiology of the blood. Blood cells; erythrocytes, leukocytes and platelets; hemostasis; water in organism: content, distribution and origin of water in the body. Physiology of the cardiovascular system. Heart: conduction system; electrical and mechanical changes in heart beat; the parameters of cardiac function; work and metabolism of the heart muscle; coronary circulation. Circulation: arterial, venous and capillary circulation; lymph and lymphatic system; regulation of cardiovascular function. Physiology of the respiratory system. Respiratory pathways. Mechanics of breathing. Transport and exchange gases. Regulation of breathing.

Practical classes

Membrane potentials and synaptic transmission. Reflexes: patellar and pupil reflex. Mechanism of genesis and characteristics of skeletal muscle contraction. Erythrocytes: determination of hemoglobin concentration, erythrocyte count and erythrocyte osmotic fragility. Leukocytes: determining the blood levels. The buffering capacity of the blood plasma. Coagulation of the blood. Determination of heart rate and arterial blood pressure. Auscultation of heart sounds. Control of cardiovascular function. Lung volumes and vital capacity of the lung (spirometry). Control of breathing.

Recommended literature:

1. Plećaš B. Skripta za predavanja „FIZIOLOGIJA - PREDAVANJA 2011/2012“. Drugo ispravljeno i dopunjeno izdanje. Beograd; 2011.
2. Pešić V, Nedeljković M. Priručnik za praktičnu nastavu. Beograd: Autorsko izdanje; 2007.
3. Koeppen BM, Stanton BA. Berne & Levy PHYSIOLOGY. 6th ed. Philadelhia: Mosby, Elsevier; 2010.
4. McCorry LK. Essentials of Human Physiology for Pharmacy. 2nd edition. Boca Raton: CRC PRESS, Taylor & Francis Group; 2009.
5. Barret KE, Barman SM, Boitano S, Brooks H. Ganong's Review of Medical Physiology. 23th ed. New

York: McGraw Hill Lange; 2009.

The total of active learning classes

Lectures: 45	**Practical classes: 30**

Teaching methods:

Classes are performed in one semester using the following methods:

- theoretical lectures (lectures, PP presentations, interactive teaching)
- practical lectures combined with computer animations and simulations of physiological processes, interactive teaching (checking students' knowledge)
- consultations

Grading system:

Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0-2	Practical	
Practical classes	18	Written	70
Colloquia	10	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Botany

Teachers: Jančić B. Radiša, Lakušić S. Branislava, Slavkovska N. Violeta

Course status: mandatory

Semester: II	**Year of studies: I**
ECTS points: 6	**Course code:**

Requirements: none

Course aims:

Gathering knowledge on the basics of morphology, anatomy, physiology and ecology of plants important for pharmacy. Localization of primary and secondary metabolites and their biological role. Introduction to the classification systems as information systems. Knowledge of selected groups of medicinal plants.

Course outcomes:

Student is able to explain the morphological and anatomical characteristics of plant organs important for pharmacy, describe and explain the basic physiological processes of plants, properly appoint and classify selected taxa; predict properties of taxa based on their systematic affiliation; is familiar with gathering of information about the plants of interest to the pharmacy; is able to identify groups of medicinal herbs.

Course contents:

Lectures

Specifics of plant cells, cell wall, plastids, vacuoles, organization of the plant body: single-celled organisms, colonies, multicellular organisms, tissues: meristematic, permanent; secretory tissues; organography: vegetative, reproductive organs, metamorphosis; structure of the plant organs: root, stem (primary and secondary) and leaves; basic concepts of plant physiology: photosynthesis, respiration, mineral nutrition, metabolic products, taxonomy, nomenclature rules and descriptions, taxon and methods of groups creation; system of plants classification, natural, phylogenetic and special systems; review of biosystematic group of plants (Plantae) at the level of partition: *Cyanophyta (Cyanobacteria), Chlorophyta, Phaeophyta, Bryophyta, Equisetophyta, Polypodiophyta, Pinophyta, Magnoliophyta* including selected species of importance for pharmacy; morphology of vegetative and reproductive organs and systematics of *Pinophyta* (gymnosperms): *Gnetopsida, Ginkgopsida, Cycadopsida, Pinopsida*; morphology of vegetative and reproductive organs of *Magnoliophyta* (angiosperms); *Magnoliopsida* and *Liliopsida* – selected taxa important for pharmacy; kingdom of *Fungi* – selected taxa of significance for pharmacy; basics of plants ecology; botany and biotechnology – tissue cultures, transgenic plants.

Practical classes

Microscopy: plant cell, tissues and organs; macroscopy: morphology of vegetative and reproductive organs; selected species of relevance for pharmacy from allotments: *Bryophyta, Equisetophyta, Polypodiophyta, Pinophyta, Magnoliophyta*; methods of determination of vascular plants with the botanical literature and databases.

Recommended literature:

1. Jančić R. Botanika farmaceutika. Beograd: Službeni list; 2004.
2. Lakušić B, Slavkovska V, Stojanović D. Priručnik za vežbe iz botanike za studente Farmaceutskog fakulteta. Beograd: Univertitet u Beogradu - Farmaceutski fakultet; 2005.
3. Jančić R, Stojanović D. Ekonomska botanika. Beograd: Zavod za izdavanje udžbenika; 2008.
4. Jančić R. Rečnik botaničkih morfoloških pojmova. Beograd: SANU; 2010.
5. Applequist W. The indetification of medicinal plants. Missouri, St. Louis: Missouri Botanical Garden Press; 2006.

The total of active learning classes			
Lectures: 45		**Practical classes:** 45	
Teaching methods: lectures and practical classes			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0-3	Practical	
Practical classes	14-27	Written	18-35
Colloquia		Oral	18-35
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Analytical Chemistry 1

Teachers: Kapetanović P. Vera, Jelikić-Stankov D. Milena, Karljiković-Rajić D. Katarina, Ražić S. Slavica, Uskoković-Marković M. Snežana, Odović V. Jadranka

Course status: mandatory

Semester: II	**Year of studies:** I
ECTS points: 4	**Course code:**

Prerequisite for attending course: none

Course aims:

Knowledge acquisition about qualitative chemical analysis in order to enable student for solving analytical problems important to professional courses:

- Basic knowledge acquisition about heterogeneous equilibrium
- Sample preparation and ion identification using selected reagents
- Identification of unknown substances
- Separation and identification of ions using chromatographic and extraction techniques.

Course outcomes:

Student is enabled to:

- Apply obtained knowledge about heterogeneous systems and evaluation of precipitation and dissolution
- Evaluate and apply, based on existing data, appropriate sample preparation
- Implement obtained knowledge about identification of ions in substance analysis
- Apply separation techniques in separation, purification and concentrating of analyte

Course contents:

Lectures

Basic principles of qualitative chemical analysis. Chemical equilibrium of heterogeneous systems. Conditions of precipitation/dissolution-the influence of sharing ion, foreign ion, pH value and complexation. Fraction separation/precipitation of hydroxide and suphide. Analytical principles of sample preparation (translation ions in soluble form) for qualitative chemical analysis of cations and anions. Analytical principles of ion separation: separation, concentrating and purification. Applying chromatography techniques in separation and identification of inorganic ions with special reference to the partition, ion exchange, and ion chromatography. Theoretical principles and implementation of extraction methods in separation and identification of inorganic ions with special reference to the liquid-liquid extraction, solid phase extraction-SPE and cloud point extraction-CPE. Selected examples of use separation methods in ion analysis important for pharmaceutical analysis.

Practical training

Identification reactions for anions and cations (group, selective, specific). Identification of unknown substances with special reference to translating hardly soluble substances into soluble form-preparation of soda extract. Examples of implementation of chromatographic and extracting techniques in ion separation and identification. Separation of cations in IV and V analytical group using paper chromatography. Extraction of ions using SPE. Metal ion separation through chelating complex c ompounds using liquid-liquid chromatography.

Recommended literature:

1. Kapetanović V, Jelikić-Stankov M. Analitička hemija I uvod u semimikrokvalitativnu analizu, Beograd: Univerzitet u Beogradu; 1998.

2. Jelikić Stankov M, Kapetanović V, Karljković-Rajić K, Aleksić M, Ražić S, Uskoković-Marković S, Odović J. Semimikrokvalitativna hemijska analiza, Praktikum za studente farmacije. Beograd:

<table>
<tr><td colspan="4">Farmaceutski fakultet;2002.
3. Dean JR. Extraction Techniques in Analytical Sciences. Chichester: John Wiley & Sons; 2009.
4. Vogel AI. Qualitative Inorganic Analysis. 7th ed. London: Longman; 1996.
5. Miller JM. Chromatography, Concepts and Contrasts. 2nd ed. New York: John Wiley & Sons; 2005.</td></tr>
<tr><td colspan="4">The total of active learning classes</td></tr>
<tr><td colspan="2">Lectures: 30</td><td colspan="2">Practical training: 30</td></tr>
<tr><td colspan="4">Teaching methods: lectures, laboratory practice, work in groups, consultations, interactive teaching</td></tr>
<tr><td colspan="4">Grading system:</td></tr>
<tr><td>Exam prerequisites</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Active participation in lectures</td><td>6</td><td>Practical</td><td></td></tr>
<tr><td>Practical training</td><td>24</td><td>Written</td><td>50</td></tr>
<tr><td>Colloquia</td><td>20</td><td>Oral</td><td></td></tr>
<tr><td>Seminars</td><td></td><td></td><td></td></tr>
<tr><td>Other activities</td><td></td><td></td><td></td></tr>
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University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Foreign Language of Pharmaceutical Profession – English

Teachers: Kerničan N. Leontina

Course status: elective

Semester: II	**Year of studies: I**
ECTS points: 2	**Course code:**

Requirements: none

Course aims:

- Introduction to the professional terminology in the field of pharmacy.
- Development of oral and written communication skills regarding basic concepts of the pharmaceutical profession.
- Development of the ability to understand written information in the pharmaceutical profession.

Course outcomes:

Student will be able to:

- Actively apply the knowledge of the language.
- Express own opinion regarding specific fields of the pharmaceutical profession.
- Understand less complex pharmaceutical references.

Course contents:

Introduction to the basic concepts of the pharmaceutical profession. Chemistry, periodic system, measurement units. Laboratory glassware and laboratory analysis. Cell, tissues, human body. Description and classification of medicines. Usage and dispensing of medicines. Health and illness. Patient communication. Composition and the text processing.

Verbal communication practical classes. Discussion on the topics of the pharmaceutical profession, fundamental goals of the working pharmacists, and medicines. Lexical practical classes on the usage of the professional terminology. Definition and reformulation. Practical classes on the text processing.

Recommended literature:

1. Kerničan L. English Language in Pharmacy Practice, zbirka tekstova i vežbanja. 3. izdanje. Beograd: Grafopan; 2011.
2. Mićić S. Nazivi bolesti i poremećaja u engleskom jeziku, 1. izdanje. Beograd: Beogradska knjiga; 2004.
3. Arneri-Georgijev J. More Medical Words You Need. 1. izdanje. Beograd: Savremena administracija a.d; 2002.
4. Bujas Z. Englesko-hrvatsko-engleski rečnik. 2. izdanje. Zagreb: Nakladni zavod Globus; 2001.
5. Hlebec B. Enciklopedijski srpsko-englesko-srpski rečnik. 1. izdanje. Beograd: Zabod za udžbenike; 2012.

The total of active learning classes

Lectures: 30	**Practical classes:** 0

Teaching methods:

interactive lectures, group work, role-playing, individual assignments

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	5-10	Practical	
Practical classes		Written	15-30
Colloquia		Oral	15-30
Seminars	15-30		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Foreign Language of Pharmaceutical Profession - French

Teachers: Mirić M. Milica

Course status: elective

Semester: II	**Year of studies: I**
ECTS points: 3	**Course code:**

Requirements: none

Course aims:

Introduction of students to the basic terminology in the field of pharmacy, development of the professional communication skills, as well as the understanding of the professional/scientific references in French language, and the possibility to actively apply gained knowledge.

Course outcomes:

Upon completion of the course, the student is expected to actively use basic terminology of the pharmaceutical profession, to apply the gained knowledge for understanding of the less complex professional/scientific references, and to express own opinion regarding different fields of the pharmaceutical profession.

Course contents:

Lectures

Introduction to the basic terminology from different fields of the pharmaceutical profession. Fields: pharmacy studies, pharmaceutical profession; human body parts, cells, tissues, systems of organs; chemistry: periodic system, laboratory glassware; health and illness; medicines: dosage forms, classes, prescription, instructions for usage of medicines, dispensing of medicines. Application of the professional terminology. Patient communication. Discussions on various topics of the pharmaceutical profession. Elaboration of the professional references.

Recommended literature:

1. Mirić M. Francuski jezik farmaceutske struke, nerecenzirana skripta.
2. Thieulle J, Van Eibergen J. Le langage médical : A l'usage des futurs professionnels de la santé. Collection: REUSSIR DEAS. Paris: Editions Lamarre; 2010.
3. Mourlhon-Dallies F, Tolas J. Santé-médécine.com. Paris: CLE International; 2004.
4. Garnier M, Delamare V, Delamare J, Delamare T. Dictionnaire illustré des termes de médecine. 29e édition, Paris: Maloine; 2006.
5. Jovanović AS. Savremeni fracusko-srpski rečnik sa gramatikom, Beograd: Prosveta; 2005.

The total of active learning classes

Lectures: 30	**Practical classes:** 0

Teaching methods:

interactive lectures, group work, individual assignments

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	0-2	Practical	
Practical classes		Written	15-30
Colloquia	0-18	Oral	
Seminars			
Other activities (homework, presentation)	0-50		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Application of Information Technology in Pharmacy

Teachers: Ranković D. Dragana, Lakić M. Dragana

Course status: elective

Semester: II	**Year of studies: I**
ECTS points: 3	**Course code:**

Requirements: none

Course aims:

Gathering new skills and knowledge in the field of information technology for the future professional development. Application of the contemporary information technology methods in the processes of learning and teaching. Introduction to the information technology systems in the pharmaceutical profession and the healthcare system.

Course outcomes:

Knowledge and understanding of information technologies. Student will be able: to use MS Word and Excel for the purposes of learning and the future professional work, to search through the web pages in order to find studying materials, as well as to use the possibilities of on-line learning. Usage of the pharmaceutical and healthcare information systems.

Course contents:

Lectures

Operative system and its purpose, Windows working environment, folders and files, basic elements of windows and manipulation, saving of files.

MS Word. Cursors and selection of text, font formatting, search and replacement of text, paragraph formatting, bullets and numbering, creation of tables, conversion of text to table, processing of multiple pages text, column formatting, working with different styles.

MS Excel. Basic elements of the window, data entry and table formatting, insertion and copying of formulas, absolute and relative cell addresses, charting of graphs, various types of graphs, using multiple sheets and files.

Internet-intranet networks. Searching tools. Sourcing of the learning material. On-line learning. Information systems and information technologies. Information systems in pharmacy – design, architecture and structure. Methods and software for the pharmaceutical and healthcare system. Standards and norms in the pharmaceutical information technology.

Recommended literature:

1. On-line materials
2. Millares M. Applied Therapeutics - Applied Drug Information: Strategies for Information Management. Vancouver Washington; 1998.

The total of active learning classes

Lectures: 30	**Practical classes:** 0

Teaching methods:

lectures, discussions

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	10	Practical	
Practical classes		Written	70
Colloquia		Oral	
Seminars			
Other activities	20		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Physiology 2

Teachers: Plećaš-Solarović A. Bosiljka, Pešić R. Vesna, Nedeljković S. Miodrag

Course status: mandatory

Semester: I	**Year of studies: II**
ECTS points: 5	**Course code:**

Requirements: Physiology 1

Course aims:

Provision of important knowledge from physiology of cell, tissue, organ systems and human body as whole, relevant to pharmaceutical practice. Provision of theoretical basis relevant for other courses (pathophysiology, pharmacology, medical biochemistry, pharmacognosy, pharmacotherapy, clinical pharmacy, pharmacotherapy, toxicology, bromatology).

Course outcomes:

After finishing this course student will be trained to:

- properly use medical terminology
- be familiar with function of individual organs, understand integrated function of organs and control mechanisms related to them.
- understand interconnections of regulatory systems, which is important for organism adaptation to inner and outer environmental changes in everyday basis.

Course contents:

Theoretical lectures

Physiology of the digestive system. Motility and secretory function and their regulation. Processes in the oral cavity, pharynx and esophagus. Stomach. Small intestine. Exocrine pancreas. Bile: composition, role, formation and regulation of secretion. Colon. Digestion and absorption: carbohydrates, proteins, and lipids; Absorption of water, electrolytes and vitamins. Liver. Quantitative metabolism. Body temperature: regulation and disorders. Physiology of the urinary system. Functional anatomy of the kidney; juxtaglomerular device; blood flow through the kidneys. The formation of urine: glomerular filtration, tubular reabsorption and secretion; concentrating urine. The composition of urine. Micturition reflex. Maintenance of acid-base balance. H^+ concentration in the body fluids. The role of chemical buffer, the respiratory system and the kidneys in the H^+ homeostasis. Basic H^+ homeostasis disorders. Maintaining the balance of electrolytes and water in the body. Physiology of the endocrine system. General characteristics of hormones. Thyroid gland. Hormonal regulation of calcium and phosphate homeostasis: parathyroid hormone, calcitonin and vitamin D hormone. Endocrine pancreas. Adrenal gland: hormones of the cortex and medulla. Pituitary gland: hormones of the anterior and posterior lobes. Hypothalamus. Gonads. Physiology of the skin.

Practical classes

Digestive enzymes (ptyalin, pepsin, trypsin) and bile: characteristics, roles. Renal physiology: processes responsible for the formation of urine. General physiology of the endocrine system, endocrine pancreas and blood glucose determination.

Recommended literature:

1. Plećaš B. Skripta za predavanja „FIZIOLOGIJA - PREDAVANJA 2011/2012“. Drugo ispravljeno i dopunjeno izdanje, Beograd; 2011.
2. Pešić V, Nedeljković M. Priručnik za praktičnu nastavu. Beograd: Autorsko izdanje; 2007.
3. Koeppen BM, Stanton BA. Berne & Levy PHYSIOLOGY. 6th ed. Philadelhia: Mosby, Elsevier; 2010.
4. McCorry LK. Essentials of Human Physiology for Pharmacy. 2nd edition. Boca Raton: CRC PRESS, Taylor & Francis Group; 2009.
5. Barret KE, Barman SM, Boitano S, Brooks H. Ganong's Review of Medical Physiology. 23th ed. New

York: McGraw Hill Lange; 2009.

The total of active learning classes

Lectures: 45	**Practical classes: 15**

Teaching methods: Teaching methods:

Classes are performed in one semester using the following methods:

- theoretical lectures (lectures, PP presentations, interactive teaching)
- practical lectures combined with computer animations and simulations of physiological processes, interactive teaching (checking students' knowledge)
- consultations

Grading system:

Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0-2	Practical	
Practical classes	18	Written	70
Colloquia	10	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Immunology

Teachers: Arsenović Ranin M. Nevena, Stojić-Vukanić M. Zorica

Course status: mandatory

Semester: III	**Year of studies: II**
ECTS points: 5	**Course code:**

Requirements: none

Course aims:

Introduction of students to: the properties of innate and adaptive immunity and their effector mechanisms in resistance to microorganisms; the disorders of the immune system function: hypersensitivity reactions, autoimmune diseases and immunodeficiencies; immune response to tumors and transplant tissues; principles and applications of immunological tests based on antigen-antibody reaction.

Course outcomes:

Upon completion of the course, the student will: know the effector mechanisms of innate and adaptive immunity in resistance to microorganisms; know the pathogenesis, the most important clinical manifestations and the therapy of illnesses caused by disorders in immune system function; be familiar with the immune response to tumors and transplant tissues; master the principles of immunological tests for qualitative and/or quantitative determination of antigens and antibodies.

Course contents:

Lectures

Innate immunity – recognition of microorganisms, components of the innate immunity. Adaptive immunity. Antigens recognized by T and B lymphocytes. Structure and functions of the major histocompatibility complex molecules. Uptake, processing, and presentation of protein antigens to T lymphocytes. Structure of the antigen receptors on lymphocytes. The emergence of the immune repertoire. Cell-based immune response – activation of T lymphocytes by intracellular microorganisms. Effector mechanisms of T-cell based immune response – elimination of the intracellular microorganisms. Humoral immune response – activation of B lymphocytes and antibodies production. Effector mechanisms of humoral immune response – elimination of the extracellular microorganisms and toxins. Autoimmunity – principles and pathogenesis. Immune response to tumors and transplant tissues. Hypersensitivity reactions – types, mechanisms of the tissue damage, clinical syndromes, therapy. Congenital and acquired immunodeficiencies (AIDS).

Practical classes

Immunization, production of polyclonal and monoclonal antibodies. Precipitation reactions. Agglutination reactions. Complement fixation test and determination of the total hemolytic activity of the complement. Radioactive markers tests. Enzyme markers tests. Fluorochrome markers – immunofluorescence and flow cytofluorometry. Immunohistochemistry. Methods for the selective extraction of cells. Methods for the assessment of humoral and cell immunity *in vitro* and *in vivo*. Tests performed prior to transplantation. Detection of immune complexes in tissues and biological liquids. Techniques of the molecular biology in immunology.

Recommended literature:

1. Abbas AK, Lichtman AH. Osnovna imunologija-funkcionisanje i poremećaji imunskog sistema. Treće izdanje. Beograd: Data status; 2009.
2. Abbas AK, Lichtman A, Pillai S. Cellular and molecular immunology. 7th ed. Philadelphia: Elsevier Saunders; 2012.
3. Kindt TJ, Goldsby RA, Osborne BA. Kuby Immunology. 6th ed. New York: W.H. Freeman and Company; 2007.

<table>
<tr><td colspan="4">4. Murphy K. Janeway's Immunobiology. 8th ed. New York: Garland Science,Taylor & Francis Group, LLC; 2012.
5. Arsenović Ranin N, Stojić-Vukanić Z, Bufan B. Metode u imunologiji i imunohemiji. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2012.</td></tr>
<tr><td colspan="4">The total of active learning classes</td></tr>
<tr><td colspan="2">Lectures: 30</td><td colspan="2">Practical classes: 30</td></tr>
<tr><td colspan="4">Teaching methods:
lectures, practical classes</td></tr>
<tr><td colspan="4">Grading system:</td></tr>
<tr><td>Exam prerequisites</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Active participation in lectures</td><td></td><td>Practical</td><td></td></tr>
<tr><td>Practical classes</td><td>5</td><td>Written</td><td>65</td></tr>
<tr><td>Colloquia</td><td>30</td><td>Oral</td><td></td></tr>
<tr><td>Seminars</td><td></td><td></td><td></td></tr>
<tr><td>Other activities</td><td></td><td></td><td></td></tr>
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University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Instrumental Methods

Teachers: Medenica B. Mirjana, Pejić D. Nataša

Course status: mandatory

Semester: III	**Year of studies:** II
ECTS points: 6	**Course code:**

Prerequisite for attending course: Physical Chemistry

Course aims: Introduction to principles, devices, way of performing and possibilities of application of different instrumental methods which student will use in other courses as well as in laboratories which pharmacist work in. Within practical training, throughout individual work, student will master instrumental methods.

Course outcomes: Student is enabled (both theoretically and practically) to independently select appropriate instrumental method according to the task, and in accordance with specificity of pharmaceutical profession. Student is capable to, with help of instructions, independently do the experiment and to process obtained results.

Course contents:

Lectures

Principles and instrumental methods division. Signal and response detection. Measuring devices. Spectroscopic methods. Electromagnetic radiation, photocells, qualitative-quantitative aspect of spectrophotometry and application. Instrumental methods based on rotation and reflection of light. Radiation absorption and emission. Lambert-Beer law. Atomic absorption and emission (flame photometry) spectrometry. Molecular spectrophotometry: interaction of electromagnetic radiation and molecules, UV, VIS, IR radiation absorption, molecular absorption and emission spectrometry methods (UV-VIS and IR spectrometry, fluorimetry). Methods based on light scattering (turbidimetry, nephelometry). Mass spectrometry (theory bases). Electrochemical methods. Electrolytes, conductance, Kohlrausch laws, conductance measuring, protolysis degree and protolysis constant calculation, electrophoretic effect, conductometry and conuctometric titration. Electrochemical cell, electrode, membrane and diffuse potential, Nernst equation for electrode potential, types of electrodes and electrodes division, ion selective electrodes, pH-metry, pX-metry. Potentiometry and potentiometric titration. Electrolytic cell, culometry, Carl-Fischer titration. Polarization and depolarization of electrode, polarography. Instrumental methods of separation. Separation techniques: principles of separation (adsorption, solution, ion exchange, charge and particle mobility). Classification of separation instrumental methods. Gas and liquid chromatography: principles, division, separation factors, instruments and use. Electrophoresis: principle, division, instruments.

Practical training

Laboratory training: Polarymetry. Refractometry. Atomic absorption spectroscopy and flame photometry. UV-VIS spectrophotometry and fuorimetry. Nephelometry and turbidimetry. Conductometry and conductometric titration. Potentiometry and potentiometric titration. PH-metry and pX-metry. Culometry. Carl-Fischer titration. Polarography. Selected separation methods (gas and liquid chromatography). Electrophoresis.

Recommended literature:

1. Medenica M, Malešev D. Eksperimentalna fizička hemija. Beograd: Medenica M; 2002.
2. Skoog D, Holler FJ, Niemen TA. Principles of Instrumental Analysis (4th ed.). Philadelphia: Sounders College Publishing; 1998.
3. Antić Jovanović A, Molekulska spektroskopija – spektrohemijski aspekt. Univerzitet u Beogradu, Fakultet za fizičku hemiju; 2002.

<table>
<tr><td colspan="4">4. Rouessac F, Rouessac A. Chemical Analysis Modern Instrumentation Methods and Techniques. USA: John Wiley & Sons, Ltd.; 2007.
5. Kuntić V, Aleksić M, Pavun L, Pejić N. Zbirka zadataka iz fizičke hemije. Beograd: Pavun L; 2003.</td></tr>
<tr><td colspan="4">The total of active learning classes</td></tr>
<tr><td colspan="2">Lectures: 45</td><td colspan="2">Practical training: 45</td></tr>
<tr><td colspan="4">Teaching methods: lectures, laboratory training, consultations, interactive teaching, student scientific research</td></tr>
<tr><td colspan="4">Grading system:</td></tr>
<tr><td>Exam prerequisites</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Active participation in lectures</td><td></td><td>Practical</td><td></td></tr>
<tr><td>Practical training</td><td>30</td><td>Written</td><td>70</td></tr>
<tr><td>Colloquia</td><td></td><td>Oral</td><td></td></tr>
<tr><td>Seminars</td><td></td><td></td><td></td></tr>
<tr><td>Other activities</td><td></td><td></td><td></td></tr>
</table>

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Pharmaceutical Chemistry 1

Teachers: Erić M. Slavica, Brborić S. Jasmina, Marković D. Bojan

Course status: mandatory

Semester: III	**Year of studies:** II
ECTS points: 5	**Course code:**

Prerequisite for attending course: Organic Chemistry 1, Organic Chemistry 2

Course aims: student to acquire basic knowledge about pharmaceutical and medicinal chemistry which he will use in mastering courses Pharmaceutical Chemistry 2 and 3, as well as Pharmacology and Pharmacokinetics.

Course outcomes: Student is expected to obtain knowledge about physicochemical properties of pharmacologically active molecules, about reactivity of their functional groups, about chemical and metabolic stability of medicines, to understand target and mechanisms of drug effects on molecular level, to analyze relationships of chemical structure, properties and effects of medicines.

Course contents:

Lectures

Introduction to pharmaceutical-medicinal chemistry, functional groups that are important to medicinal chemistry, nomenclature of medicines, physicochemical properties of pharmacologically active compounds: ionization, lipophilicity and solubility of medicines; molecular-chemical bases of drug effects: targets of drug effects; structure-effect relationship analysis; chemical stability of medicinal compounds (oxidation, hydrolysis and other instability reactions with examples); chemical aspects of drug biotransformation of medicines, I and II phase metabolism reactions with examples; bioisosteres in medicinal chemistry, prodrug: properties, division and application with examples.

Practical training

Data bases review, experimental determination of physicochemical parameters: lipophilicity, solubility, drug ionization; application of computational methods in drug structure-effect relationship analysis; calculation of molecular descriptors of pharmacologically active compounds, introduction to basic principles of molecular modeling of drugs; functional groups review, examples of chemical stability and drug biotransformation.

Recommended literature:

1. Patrick GL. Introduction to Medicinal Chemistry. 4th ed. Oxford: University Press; 2009.
2. Lemke TL. Review of Organic Functional Groups. Introduction to Medicinal Organic Chemistry. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2012.
3. Cairns D. Essentials of Pharmaceutical Chemistry. 3rd ed. London, Chicago: Pharmaceutical Press; 2008.
4. Foye's Principles of Medicinal Chemistry. 7th ed. Williams DA, Lemke TL, editors. Baltimore: Lippincott Williams & Wilkins; 2013.
5. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry. 12th ed. Beale JM, Block JH, editors. Philadelphia: Lippincott Williams & Wilkins; 2011.

The total of active learning classes

Lectures: 45	**Practical training:** 30

Teaching methods: oral lectures, interactive teaching, experimental training, computational training

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	
Practical training	30	Written	70

Colloquia		Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Analytical Chemistry 2

Teachers: Kapetanović P. Vera, Jelikić-Stankov D. Milena, Karljiković-Rajić D. Katarina, Ražić S. Slavica, Uskoković-Marković M. Snežana, Odović V. Jadranka

Course status: mandatory

Semester: III	**Year of studies:** II
ECTS points: 5	**Course code:**

Prerequisite for attending course: none

Course aims:

Knowledge acquisition about quantitative chemical analysis in order to enable student for solving analytical problems:

- Theoretical and practical approach to quantitative chemical analysis
- Methods of classic quantitative chemical analysis
- Basic principles of calculation in gravimetric and volumetric analysis
- Analytical application of selected instrumental methods in inorganic ion analysis
- Evaluation, processing, interpretation of results and validation of analytical methods.

Course outcomes:

Student is expected to:

- Evaluate if the analyte determination reaction is quantitative
- Calculate and draw titration curves
- Explain and properly select indicators for appropriate titration systems
- Select method according to the determination of specific ion
- Perform all phases of quantitative chemical analysis
- Process, evaluate and explain obtained results

Course contents:

Lectures

Introduction to quantitative chemical analysis. Gravimetric analysis. Introduction to volumetric analysis. Acid-base titration of monoprotic and polyprotic systems. Importance of distribution diagram. Acid-base titration in non-aqueous environment-examples important for professional courses. Oxido-reduction titrations-methods of cerimetry, permanganometry, iodometry. Theoretical principles of Karl-Fischer titration and Winkler method. Precipitation titration. Halogenide determination using classic methods including adsorption indicators. Complexometric titrations. Theoretical principles of water hardness determination. Selection of analytical methods and results processing. Applying of selected instrumental methods in inorganic ion analysis. Examples of photometric titration based oh chelate compounds and potentiometric determination of mixtures of halogenides. Mistakes and basic parameters of analytical methods validation process.

Practical training

Basic procedures in quantitative chemical analysis. Selected example of gravimetric titration. Examples of acid-base titrations. Acidic and phosphoric acid determination. Determination of carbonates assay in sodium hydroxide. Examples of oxido-reduction titrations. Determination of hydrogen peroxide, iron, arsenic/cupper. Examples of precipitation titration. Chloride determination using Mohr and Volhardt method. Examples of complexometric titrations. Magnesium and calcium determination. Processing results-test of significance. Analytical implementation of selected instrumental methods in inorganic ion analysis: potentiometric titration of phosphorica acid, spectrophotometric analysis based on complex forming-photometric cupper titration, photometric titration of mixture of cupper and bismuth.

Recommended literature:

1. Skoog DA, West DM, Holler FJ. Fundaments of Analytical Chemistry. 7th ed. Philadelphia: Saunders College Publishing; 1996.
2. Christian GD. Analytical Chemistry. 6th ed. New York: John Wiley & Sons, INC; 2004.
3. Jelikić – Stankov M, Kapetanović V, Karljiković – Rajić K, Aleksić M, Ražić S,Uskoković-Marković S, Odović J. Kvantitativna hemijska analiza, Praktikum i zbirka zadataka za studente farmacije. Beograd: Farmaceutski fakultet; 2011.
4. Savić J, Savić M. Osnovi Analitičke hemije Klasične metode. Sarajevo: Svjetlost; 1989.
5. Thomas M. Analytical Chemistry by Open Learning: Ultraviolet and Visible Spectroscopy. New York: John Wiley & Sons; 1996.

The total of active learning classes

Lectures: 45	**Practical training:** 45

Teaching methods: lectures, laboratory practice, work in groups, consultations, interactive teaching

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	6	Practical	
Practical training	24	Written	40
Colloquia	30	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: General Biochemistry

Teachers: Spasojević-Kalimanovska V. Vesna, Jelić-Ivanović D. Zorana, Bogavac-Stanojević Nataša, Kotur-Stevuljević Jelena

Course status: mandatory

Semester: III	**Year of studies:** II
ECTS points: 6	**Course code:**

Prerequisite for attending course: Organic Chemistry 2

Course aims:

Student to acquire, realize and understand: basic catabolic, anabolic and common metabolic pathways in living cells as well as their regulation.

Course outcomes:

After successfully mastered course student is expected to: describes and analyses flows of main catabolic, anabolic and mutual metabolic pathways.

Course contents:

Lectures

Connection of structure and function of biomolecules. Structure and mechanism of enzyme action, kinetics of enzymatic catalyzed reactions, types of enzyme inhibition. Basic principles of bioenergetics. Catabolism and anabolism of carbohydrates, lipids and nitro compounds, regulation of catabolic and anabolic pathways. Biosynthesis of proteins and nucleic acids. Intercellular signalization.

Practical training

Workshops:

- Enzymes: general properties, connection of structure and function and enzyme classification. Saturation kinetics and significance of Michaelis-Menten constant determination. The influence of different inhibitors on course of enzymatic reaction. Mechanisms of regulation of enzymatic activity.
- Catabolism of carbohydrates: chemical and thermodynamic aspects, regulation of glycolysis, gycogenolysis and citric acid cycle. The significance of some products of listed processes in anabolic pathways. Respiratory chain and oxidative phosphorylation.
- Eicosanoides and cholesterol: structure, biosynthesis and regulation. The influence of lipoproteins in cholesterol transport in organism.
- Biosynthesis of nucleonic acids and proteins: central dogma in protein biosynthesis. Structure and function of nucleic acids. Interaction of DNA with histones in order to organize genetic material of eukaryotes into chromosomes. Replication, transcription and translation in prokaryotes and eukaryotes.

Recommended literature:

1. Spasić S, Jelić-Ivanović Z, Spasojević-Kalimanovska V. Opšta biohemija, Beograd, 2003.
2. Devlin TM. Textbook of Biochemistry with Clinical Correlations. John Wiley & Sons, New York, 2011.

The total of active learning classes

Lectures: 45	**Practical training:** 15

Teaching methods: oral lectures, experimental training- interactive teaching, workshops, discussions, problem solving, seminar paper

Grading system:

Exam prerequisites	Points	Final exam	Points

Active participation in lectures	2	Practical	
Practical training		Written	70
Colloquia	10	Oral	
Seminars	18		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmacology 1

Teachers: Ugrešić D. Nenad, Stepanović-Petrović M. Radica, Savić M. Miroslav, Ilić V. Katarina, Novaković N. Aleksandra, Tomić A. Maja

Course status: mandatory

Semester: IV	**Year of studies: II**
ECTS points: 4	**Course code:**

Requirements: Physiology 2

Course aims:

To provide students with:

- Knowledge of the mechanisms of drugs action
- Information necessary for understanding the effects of various drugs
- Understanding the therapeutic and side effects of certain groups of drugs
- Knowledge of the principles of therapeutic applications of drugs

Course outcomes:

Upon final examination, the student is expected to be able to:

- Identify mechanisms of various effects of certain groups of drugs
  Connect the therapeutic and side effects of certain groups of drugs with their different pharmacological effects
- Build your own critical attitude towards drug

Course contents:

Lectures

General principles of pharmacology. Drug development. Receptor/cell/molecular level of mechanisms of action of drugs. The target site of drugs action. Receptors. Affinity. Efficiency. Agonists, inverse agonists, antagonists. Competitive, noncompetitive, and irreversible antagonism. The mechanisms of signal transduction. G proteins. Second messengers. Ion channels. Enzymes. Transporters. Drug interactions. Safety of medicines. Principles of chemotherapy. Antibacterial drugs. Resistance to antibacterial drugs. Antimicrobial agents that interfere with the synthesis or action of folate. Beta-lactam antibiotics. Antimicrobial agents that interfere with bacterial protein synthesis. Antimicrobial agents that act on topoisomerase. Antituberculosis drugs. Antifungals. Antivirals. Antiprotozoal drugs. Anthelmintic. Cytostatics. Immunopharmacology (inflammation / autacoids). Eicosanoids. Nonsteroidal anti-inflammatory drugs. Histamine and antihistamines. Immunomodulators.

Practical classes

Computer simulations of learning through discussion of experimental results: The new drug development. Routes of drug administration. Dose-effect relationship. Antagonism. Antibacterial drugs. Cytostatics. The effect of drugs on inflammation.

Recommended literature:

1. Rang HP, Dale MM, Ritter JM, Moore PK. Farmakologija. I srpsko izdanje, prevod V izdanja udžbenika na engleskom. Beograd: Data-status; 2005.
2. Varagić V, Milošević M. Farmakologija. XXII izdanje. Beograd: Elit Medika; 2010.
3. Rang HP, Dale MM, Ritter JM, Flower RJ, Henderson G. Rang and Dale's Pharmacology. 7th edition. London: Churchill Livingstone Elsevier; 2011.
4. Brunton LL, Chabner BA, Knollmann BC, eds. Goodman&Gliman's the Pharmacological Basis of Therapeutics. 12th editon. New York: McGraw Hill; 2011.
5. Katzung BG, ed. Basic & Clinical Pharmacology. 12th ed. New York: Lange Medical Books,

McGraw-Hill Medical Publishing Division; 2012.			
The total of active learning classes			
Lectures: 30		**Practical classes: 15**	
Teaching methods: Lectures, recorded in vivo and in vitro laboratory experiments on animals, also the use of computer simulation of experiments.			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical classes	5	Written	
Colloquia	25	Oral	70
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Pharmaceutical Chemistry 2

Teachers: Vladimirov M. Sote, Agbaba D. Danica, Čudina A. Olivera, Marković D. Bojan

Course status: mandatory

Semester: IV	**Year of studies:** II
ECTS points: 8	**Course code:**

Prerequisite for attending course: Pharmaceutical Chemistry 1

Course aims: Student is expected to obtain basic knowledge about chemistry of specific medicine groups. Adopted knowledge from this field is important for mastering courses of medicinal, pharmaceutical-technological group and courses of pharmaceutical practice.

Course outcomes: Student is expected to be introduced to physicochemical properties of pharmacologically active molecules and to reactivity of their functional groups, basic mechanisms of action, chemical structure-biological activity relationships, chemical interactions of medicines, drug-receptor interactions, chemical aspects of drug metabolism *in vivo* and *in vitro* conditions.

Course contents:

Lectures

Chemotherapeutics: antibiotics (beta-lactam antibiotics: the penicillins and cephalosporins; aminoglycoside antibiotics; macrolides; tetracyclines; chloramphenicol; lincosamides; polypeptide and other antibiotics-chemical properties, mechanism of action, structure-activity relationship, biotransformation. Other antimicrobial drugs: sulphonamides, foliate reductase inhibitors, qinolones, and fluoroquinolones. Disinfecting agents, antiseptic agents, antimycotics, atiprotosoic and antiparasitic drugs; uroantiseptics, anituberculotics, antineoplastics, (antimetabolites, alkilating agents); antivirotics.

Steroid hormones and hormones containing other structures. Nomenclature of sterides, stereochemistry and stereochemical modifications, biosynthesis, structure-activity relationship, biotransformation. Estrogen hormones and antiestrogens; androgen hormones, anabolics and antiandrogens; gestagen hormones, oral contraceptives; corticosteroids (mineralocorticosteroids and gycocorticosteroids); anti-inflammatory steroids; thyroxin and tyreostatics; oral antidiabetics (sulphonil urea derivatives, bigvanidines, thiasolidinone derivatives, etc.)

Vitamins and coenzymes: chemical properties, biological role, stability, provitamins and antivitamins. Liposolubile vitamins: vitamins A, synthetic and semisynthetic retinoides, vitamins D, E and K. Hydrosolubile vitamins: vitamins B and vitamin C.

Practical training

Preparative obtaining, isolating, purification, identification and characterization of selected pharmaceutical compounds using analytical methods, separation techniques, spectroscopic methods. Determination of physicochemical constants. Case study analysis.

Recommended literature:

1.Foye's Principles of Medicinal Chemistry. 7th ed. Williams DA, Lemke TL, editors. Baltimore: Lippincott Williams & Wilkins; 2013.

2. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry. 12th ed. Beale JM, Block JH, editors. Philadelphia: Lippincott Williams & Wilkins; 2011.

3. Vladimirov S, Živanov-Stakić D. Farmaceutska hemija. II deo. Beograd: Farmaceutski fakultet; 2006.

4. European Pharmacopoeia. 7th ed. Strasbourg: Council of Europe; 2010.

5. Pripremni materijal za vežbe

The total of active learning classes

Lectures: 45	**Practical training:** 60

Teaching methods: oral lectures, interactive teaching, experimental training

Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical training		Written	60
Colloquia	30	Oral	10
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Pathophysiology 1

Teachers: Leposavić M. Gordana

Course status: mandatory

Semester: IV	**Year of studies:** II
ECTS points: 5	**Course code:**

Prerequisite for attending course: Physiology 1, Physiology 2, Immunology

Course aims:

Introducing student to:

- The most significant causes and mechanisms of occurrences of cell and tissue damage, as well as mechanisms of local and systematic response of organism to the damage;
- Etiopathogenesis and clinical manifestations of the most significant metabolic disorders;
- Causes and mechanisms of malignant cell transformation, characteristics of malignant changed cell, characteristics of tumor growth and changes which occur in the host organism.

Course outcomes:

Student to understand:

- Molecular and cellular base of damage and function disturbance of different organs/organ systems;
- Etiology and pathogenesis of the most significant metabolic disorders and their importance for development disorders of different organs and organ systems, measures for their prevention and therapy strategy;
- Measures for prevention and therapy of malignant diseases.

Course contents:

Lectures

Introduction to pathophysiology (health, disease, etiology, pathogenesis). Subcellular and molecular mechanisms and cellular damage under the influence of different etiological factors (ischemia, free radicals, biological agents). Adaptation and cell death. Types of cell death (necrosis and apoptosis). Etiopathogenesis of acute and chronic inflammation. Acute-phase response. Etiopathogenesis of shock. Malignant transformation of cell and growth (carcinogenic, carcinogenesis, changes in host organism). Disorders in circulation of water and sodium, potassium, calcium and phosphates (etiology, pathogenesis and the most significant pathophysiological manifestations). Etiopathogenesis of malnutrition and obesity and the most significant pathophysiological consequences. Etiopathogenesis of diabetes mellitus. Acute and chronic complications of diabetes mellitus. Etiopathogenesis of atherosclerosis.

Practical training

Ischemic cell damage and death. Cell damage by free radicals. Cell damage by biological agents. Acute inflammation with special reference to mediators of inflammation. Malignant transformation of cell and growth. Paraneoplastic syndrome. Disorders in circulation of water and sodium. Disorders in circulation of potassium, calcium, magnesium and phosphates. Etiopathogenesis of diabetes mellitus type 2. Chronic complications of diabetes mellitus. Etiopathogenesis of atherosclerosis.

Recommended literature:

1. Leposavić G. Patološka fiziologija za studente farmacije. Beograd: Univerzitet u Beogradu-Farmaceutski fakultet; 2012.
2. Gamulin S, Marušić M, Kovač Z i sur. Patofiziologija. Zagreb: Medicinska naklada; 2011.
3. Živančević-Simonović S. Opšta patološka fiziologija. Kragujevac: Medicinski fakultet u Kragujevcu; 2002.

4. Stošić Z, Borota R. Osnovi kliničke patofiziologije. Novi Sad: Univerzitet u Novom Sadu - Medicinski fakultet; 2012. 5. Kovač Z, Gamulin S i sur. Patofiziologija – Zadaci za problemske seminare. Zagreb: Medicinska naklada; 2006.			
The total of active learning classes:			
Lectures: 30		**Practical training:** 30	
Teaching methods: lectures, problem orientated seminars			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Exercises		Written	70
Colloquia	20	Oral	
Seminars	10		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Microbiology

Teachers: Milenković T. Marina, Antić Stanković A. Jelena

Course status: mandatory

Semester: IV	**Year of studies: II**
ECTS points: 6	**Course code:**

Requirements: none

Course aims:

Introduction of students to the morphological properties and pathogenic potential of microorganisms (bacteria, viruses, fungi, protozoa) causing human infections; the principles of laboratory diagnostics of infectious diseases, prevention measures (active and passive immunization); pathogenesis and epidemiology of infectious diseases. Introduction to the mechanism of action of antimicrobial medicines and mechanisms of the resistance to antimicrobial agents.

Course outcomes:

Knowledge of the microorganisms' classification, morphological properties and factors of virulence of microorganisms (bacteria, viruses, fungi, protozoa) pathogens to humans. Knowledge of the epidemiology of infectious diseases, prevention measures, laboratory diagnostics of infectious diseases. Knowledge of the mechanisms of action of antimicrobial medicines (antibiotics, antimycotics, antiviral and antiparasitic medicines). Acquisition of the knowledge and skills necessary for the work in aseptic laboratory environment.

Course contents:

Lectures

Morphology and physiology of the bacterial cell. Pathogenic bacteria virulence factors. Growth of bacteria and factors of growth. Effects of physical and chemical factors on microorganisms. Antibiotics: classification and mechanisms of action. Gram positive and negative cocci of importance for medicine. Gram positive asporogenous and Gram positive sporogenous bacilli. Properties of the enterobacteria causing human infections. Classification of viruses. Morphologic properties and viruses replication. Laboratory diagnostic of viral infections. Interferons – classification and mechanisms of action of antiviral interferons. Antiviral medicines – classification and mechanisms of action. Antiviral vaccines. Properties of DNA and RNA viruses of significance to human pathology. Medical protozoology: biological and morphological classification of protozoa. Protozoa of digestive and urogenital tract. Protozoa of blood and tissues. Medical helminthology: classification of helminths, lifecycle of helminths. Helminthosis of the great medical importance. Laboratory diagnostic methods in parasitology. Antiparasitic agents. Fungi of medical importance (yeasts, dermatophyte molds). Basic laboratory diagnostic methods in mycology. Antimycotics – classification and mechanisms of action. Antimycotics for the systemic application, antimycotics for the local application.

Practical classes

Microscopy and staining of bacteria. Preparation of the growth media. Sterilization and disinfection. Antibiogram. Gram positive and negative cocci of medical importance. Gram positive asporogenous and Gram positive sporogenous bacilli. Enterobacteria of medical importance. Laboratory methods in diagnostics of viral infections. Microscopy of stained smears of urogenital and blood-tissue protozoa.

Recommended literature:

1. Levinson W. Medical Microbiology and Immunology. 12th ed. San Francisco: The McGraw-Hill Companies; 2012.
2. Ryan KJ, Ray CG. Sherris Medical Microbiology. 5th ed. Tucson: The McGraw-Hill Companies; 2010.

<table>
<tr><td colspan="4">3. Švabić Vlahović M. Medicinska bakteriologija. Beograd: Savremena administracija; 2005.
4. Jovanović T, Marković LJ. Virusologija. Beograd: Univerzitet u Beogradu - Medicinski fakultet; 2008.
5. Arsić Arsenijević V, Otašević S, Milenković M, Pavlica D. Medicinska mikologija i parazitologija. Beograd: Centar za inovacije u mikologiji; 2012.</td></tr>
<tr><td colspan="4">The total of active learning classes</td></tr>
<tr><td colspan="2">Lectures: 60</td><td colspan="2">Practical classes: 30</td></tr>
<tr><td colspan="4">Teaching methods: lectures, practical classes</td></tr>
<tr><td colspan="4">Grading system:</td></tr>
<tr><td>Exam prerequisites</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Active participation in lectures</td><td>2</td><td>Practical</td><td></td></tr>
<tr><td>Practical classes</td><td>18</td><td>Written</td><td>60</td></tr>
<tr><td>Colloquia</td><td>20</td><td>Oral</td><td></td></tr>
<tr><td>Seminars</td><td></td><td></td><td></td></tr>
<tr><td>Other activities</td><td></td><td></td><td></td></tr>
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University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Selected Chapters of Analytical Chemistry

Teachers: Kapetanović P. Vera, Jelikić-Stankov D. Milena, Karljiković-Rajić D. Katarina, Ražić S. Slavica, Uskoković-Marković M. Snežana, Odović V. Jadranka

Course status: elective

Semester: IV	**Year of studies:** II
ECTS points: 2	**Course code:**

Prerequisite for attending course: none

Course aims:

Aim is that student learns what a real sample is and how to solve concrete analytical problem. Complex samples necessitate a need for systematical approach to the problem, so the student gets first experiences in setting methodology for solving concrete analytical problems.

Course outcomes:

- Student mastered approach in real sample analysis
- Student is capable to define problem and select proper sampling technique, as well as a method and/or methods of sample preparation and to prepare quantitative chemical analysis
- Student obtained knowledge for appropriate selection of analytical method in inorganic ion analysis, processing and explaining of results

Course contents:

Lectures

Analysis of real samples which are important for pharmacy. Method selection for preparation of samples depending on type of sample, nature of analyte and expected concentrations (ultra traces, traces or macro components). Real sample preparation (purification, preconcentration, separation, identification and interference removal) for quantitative chemical analysis-dry burning methods, moist and microwave digestion. Application of selected instrumental methods in inorganic ion analysis-UV/VIS spectroscopy with review to the derivative spectrphotometry, atomic spectrometry, electroanalytical methods (potentiometry and voltammetry).
Result processing using validation of applied analytical methods.

Practical training

Selected examples of analysis of real samples that are important for pharmacy. Data base searching.

Recommended literature:

1. Skoog DA, West DM, Holler FJ. Fundaments of Analytical Chemistry. 7th ed. Philadelphia: Saunders College Publishing; 1996.
2. Christian GD. Analytical Chemistry. 6th ed. New York: John Wiley & Sons, INC; 2004.
3. Mitra S. Sample Preparation Techniques in Analytical Chemistry. New York: John Wiley & Sons; 2003.
4. Articles available on internet related to concrete analytical problem
5. Authorized script, authors-teachers and assistants on the Department of analytical chemistry

The total of active learning classes

Lectures: 15	**Practical training:** 15

Teaching methods: lectures, laboratory practice, work in groups, consultations, interactive teaching

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	4	Practical	
Practical training	26	Written	70

Colloquia		Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Selected Chapters of General Biochemistry

Teachers: Bogavac-Stanojević Nataša, Kotur-Stevuljević Jelena

Course status: elective

Semester: IV	**Year of studies:** II
ECTS points: 2	**Course code:**

Prerequisite for attending course: Organic Chemistry 2

Course aims:

Student to realize and understand common metabolic pathways in special physiological and pathological conditions as well as their regulation. Basic knowledge acquisition about drug influence on biochemical processes.

Course outcomes:

After successfully mastered course student is expected to: describe and analyze metabolic pathways in special physiological and pathological conditions as well as the influence of some drugs on biochemical processes.

Course contents:

Lectures

Metabolism in special physiological and pathological conditions. Changing of metabolic processes in alcoholism. The influence of physical activity on anabolic and catabolic pathways. Metabolic processes in cancer. The drug influence on biochemical processes (example of anticoagulant therapy).

Practical training

Comparison of anabolic and catabolic pathways in hunger and state after meals. Changing of metabolic processes in pregnancy. The influence of physical activity on metabolism of carbohydrates and lipids. Metabolic pathways in alcoholism and cancer.

Recommended literature:

1. Devlin TM. Textbook of Biochemistry with Clinical Correlations. John Wiley & Sons, New York, 2011.

The total of active learning classes

Lectures: 15	**Practical training:** 15

Teaching methods: oral lectures, experimental training- interactive teaching, workshops, discussions, problem solving, seminar paper

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	20	Practical	
Practical training		Written	40
Colloquia		Oral	
Workshops	40		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Chemistry of Solutions

Teachers: Tatijana S. Jovanović, Čakar M. Mira, Popović V. Gordana

Course status: elective

Semester: IV	**Year of studies:** II
ECTS points: 2	**Course code:**

Prerequisite for attending course: General and Inorganic Chemistry, Organic Chemistry 1

Course aims: Acquisition of knowledge about substances dissolution mechanisms (both organic and inorganic), properties of solutions and their use in pharmacy, including acid-base reactions, buffer mixtures, complexation reactions and solubility.

Course outcomes: After successful mastering the course Chemistry of Solutions, a student is expected to be capable to

- Understand general principles of solubility
- Predict solubility of substances in different solvents
- Perform pH selection for organic acids and bases solution in water
- Perform selection and prepare buffer of certain pH value, capacity and ionic force for concrete application
- Implement obtained knowledge on different chemical and pharmaceutical processes

Course contents:

Lectures

General principles of solubility. Dissolution of organic and inorganic substances. Solvent properties and dissolution mechanisms. Dissolution speed of solid substances in liquid solvents. Ideal solubility. Real solutions. Coefficient of solubility. The influence of physicochemical properties of substances on solubility. The influence of temperature and pH on solubility. Nonaqueous solvents. Solvent mixtures. Buffer capacity. Pseudo buffers, just buffers, and buffer mixtures. Universal buffers. Britton Robinson's buffer: composition and preparation protocol. Factors which have influence on buffer selection. Buffers for special applications. Limitations in practical application of buffers.

Practical training

Linkage of theoretical knowledge about dissolution with practical examples. Solving of some problems in real solutions preparation.

Recommended literature:

1. Kotz J, Treichel P. Chemistry and chemical reactivity. 8th ed. Saunders college publishing; 2012.
2. Thomas G. Chemistry for pharmacy and the life sciences. Prentice Hall, 1997.
3. Perrin DD, Dempsey B. Buffers for pH and metal ion control. Chapman and Hall, 1974.

The total of active learning classes

Lectures: 15	**Practical training:** 15

Teaching methods: oral lectures, practical training, discussions, problem solving

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	
Practical training	10	Written	70
Colloquia		Oral	
Seminars	20		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Introduction to Molecular Genetics

Teachers: Biljana M. Potparević, Lada P. Živković

Course status: elective

Semester: IV	**Year of studies: II**
ECTS points: 3	**Course code:**

Requirements: Biology with human genetics

Course aims:

Molecular genetics studies the hereditary phenomena, and their regularities at the molecular level, and determines the mechanisms of genes activity regulation. Course aims are: knowledge and understanding of the central dogma of molecular genetics; knowledge of the mechanisms of genetic material recombination and regulation of the genes expression and basic mechanisms of reparation; knowledge of the basic molecular genetic methods.

Course outcomes:

Upon completion of the course the student is able to: write and explain the chemical composition, structure and function of nucleic acids; understand the universality of genetic code; explain the transfer of genetic information from DNA, to RNA and primary protein structure; be introduced and understand the importance and application of the basic molecular genetics methods.

Course contents:

Lectures

Structure and biological role of nucleic acids. Central dogma of the molecular biology. Genes and genome. Genome expression. Genetic material recombination: homologous recombination, site-specific DNA recombination and transposition. Mutations. DNA molecule reparation. Regulation of prokaryotes and eukaryotes genes expression. Functional genomics. Molecular genetics methods.

Practical classes

Introduction to the basic methods of molecular genetics: isolation of DNA molecule; method of fluorescent *in situ* hybridization – FISH; DNA polymerase chain reaction DNA-PCR; Southern blot; RNA analyses; Northern blot; NPA; RT-PCR; array analyses.

Recommended literature:

1. Matić G, Savić Pavićević D. Molekularna biologija 1. Beograd: NNK Internacional; 2011.
2. Brajušković G. Molekularna biologija 2. Beograd: Savremena administracija; 2012.
3. Papović R, Luković LJ, Novaković: Humana genetika. Beograd: Univerzitet u Beogradu - Medicinski fakultet; 2007.
4. Malacinski ГМ. Essentials of molecular biology. Boston: Jones and Bartlett Publishers; 2005.
5. Craig H, Cohen-Fix O, Green R, Greider C, Storz G, Wolberger C. Molecular Biology: Principles of Genome Functions. Oxford; 2010.

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: lectures, interactive lectures, consultations, practical classes

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	2	Practical	
Practical classes	8	Written	
Colloquia		Oral	60
Seminars	30		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Colloidal Chemistry

Teachers: Pejić D. Nataša, Aleksić M. Mara

Course status: elective

Semester: IV	**Year of studies:** II
ECTS points: 3	**Course code:**

Prerequisite for attending course: none

Course aims: Expand knowledge about properties and behavior of colloidal system , characteristics of natural and synthetic macromolecules, surface-active substances, sol and dispersed systems with the goal of better understanding of the technology and production of medicinal and cosmetic preparations, as well as understanding of different biochemical systems.

Course outcomes: Knowledge of chemistry of colloidal systems, types, structure, properties and behavior of natural and synthetic macromolecules, isolation methods, purification and colloid characterization, as well as fundamental principles of rheology and different techniques of rheological properties determination of pharmaceutical products and biochemical samples.

Course contents:

Lectures

Division and classification of disperse and colloidal-disperse systems. Micellar colloids (colloidal surface-active substances, SAS-structure and activity, solubilization, practical significance of SAS). Stability and coagulation of colloidal systems. Separation of colloids using methods from pharmaceutical practice. Optical properties of colloidal solutions (light dispersion, turbidimetry and nephelometry: principle and application on determination of concentration of disperse systems, determination of micellar concentration and solubilization). Basics of rheology-Newton and non-newton systems (plastic, pseudoplastic and dilatant systems; thixotropic and high-elastic systems). Application of rheologic measurments in pharmacy (rheologic properties of pharmaceutical and cosmetic preparation). Colloids in pharmacy (gels, membranes, emulsions and suspensions).

Practical training

Conductometric determination of critical micellar concentration; Turbidimnetric, determination of casein concentration; Viscosymetric determination of average molecular mass of polymers.

Recommended literature:

1. Pejić N, Aleksić M. Odabrana poglavlja koloidne hemije, Beograd: Farmaceutski fakultet, Univerzitet u Beogradu; 2013.
2. Đaković Lj. Koloidna hemija. Beograd: Zavod za udžbenike i nastavna sredstva; 2006.
3. Đaković Lj, Dokić P. Praktikum koloidne hemije, Beograd: Zavod za udžbenike i nastavna sredstva; 2003.
4. Martin A. Physical Pharmacy. New York: Williams&Wilkins; 1993.
5. Ficher E. Colloidal Dispersion. New York: John Wiley&Sons; 1953.

The total of active learning classes

Lectures: 30	**Practical training:** 15

Teaching methods: lectures, laboratory training, consultations, interactive teaching, student scientific research

Grading system: differnt: oral, writting test, project presentation, seminar papers...

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	10	Practical	
Practical training	30	Written	60
Colloquia		Oral	

Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Selected topics of physiology

Teachers: Plećaš-Solarović A. Bosiljka, Pešić R. Vesna, Nedeljković S. Miodrag

Course status: elective

Semester: IV	**Year of studies: II**
ECTS points: 3	**Course code:**

Requirements: Physiology 1 and Physiology 2

Course aims:

Providing information that may be of interest to the pharmaceutical profession that are not included in the basic course of physiology: physiology of nutrition, physiology of exercise (sport) and physiology of aging. Knowledge in these areas can help students to understand the pathological processes that are associated with them, and their impact on the pharmacotherapy.

Course outcomes:

Upon completion of the course the students are expected to know and understand:

- biological and physiological basis for food intake, physical activity and aging.
- relationship of the regulatory systems of these processes and conditions, related to the functioning of the organism as a whole

Course contents:

Theoretical lectures

Physiology of nutrition: Energy requirements, regulation of food intake, the most common disorders of food intake. Physiology of exercise: changes in various organ systems that occur during intense physical activity. Regulation of the activities of the various organ systems, as well as adaptation of the organism as a whole in such conditions. Physiology of aging: life expectancy, aging and death, the molecular and cellular basis of the phenomenon of aging, theories of aging, the most important physiological changes that occur in certain organs and organ systems. Contemporary strategies to prevent or delay aging process.

Practical classes

Workshops: causes and consequences of food intake disorders, changes in relevant physiological parameters in sportsmen, depending on the type of sport; "anti-aging" methods: achievements and shortcomings.

Recommended literature:

1. Koeppen BM, Stanton BA. Berne & Levy PHYSIOLOGY. 6th ed. Philadelhia: Mosby, Elsevier; 2010.
2. McCorry LK. Essentials of Human Physiology for Pharmacy. 2nd ed. Boca Raton: CRC PRESS, Taylor & Francis Group; 2009.
3. Boron WF, Boulpaep EL. Medical Physiology: A Cellular and Molecular Approach. 2nd ed. New York: Saunders,Elsevier Science; 2009.
4. Timaris PS, editor. Physiological Basis of Aging and Geriatrics. 4th ed. New York: Informa Healthcare; 2007.
5. Aspinall R, editor. Biology of Aging and its Modulation. Dordrecht, Boston, London: Kluwer Academic Publishers; 2004.

The total of active learning classes

Lectures: 30	**Practical classes: 15**

Teaching methods:

Classes are performed in one semester using the following methods:

- theoretical lectures (lectures, PP presentations, interactive teaching)
- practical lectures (workshops and seminars)

• independent student work			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical classes	15	Written	40
Colloquia		Oral	
Seminars	20		
Other activities	20		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmacology 2

Teachers: Ugrešić D. Nenad, Stepanović-Petrović M. Radica, Savić M. Miroslav, Ilić V. Katarina, Novaković N. Aleksandra, Tomić A. Maja

Course status: mandatory

Semester: V	**Year of studies: II**
ECTS points: 6	**Course code:**

Requirements: Physiology 2

Course aims:

To provide students with:

- Knowledge of the mechanisms of drugs action
- Information necessary for understanding the effects of various drugs
- Understanding the therapeutic and side effects of certain groups of drugs
- Knowledge of the principles of therapeutic applications of drugs

Course outcomes:

Upon final examination, the student is expected to be able to:

- Identify mechanisms of various effects of certain groups of drugs
- Connect the therapeutic and side effects of certain groups of drugs with their different pharmacological effects
- Build your own critical attitude towards drug

Course contents:

Lectures

Chemical mediators and the autonomic nervous system. Cholinergic transmission. Noradrenergic transmission. 5-hydroxytryptamine. Purines. Nitrous oxide. Introduction to cardiovascular pharmacology. Calcium channel blockers. Angiotensin-converting enzyme inhibitors and angiotensin receptor antagonists. Diuretics. Drugs in the treatment of heart failure. Drugs in the treatment of ischemic heart disease. Drugs in the treatment of hypertension. Antiarrhythmics. Drugs acting on hemostasis and thrombosis. Drugs that act on the metabolism of lipoproteins. Drugs in the treatment of respiratory diseases.

Practical classes

Computer simulations of learning through discussion of experimental results: The influence of drugs on cholinergic transmission. The influence of drugs on adrenergic transmission. Drugs that modulate the effects of 5-hydroxytryptamine, purines and nitric oxide. Influence of adrenergic and cholinergic agonists and antagonists on blood pressure and heart rate. The effect of drugs on the renin-angiotensin-aldosterone system. The effect of drugs on the isolated heart and blood vessels. The influence of drugs on coronary insufficiency. The influence of drugs on heart failure. The effect of drugs on renal function. The effect of drugs on coagulation. Drugs and thrombotic processes. Drugs and disorders of lipoprotein metabolism. The effect of drugs on the smooth muscle of respiratory system. Antitussives and expectorants.

Recommended literature:

1. Rang HP, Dale MM, Ritter JM, Moore PK. Farmakologija. I srpsko izdanje, prevod V izdanja udžbenika na engleskom. Beograd: Data-status; 2005.
2. Varagić V, Milošević M. Farmakologija. XXII izdanje. Beograd: Elit Medika; 2010.
3. Rang HP, Dale MM, Ritter JM, Flower RJ, Henderson G. Rang and Dale's Pharmacology. 7th edition. London: Churchill Livingstone Elsevier; 2011.
4. Brunton LL, Chabner BA, Knollmann BC, eds. Goodman&Gliman's the Pharmacological Basis of

Therapeutics. 12th editon. New York: McGraw Hill; 2011.
5. Katzung BG, ed. Basic & Clinical Pharmacology. 12th ed. New York: Lange Medical Books, McGraw-Hill Medical Publishing Division; 2012.

The total of active learning classes

Lectures: 45	**Practical classes: 30**

Teaching methods:
Lectures, recorded in vivo and in vitro laboratory experiments on animals, also the use of computer simulation of experiments.

Grading system:

Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical classes	5	Written	
Colloquia	25	Oral	70
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Pathophysiology 2

Teachers: Leposavić M. Gordana

Course status: mandatory

Semester: V	**Year of studies:** III
ECTS points: 5	**Course code:**

Prerequisite for attending course: Physiology 1, Physiology 2, Immunology, Pathophysiology 1

Course aims:

Introducing student to:

- The basic medicinal terms
- The most significant causes and mechanisms of formation of the most important function disorders of some organs (particularly the ones that demand pharmacological therapy), as well as their most significant clinical manifestations (symptoms and signs).

Course outcomes:

Student should:

- Know elementary medical terminology, be capable to understand and adequately present relevant facts
- Understand etiopathogenesis of the most significant function disorders of different organs/systems of organs and their clinical manifestations
- Understand pathobiological basis of mechanism of acting chemical agents and drugs, as well as diagnostics, prevention and pharmacotherapy of the most important diseases.

Course contents:

Lectures

Etiology and pathogenesis of the most important function disorders of cardiovascular system (artery hypertension and hypotension, ischemic heart disease, arrhythmia, heart insufficiency); respiratory system (chronic obstructive pulmonary disease, bronchial asthma, pneumonia, pulmonary embolism and lung edema); digestive tract (GERD, ulcer, diarrhea and obstipation), liver (cirrhosis) and pancreas, as well as endocrine (hypo and hyper function of pituitary, thyroid, adrenal and genital glands) nervous system (cerebrovascular disease, Parkinsonism, epilepsy, anxiety, schizophrenics, bipolar disorders). Pain pathophysiology. Kidney function disorders (acute and chronic kidney insufficiency). Disorders of composition and function of blood (anemia).

Practical training

Etiology, pathogenesis and the most important clinical manifestation of function disorders of: cardiovascular system (artery hypertension, arrhythmia, heart insufficiency); respiratory system (chronic obstructive pulmonary disease, bronchial asthma), digestive tract (ulcer) and liver (insufficiency of liver); endocrine (hypothyreosis, hyperthyreosis, Cushing and Addison syndrome) and nervous system (Parkinsonism, epilepsy, anxiety, schizophrenics, bipolar disorders). Function disorders of kidney (acute and chronic kidney insufficiency). Hypochrome and megaloblastic anemia.

Recommended literature:

1. Leposavić G. Patološka fiziologija za studente farmacije. Beograd: Univerzitet u Beogradu-Farmaceutski fakultet; 2012.
2. Gamulin S, Marušić M, Kovač Z i sur. Patofiziologija. Zagreb: Medicinska naklada; 2011.
3. Živančević-Simonović S. Opšta patološka fiziologija. Kragujevac: Medicinski fakultet u Kragujevcu; 2002.
4. Stošić Z, Borota R. Osnovi kliničke patofiziologije. Novi Sad: Univerzitet u Novom Sadu - Medicinski fakultet; 2012.

5. Kovač Z, Gamulin S i sur. Patofiziologija – Zadaci za problemske seminare. Zagreb: Medicinska naklada; 2006.			
The total of active learning classes:			
Lectures: 30		**Practical training:** 30	
Teaching methods: lectures, problem orientated seminars			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Exercises		Written	70
Colloquia	20	Oral	
Seminars	10		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy	
Course title: Bromatology	
Teachers: Slađana S. Šobajić, Ivan M. Stanković, Brižita I. Đorđević	
Course status: mandatory	
Semester: V	**Year of studies: III**
ECTS points: 4	**Course code:**
Requirements: Organic Chemistry 1, Organic Chemistry 2, General Biochemistry	

Course aims:

Introduction to the fundamental properties of macro- and micronutrients and their physiological and nutritional functions; introduction to the chemical composition of foodstuffs and their potential to fulfill nutritive and energy needs of humans; interactions of vitamins, minerals and medicines; basic information regarding nutritional additives and food contaminants; introduction to dietary products.

Course outcomes:

Upon completion of the course student is trained: to provide information on the appropriate choice of foodstuffs and foodstuffs combinations for various population groups; to be aware of the basic characteristics of the chemical composition and energy values of foodstuffs; to know basic concepts regarding food safety; to recognize the most important interactions of minerals, vitamins and medicines.

Course contents:

Lectures

Bromatology as a scientific discipline – relations to other scientific fields; definition of the food, foodstuffs and nutriments; foodstuffs types; roles of the food; factors influencing the selection of food and bioavailability of nutriments; energy values of foodstuffs; basic nutrients, chemical properties, basic functions in the organism, biological value, requirements for macronutrients, changes in nutriments due to storage and processing of foodstuffs; vitamins and minerals, recommended daily allowances, functions in the organism, factors influencing bio-usability, interactions with medicines; malnutrition caused by imbalance in nutriments intake; biologically active non-nutritive components of foodstuffs; the influence of the thermal treatment on the food nutritive value; types of the foodstuffs according to the purpose for nutrition; tools for combining of foodstuffs and planning of daily nutrition; dietary products, infant formulas, food for young children; additives in food; contamination of food.

Practical classes

Basic techniques and methods used for analysis of foodstuffs and nutriments; fundamental working principles in the laboratory of sanitary chemistry; determination of the chemical composition and energy values of nutriments and dietary products; assessment of the nutritive value of foodstuffs and dietary products.

Recommended literature:

1. Grujić R, Stanković I, Miletić I. Nauka o ishrani čoveka. Knjiga druga. Banja Luka; 2007.
2. Stanimirović S. Bromatologija. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 1990.
3. Đorđević B, Đuričić I, Vidović B. Praktikum iz bromatologije. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2011.
4. HD Belitz, W Grosch. Food Chemistry. 3rd edition. Berlin: Springer; 2004.
5. Izvodi sa predavanja (handouts)

The total of active learning classes	
Lectures: 45	**Practical classes:** 30
Teaching methods: lectures, practical classes	
Grading system:	

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	0-5	Practical	
Practical classes	15	Written	36-70
Colloquia	6-10	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Pharmaceutical Chemistry 3

Teachers: Agbaba D. Danica, Vladimirov M. Sote, Vujić B. Zorica, Nikolić M. Katarina

Course status: mandatory

Semester: V	**Year of studies:** III
ECTS points: 8	**Course code:**

Prerequisite for attending course: Pharmaceutical Chemistry 1

Course aims:

Student is expected to obtain basic knowledge about medicinal and pharmaceutical chemistry of specific drug groups (drug that are clinically significant for the treatment of cardiovascular diseases, diseases of CNS, immunomodulators...). Adopted knowledge from this field is important for mastering courses of medicinal, pharmaceutical-technological group and courses of pharmaceutical practice.

Course outcomes:

Student is expected to be capable to reproduce obtained theoretical and practical knowledge, to do proper selection of essentially important data related to physicochemical properties of medicinal substances of some pharmacotherapeutic group of drugs and also related to chemical aspects: mechanism of action on molecular level, biotransformation reactions, *in vivo* and *in vitro* interactions and drug stability.

Course contents:

Lectures

Lectures include groups of drugs in which is discussed: chemical structures, nomenclature, synthesis, functional groups, physicochemical properties, molecular geometry, eutomers, SAR-studies, stability, potential chemical interactions (drug-receptor, drug-enzyme) on molecular level which is significant for following pharmacotherapeutic drug groups: Drug which have effect on CNS, antipsychotics, anxiolytics, antidepressants, antiemetics, antimigrenics, gastroprocinetics, hypnotics, antiepileptics, general anesthetics, analeptics, nootropics, psychomotoric stimulators, cholinergics, anticholinergics, antiparkinsonics, neuromuscular blockers, opioid analgesics, local anesthetics; Drugs that act on modulation of inflammation mediators (histamine, prostaglandins, leukotriens, troboxane, interleukins): antiallergics, antiulcer drugs, analgesic-antipyretics and nonsteroidal antirheumatics (selective and nonselective COX-inhibitors); Drugs which have effect on cardiovascular system: adrenergics (α and β receptors, biosynthesis, metabolism and stereochemistry of catecholamine, agonists/antagonists of α receptors, agonists/antagonists of β receptors, β_2-selective agonists, atiarytmics, Ca-channel agonists, vasodilatators (coronary and periphery vasodilators); cardiotonic glycosides, diuretics. Antihypertensive agents: ACE inhibitors, AT1-antagonists, β-blockers and others, antihyperlipoproteinemics, HMG-CoA reductase inhibitors, anticoagulant drugs, thrombolytics.

Practical training

Physicochemical testing of selected pharmaceutical substances: identification, related substances and degradation products, methods according to EP 7. Case study analysis.

Recommended literature:

1. Foye's Principles of Medicinal Chemistry. 7th ed. Williams DA, Lemke TL, editors. Baltimore: Lippincott Williams & Wilkins; 2013.
2. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry. 12th ed. Beale JM, Block JH, editors. Philadelphia: Lippincott Williams & Wilkins; 2011.
3. Radulović D, Vladimirov S. Farmaceutska hemija I. Beograd; 2005.
4. Europeen Pharmacopoeia. 7th Edition. Strasbourg: Council of Europe; 2010.

The total of active learning classes			
Lectures: 60		**Practical training:** 60	
Teaching methods: oral lectures, interactive teaching, laboratory practice			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical training	30	Written	60
Colloquia		Oral	10
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Statistics in Pharmacy

Teachers: Spasić M. Slavica, Bogavac-Stanojević B. Nataša, Kotur-Stevuljević M. Jelena

Course status: mandatory

Semester: V	**Year of studies: III**
ECTS points: 3	**Course code:**

Requirements: Mathematics

Course aims:

Introduction of students to the terminology used in statistics; methods for collection, organization and analysis of the data; simple statistical methods and interpretation of the obtained results; application of statistical tests on examples from the medical biochemistry; usage of the statistical package.

Course outcomes:

Upon completion of the theoretical and practical parts of the course, student is able: to correctly select the sample and collect the data; to choose the appropriate statistical method for analysis of the data; to interpret the obtained results; to competently use MS Excel and the statistical package.

Course contents:

Lectures

Statistical terminology. Population and sample. Variables and data. Editing of the data. Graphic representation and tabular representation of the data. Measures of central tendency. Measures of deviations. Normal distribution. Standard normal distribution. Calculation of the area under the normal curve. Hypothesis testing. Type I and type II errors. P-value. One and two-tailed student t test. Variance ratio test. Analysis of variance. Analysis of variance for one classification criterion. Analysis of variance for two classification criteria. Linear regression analysis. Regression equation. Correlation analysis. Coefficient of correlation. Coefficient of determination. Standard error deviation in regression analysis. Application of regression analysis for predictions. Nonparametric methods. Nonparametric t-test (Mann-Whitney U-test). Nonparametric variance analysis. Nonparametric correlation. Chi-square test. Test of agreement. Independency test. Homogeneity test. Confidence interval of predicted values.

Practical classes

Application of statistical test on examples from the medical biochemistry using the statistical packages.

Recommended literature:

1. Sheskin DJ. Handbook of parametric and nonparametric statistical procedures. Chapman & Hall/CRC, Washington, D.C., 2000.
2. Daniel, WW. Biostatistics, A foundation for analysis in the health sciences, J. Whiley and Sons, New York, USA, 1995.
3. unauthorized script, lectures materials, internet web-pages

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: lectures, usage of the statistical package, case studies (from the medical biochemistry), usage of internet and the library, e-learning

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	
Practical classes	15	Written	70

Colloquia	15	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmacognosy

Teachers: Kovačević N. Nada, Petrović D. Silvana, Maksimović A. Zoran, Kundaković D. Tatjana, Drobac M. Milica

Course status: mandatory

Semester: V and VI	**Year of studies: III**
ECTS points: 9	**Course code:**

Requirements: Botany, Organic chemistry 2, Physiology 2

Course aims:

Gathering knowledge on pharmacologically active compounds of plants and animals (chemical and physical properties, distribution, and biological activity, qualitative and quantitative analysis, principles of isolation and chemical characterization) and herbal raw materials - drugs and drug preparations (morphological, anatomical properties, chemical ingredients, method of preparation, identification, quality testing, activity and application).

Course outcomes:

Student is aware of the natural herbal medicines (drugs and drug preparation) that are used to isolate the ingredients for the pharmaceutical industry, and the development of herbal medicinal products; is able to perform qualitative and quantitative analysis of their constituents, define and perfom the procedure of extraction and separation of ingredients in the laboratory; is qualified to perform identification and test the quality of drugs and drug products; is familiar with their pharmacological principle of action and application; is qualified to participate in the design, organization and management of the production process and quality assurance of drugs and drug preparations.

Course contents:

Lectures

Definition of natural herbal medicines (drugs and drug preparations), the history of their application. Primary and secondary metabolism of plants. Secondary plant metabolites: classification, chemical and physical properties, distribution and biological activity, qualitative and quantitative analysis, principles of isolation and chemical characterization. Classification of herbal drugs based on chemical structure, biosynthetic origin and pharmacological activity of the active ingredients. Production, quality parameters and quality control of herbal drugs and herbal drug preparations. The most important herbal raw materials (drugs) that are used to isolate the ingredients used in the pharmaceutical industry. The most important herbal drugs and herbal drug preparations that are used for the production of herbal medicines and other products for health improvement (biological source, definition, description, morphological, anatomical and chemical characteristics, pharmacological effects and application).

Practical classes

Identification and testing of herbal drugs and herbal drug preparations. Macroscopic and microscopic features of herbal drugs. Qualitative and quantitative chemical analysis of herbal drugs and herbal drug preparation according to procedures prescribed in modern pharmacopoeias and other applicable regulations for herbal raw materials.

Recommended literature:

1. Kovačević N. Osnovi farmakognozije. Beograd: Srpska školska knjiga; 2002.
2. Evans WC. Trease and Evans Pharmacognosy. 16th ed. Edinburgh, London, New York, Philadelphia, St Louis, Sydney, Toronto: Elsevier; 2009.
3. Haensel R, Sticher O. Pharmakognosie-Phytopharmazie. Heidelberg: Springer-Medizin Verlag; 2007.

4. Petrović S, Maksimović Z, Kundaković T. Analiza sastojaka biljnih droga. Priručnik za teorijsku i praktičnu nastavu iz predmeta Farmakognozija. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2009. 5. Petrović S, Maksimović Z, Kundaković T. Analiza sastojaka biljnih droga. Radna sveska za praktičnu nastavu iz predmeta Farmakognozija. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2009.			
The total of active learning classes			
Lectures: 75		**Practical classes:** 60	
Teaching methods: lectures, interactive lectures, practical classes			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical classes	10	Written	65
Colloquia	20	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmacology 3

Teachers: Ugrešić D. Nenad, Stepanović-Petrović M. Radica, Savić M. Miroslav, Ilić V. Katarina, Novaković N. Aleksandra, Tomić A. Maja

Course status: mandatory

Semester: VI	**Year of studies: III**
ECTS points: 5	**Course code:**

Requirements: Pharmacology 2

Course aims:

To provide students with:

- Knowledge of the mechanisms of drugs action
- Information necessary for understanding the effects of various drugs
- Understanding the therapeutic and side effects of certain groups of drugs
- Knowledge of the principles of therapeutic applications of drugs

Course outcomes:

Upon final examination, the student is expected to be able to:

- Identify mechanisms of various effects of certain groups of drugs
- Connect the therapeutic and side effects of certain groups of drugs with their different pharmacological effects
- Build your own critical attitude towards drug

Course contents:

Lectures

Introduction to Pharmacology of the central nervous system. Chemical transmission and the effect of drugs on the central nervous system. Amino acid transmitters. Other transmitters and modulators. Depressants of the central nervous system. Anxiolytics and hypnotic drugs. Antipsychotics. Antidepressants. Stimulants of the central nervous system and psychotomimetics. Dependence and addiction. Analgesics. Anticonvulsant. Drugs in the treatment of neurodegenerative diseases. Drugs in anesthesiology. General anesthetics. Myorelaxants. Local anesthetics. Pharmacology of the endocrine system. Drugs that act on the hypothalamus, pituitary, and adrenal gland. Drugs that affect the thyroid gland. Insulin, diabetes mellitus and antidiabetics. Drugs that affect the reproductive system. Drugs acting on the gastrointestinal system. Ophthalmic drugs. Dermatological drugs.

Practical classes

Computer simulations and learning through discussion of experimental results: Pharmacology of the central nervous system. Behavioral pharmacology. Analgesics. Convulsants and anticonvulsants. Anesthetics and myorelaxants. The effect of drugs on hyperglycemia and hypoglycemia. The effect of drugs on the smooth muscles of gastrointestinal system. The effect of drugs on the uterus.

Recommended literature:

1. Rang HP, Dale MM, Ritter JM, Moore PK. Farmakologija. I srpsko izdanje, prevod V izdanja udžbenika na engleskom. Beograd: Data-status; 2005.
2. Varagić V, Milošević M. Farmakologija. XXII izdanje. Beograd: Elit Medika; 2010.
3. Rang HP, Dale MM, Ritter JM, Flower RJ, Henderson G. Rang and Dale's Pharmacology. 7th edition. London: Churchill Livingstone Elsevier; 2011.
4. Brunton LL, Chabner BA, Knollmann BC, eds. Goodman&Gliman's the Pharmacological Basis of Therapeutics. 12th editon. New York: McGraw Hill; 2011.
5. Katzung BG, ed. Basic & Clinical Pharmacology. 12th ed. New York: Lange Medical Books, McGraw-Hill Medical Publishing Division; 2012.

The total of active learning classes			
Lectures: 45		**Practical classes: 15**	
Teaching methods: Lectures, recorded *in vivo* and *in vitro* laboratory experiments on animals, also the use of computer simulation of experiments.			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical classes	5	Written	
Colloquia	25	Oral	70
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Medicinal Biochemistry

Teachers: Topić S. Aleksandra, Mirković S. Duško

Course status: mandatory

Semester: VI	**Year of studies:** III
ECTS points: 7	**Course code:**

Prerequisite for attending course: General Biochemistry

Course aims:

Introducing to the role of medicinal biochemistry in pharmacy (clinical studies, selection and drug dosage, therapy monitoring, interference of drugs to biochemical markers, discovery of side effects);introducing to metabolism of carbohydrates, proteins, lipids, water and electrolytes, as well as their disorders; introducing to basic biochemical markers (their determination and clinical significance in diagnostics).

Course outcomes:

Understanding of biomarkers characteristics and their use in rational therapy conductance. Understanding of biochemical laboratory role in diagnostics, monitoring and treatment of disease; Understanding of composition of biological material in healthy people, in specific physiological conditions and in some diseases. Capability of giving relevant information related to interpretation of results obtained by analyzing biological material.

Course contents:

Lectures

Metabolism and basic principles of metabolism regulation of carbohydrates, proteins, lipids, iron, water and electrolytes (sodium, potassium, chloride, calcium, magnesium and phosphate. Laboratory diagnostics and diabetes monitoring and other carbohydrate metabolic disorders. Characteristics and clinical significance of the most important plasma proteins. Lipid metabolism disorders, dyslipidemia diagnostics and risk factors for atherosclerosis. Metabolism disorders of water, electrolytes, and acidic-alkali equilibrium. Diagnostics of metabolic disorders of calcium, phosphates and magnesium. Parameters for iron status testing. Hemoglobin metabolism and characteristics of hemoglobinopathies. Use of biochemical tests for examination kidney, liver and gastrointestinal tract functions. Diagnostic significance of determination of enzyme activity. Diagnostics of the most important disorders of endocrine glandule function.

Practical training

Laboratory training. Introducing to characteristics of biological material and sources of preanalytical and analytical mistakes. Quantitative determination of following biochemical parameters in appropriate biological material (serum, urine, blood): glucose, total proteins, hemoglobin, bilirubin, urea, creatinine, uric acid and enzymatic activity determination. Chemical examination of urine and urine sediment. Workshops and seminar papers. Students will in small groups elaborate certain themes, solve problems and case studies, and present their work.

Recommended literature:

1. Spasić S, Jelić-Ivanović Z i Spasojević-Kalimanovska V. Medicinska biohemija. Beograd; 2004.
2. Majkić-Singh N. Medicinska biohemija. DMBSCG: Beograd; 2006.
3. Spasić S, Jelić-Ivanović Z i Spasojević-Kalimanovska V. Praktikum iz medicinske biohemije. Farmaceutski fakultet Beograd; 2005.
4. Murray RK, Granner DK, Rodwell VW. Harper's Illustrated Biochemistry. 27th ed, New York: McGraw-Hill Companies; 2006.
5. Lieberman M, Marks AD, Smith C. Marksove osnove medicinske biohemije-klinički pristup. Beograd: Data Status; 2008.

The total of active learning classes			
Lectures: 60		**Practical training:** 45	
Teaching methods: oral lectures, interactive teaching, laboratory training, discussions and case study analysis, using of library and internet			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical training	15-30	Written	36-70
Colloquia		Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmaceutical Technology 1

Teachers: Vuleta M. Gordana, Milić R. Jela, Primorac M. Marija, Savić D. Snežana, Vasiljević D. Dragana

Course status: mandatory

Semester: VI	**Year of studies: III**
ECTS points: 9	**Course code:**

Requirements: Physical Chemistry, Introduction to Pharmacy

Course aims:

Introduction to the principles of formulation, compounding or manufacturing methods and pharmaceutical technical procedures for various dosage forms (oral powders and powders for cutaneous application; granules; solutions, suspensions and emulsions for oral use and cutaneous application, or to applied in ears, nose or oral cavity; ointments, gels, creams, medicated plasters) and homeopathic preparations; training for the extemporaneous compounding and quality testing of the prepared products; teaching of the usage of the professional references; selection of the optimal dosage form, its storage and applications.

Course outcomes:

Student is aware of the types, properties and roles of the various excipients in pharmaceutical dosage forms; is familiar with the types, properties, compounding or manufacturing methods and pharmaceutical technical procedures for various dosage forms (oral powders and powders for cutaneous application; granules; solutions, suspensions and emulsions for oral use and cutaneous application, or to applied in ears, nose or oral cavity; ointments, gels, creams, medicated plasters) and homeopathic preparations; and is capable to independently use the professional references in order to formulate and compound/manufacture the appropriate dosage form or homeopathic preparation.

Course contents:

Lectures

Course structure, importance and general definitions. Pharmaceutical dosage forms. Types, basic properties and roles of the excipients/formulation aids in the formulation of various dosage forms. Surface active agents as pharmaceutical excipients: physicochemical properties. Theories of stabilization of suspension and emulsion disperse systems. Types, properties, compounding, pharmaceutical technical procedures and biopharmaceutical characterization of dosage forms according to the dispersion level, consistency and routes of application: oral powders and powders for cutaneous application; granules; solutions, suspensions and emulsions for oral use and cutaneous application; nasal preparations; ear preparations; oromucosal preparations; semisolid preparations for cutaneous application – ointments, gels, creams, medicated plasters, etc. Extracts and tinctures; application of extracts in pharmaceutical preparations. Homeopathic preparations. Rheological properties of pharmaceutical preparations.

Practical classes

Pharmacopoeias, national formularies and pharmacopeial supplements; medicines registries and other professional references in the pharmacy. Pharmacy – requirements for the space, equipment, employees, and the work management. Introduction to the regulations regarding compounding, storage and dispensing of pharmaceutical preparations. Prescription and parts of prescription. Dosing of active ingredients and checking of the dosage correctness. Types, properties, compounding, pharmaceutical technical procedures and biopharmaceutical characterization of oral powders and powders for cutaneous application; granules; solutions, suspensions and emulsions for oral use and cutaneous application; nasal preparations; ear preparations; oromucosal preparations;

semisolid preparations for cutaneous application – ointments, gels, creams and homeopathic preparations. Pharmaceutical calculations in the pharmacy. Good pharmacy practice – standards in compounding and dispensing of pharmaceutical preparations.

Recommended literature:

1. Vuleta G, Milić J, Primorac M, Savić S. Farmaceutska tehnologija I. (textbook). Beograd: Univerzitet u Beogradu, Farmaceutski fakultet; 2012.
2. Vasiljević D, Krajišnik D, Grbić S, Đekić Lj. Farmaceutska tehnologija I. (practical coursebook). Beograd: Univerzitet u Beogradu, Farmaceutski fakultet; 2012.
3. Remington: The Science and Practice of Pharmacy. 22nd ed. , London: Pharmaceutical Press; 2012.
4. Swarbrick J, Boylan JC. Encyclopedia of Pharmaceutical Technology. New York, Basel: Marcel Dekker Inc; 2002.
5. Voigt R. Pharmazeutische Technologie, Stuttgart: Deutscher Apotheker Verlag; 2006.

The total of active learning classes

Lectures: 45	**Practical classes:** 105

Teaching methods: lectures, interactive lectures, practical classes, problem based teaching

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	0 or 3	Practical	
Practical classes	3-6	Written	20-40
Colloquia	34-51	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Bromatology Practicum

Teachers: Slađana S. Šobajić, Ivan M. Stanković, Brižita I. Đorđević

Course status: elective

Semester: VI	**Year of studies: III**
ECTS points: 2	**Course code:**

Requirements: Bromatology

Course aims:

Introduction to the requirements of the national regulations, control requirements and the methods used for the assessment of the quality and safety of foodstuffs and dietary products. Introduction to the specificity of working with food as an analytical matrix.

Course outcomes:

Upon completion of practical classes, the student is trained to apply the basic analytical methods for the assessment of quality and safety of certain categories of foodstuffs, and to compare them with the requirements of the respective national legal regulations.

Course contents:

Practical classes

Methods for determination of the foodstuffs quality – analysis of selected carbohydrates and proteins, analysis and identification of fats and oils; methods used for determination of the biologically nonnutritive food ingredients; methods for determination of the food additives and chemical contaminants of food and drinking water; methods for determination of the naturally harmful food ingredients (histamine, allergens).

Recommended literature:

1. Đorđević B, Đuričić I, Vidović B. Praktikum iz bromatologije. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2011.
2. Trajković J, Mirić M, Baras J, Šiler S. Analiza životnih namirnica. Beograd: Univerzitet u Beogradu-Tehnološko-metalurški fakultet; 1983.
3. Nielson S. Food analysis. Third Edition. New York: Kluwer Academic, Plenum Publishers; 2003.

The total of active learning classes

Lectures: 0	**Practical classes:** 30

Teaching methods: laboratory practical classes

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	
Practical classes	70	Written	30
Colloquia		Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmacognosy Practicum

Teachers: Kovačević N. Nada, Petrović D. Silvana, Maksimović A. Zoran, Kundaković D. Tatjana, Drobac M. Milica

Course status: elective

Semester: VI	**Year of studies: III**
ECTS points: 2	**Course code:**

Requirements: none

Course aims:

Training of students for the independent application of methods of quality control of herbal raw materials (drugs and drug preparations) in selected assignments, analysis and interpretation of the obtained results.

Course outcomes:

Student is capable to independently perform quality control of herbal raw materials, to solve specific assignment, to write a protocol and report on performed tests and to present the obtained results.

Course contents:

Practical classes

Definition of professional/scientific problem, definition of an approach to solve this problem, selection of the necessary experimental methods, review and usage of the available professional and scientific references related to the assigned problem; individual/team work on solving the assigned problem.

Identification of the herbal raw material; quality control of the herbal material according to pharmacopeial specifications; solving of assignment related to the analysis of the herbal material; review of the current references; writing of a protocol and report upon testing of the material; discussion of the obtained results in respect to pharmacopeial specifications or other relevant references; preparation of the seminar, report and/or submission of an abstract for the student scientific project and presentation of the obtained results.

Recommended literature:

1. Petrović S, Maksimović Z, Kundaković T. Analiza sastojaka biljnih droga. Priručnik za teorijsku i praktičnu nastavu iz predmeta Farmakognozija. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2009.
2. Petrović S, Maksimović Z, Kundaković T. Analiza sastojaka biljnih droga. Radna sveska za praktičnu nastavu iz predmeta Farmakognozija. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2009.
3. Ph. Eur. 7. Strasbourg: The Council of Europe; 2011.

The total of active learning classes

Lectures: 0	**Practical classes:** 30

Teaching methods: introductory lecture, practical work, literature review, preparation of the seminar, report and/or submission of an abstract for the student scientific project

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	
Practical classes	30-70	Written	21-30
Colloquia		Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Selected Chapters of Microbiology

Teachers: Jelena A. Stanković, Marina T. Milenković

Course status: elective

Semester: VI	**Year of studies: III**
ECTS points: 2	**Course code:**

Requirements: Microbiology

Course aims:

Acquisition of knowledge of microorganisms representing contaminants in pharmaceutical industry; gathering knowledge of prevention methods and monitoring of microbial contamination, application of microorganisms in pharmaceutical industry (production of antibiotics, vitamins, amino-acids and enzymes); methods of recombination technology and application of microorganisms as biological vectors in vaccines production.

Course outcomes:

Upon completion of the course the student will gain knowledge related to the properties of microorganisms being significant for contamination in the pharmaceutical industry; be aware of principles, monitoring methods and control of microbial contamination; gain knowledge of application of microorganisms in the pharmaceutical industry, production of vaccines and biological assays.

Course contents:

Lectures

Introduction to pharmaceutical microbiology. Ecology of microorganisms: microorganisms from the air, water and ingredients. Physiological microflora and its role in the contamination of the pharmaceutical products. Hygienic standards in the pharmaceutical industry. Hygienic standards in the healthcare institutions. Sterilization methods. Disinfectants and antiseptics. Sterile pharmaceutical products. Methods of isolation and identification of microorganisms (classic and rapid tests). Evaluation of antimicrobial agents in laboratory environment. Antibiotic resistance: sources and mechanisms. Pharmaceutical biotechnology. Application of microorganisms in production of antibiotics, hormones and vitamins. Vaccines. Application of microorganisms in recombinant technology.

Practical classes

Microbiological testing of pharmaceutical products (sterility and microbial purity). Preparation of samples. Inoculation of samples into culture media. Reading of the results. Interpretation of the results. Writing of the report.

Recommended literature:

1. Black J.G. Microbiology, Principless and Explorations. 7th Edition. Asia: John Wiley&Sons;2008.
2. 5. Jugoslovenska farmakopeja. Beograd: Savezni zavod za zaštitu i unapređenje zdravlja, Savremena administracija; 2000.
3. Glayer AN, Nikaido H. Microbial Biotechnology. Second Edition. San Francisco: Cambridge University; 2007.
4. Hugo WB, Rusell AD. Pharmaceutical Microbiology. Seventh edition. San Francisco: Blackwell Publishing; 2004.
5. Tatora GJ, Funke BR, Case CL. Microbiology an Introduction. Eight Edition. San Francisco: Pearson Benjamin Cummings; 2004.

The total of active learning classes

Lectures: 15	**Practical classes:** 15

Teaching methods: lectures, practical classes

Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	25
Practical classes	20	Written	50
Colloquia		Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Medical terminology

Teachers: Leposavić M. Gordana, Mirić M. Milica

Course status: elective

Semester: VI	**Year of studies: III**
ECTS points: 2	**Course code:**

Requirements: Pathophysiology 1

Course aims:

To enable students to:

- with other health care professionals communicate verbally and in writing using appropriate complex terminology and to fully understand the information that is presented to him;
- deepen the understanding of the major pathological disorders, their clinical manifestations, basic diagnostic and therapeutic approaches.

Course outcomes:

Student will improve his knowledge of medical terminology and in parallel, their knowledge of macro and microanatomy of human body, basic pathology and clinical manifestations of major diseases, as well as basic diagnostic and therapeutic procedures related to them.

Course contents:

Theoretical lectures

Basic information related to the structure and types of medical terms: root words, suffixes and prefixes, eponyms, significant abbreviations/acronyms, synonyms, antonyms. Professional terminology used to describe the anatomical position and relations. Professional terminology which contain a description of the most important pathoanatomical and pathophysiological as well as laboratory and clinical phenomena, basic diagnostic and therapeutic procedures related to the most common and important diseases of the cardiovascular and respiratory system, gastrointestinal tract, liver, pancreas, kidneys, urinary tract, and nerve (motor and sensory disturbances, disturbances of consciousness, psychiatric diseases), and musculoskeletal system.

Practical classes

Workshops through which, using specific examples, students will learn how to use technical terminology, for describing the most important pathoanatomical, pathophysiological, and also, clinical and laboratory phenomena, natural diagnostic and therapeutic procedures related to the most common and important diseases of the cardiovascular and respiratory system, gastrointestinal tract, liver, kidneys, nerves (motor and sensory disturbances, disturbances of consciousness, psychiatric diseases), and musculoskeletal system.

Recommended literature:

1. Leposavić G. Patološka fiziologija za studente farmacije. Beograd: Univerzitet u Beogradu Farmaceutski fakultet; 2012.
2. Stošić Z, Borota R. Osnovi kliničke patofiziologije. Novi Sad: Univerzitet u Novom Sadu Medi cinski fakultet; 2012.
3. Enrlich A, Schroeder CL. Medical Terminology for Health Professions. VII edition. New York: Delmare Learning; 2011.
4. Jones BD. Comprenhensive Medical Terminology. IV Edition. New York: Delmar; 2011.
5. Chabner DE. Medical Terminology: A Short Course. 5th Edition. Amsterdam: Elsevier Science Health Science Division; 2008.

The total of active learning classes

Lectures: 15		**Practical classes: 15**	
Teaching methods: Interactive lectures, workshops			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical classes		Written	30
Colloquia		Oral	
Seminars			
Other activities	70		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Medicinal plants and environment

Teachers: Jančić B. Radiša, Lakušić S. Branislava, Slavkovska N. Violeta

Course status: elective

Semester: VI	**Year of studies: III**
ECTS points: 2	**Course code:**

Requirements: Botany

Course aims:

Introduction to fundamental concepts in ecology, processes and importance of biodiversity. Elucidation of the effects of environmental factors on the distribution of medicinal plants and the quantity and quality of their secondary metabolites (essential oils, flavonoids, alkaloids). Introduction to the impact of biodiversity exploitation on the environment and human health. Basics of sustainable exploitation of self-seeding medicinal plants in Serbia.

Course outcomes:

Understanding the importance of biodiversity in public health and the significance of the influence of ecological factors on medicinal plants. Student is aware of potentials of natural resources of indigenous self-seeding medicinal plants in Serbia and understands the importance of preserving natural resources and environment; understands the negative effects of anthropogenic factors being the threat to individual species and biodiversity in general.

Course contents:

Lectures

Ecology, topic definition, division and relation to other sciences. Difference between the ecology and protection of the environment. Basic concepts in ecology: environment, habitat, ecosystem and vegetation. Biogeochemical processes in the nature. Importance of the knowledge of basic ecological principles for future pharmacists. Biodiversity: the essential and the potential importance of different levels of biodiversity - genetic, of species, of population, biodiversity and health. Natural resources: diversity of native flora, indigenous officinal and potentially applicable medicinal and aromatic species, endemic species, status of self-seeding populations, the causes of vulnerability. Protection of biodiversity: scientific, legal and practical advantages and disadvantages. Sustainable use of self-seeding plants. Monitoring.

Recommended literature:

1. Jančić R, Lakušić B, Slavkovska V. Lekovite biljke i životna sredina za studente Farmaceutskog fakulteta. Predavanja (nerecenzirana skripta); 2011.
2. Jančić R, Stojanović D. Ekonomska botanika. Beograd: Zavod za izdavanje udžbenika; 2008.
3. Jovanović S, Lakušić D. (ur.) Ugrožene biljke Srbije. Beograd: Univerzitet u Beogradu - Biološki fakultet i IP NNK Internacional; 2006.
4. Medicinal Plant Specialist Group. International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP) Version 1.0. Bon: Bundesamt für Naturschutz (BfN), Federal Agency for Nature Conservation; 2007.

The total of active learning classes

Lectures: 15	**Practical classes:** 15

Teaching methods: lectures and practical classes

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	0-10	Practical	
Practical classes	20	Written	
Colloquia		Oral	70

Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Foreign Language of Academic and Professional Communication - English

Teachers: Kerničan N. Leontina

Course status: elective

Semester: VI	**Year of studies: III**
ECTS points: 2	**Course code:**

Requirements: none

Course aims:

- Development of the ability to structurally reconstruct text (abstract, synthesis)
- Acquisition of phrases and forms necessary for the professional communication
- Mastering of the oral and written expressions at the level of academic and professional communication

Course outcomes: Student will be able to:

- Apply the gained knowledge in the professional environment
- Create the necessary written forms, depending of the needs of profession
- Organize the speech patterns adapted to the professional environment

Course contents:

Lectures

Abstract and synthesis – properties, the way of writing. CV – basic characteristics, models, elements, writing rules. Motivational letter – the purpose, properties and elements. Professional correspondence – elements of the business letter, an application for employment, response to a formal letter, searching for information. Presentation and oral exposition. Job interview. Professional phone communication.

Practical classes

Structural reconstruction of the text towards abstract and synthesis. Preparation of CV. Writing a motivation letter. Writing of the business letter based on the presented elements. Oral presentations on selected topics of the pharmaceutical profession. Simulation of the oral professional communication.

Recommended literature:

1. Villemaire D, Villemaire L. Grammar & Writing Skills for the Health Professional. 2nd edition. Thomson Delmar Learning; 2005.
2. Leki I. Academic Writing. 2nd edition. Cambridge University Press; 2007.
3. Kerničan L. English Language in Pharmacy Practice. Zbirka tekstova sa vežbanjima na engleskom jeziku. treće dopunjeno izdanje. 2011.
4. Marion Field. Improving Your Written English. 3rd edition. How To Books Ltd. 2001
5. Ursache I. Get Ready for Academic Writing. izdavačka kuća Polirom, 2007.

The total of active learning classes

Lectures: 15	**Practical classes:** 15

Teaching methods:

interactive lectures, group work, simulations, individual assignments

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	5-10	Practical	
Practical classes		Written	15-30
Colloquia		Oral	15-30
Seminars	15-30		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Foreign Language of Academic and Professional Communication - French

Teachers: Mirić M. Milica

Course status: elective

Semester: VI	**Year of studies: III**
ECTS points: 2	**Course code:**

Requirements: none

Course aims: Acquisition of phrases and forms necessary for the professional communication, mastering of the oral and written expressions at the level of academic and professional communication, development of the ability to structurally reconstruct text.

Course outcomes: Upon the course completion, the student will be able: to actively apply the obtained knowledge regarding professional development, to create the appropriate written/oral forms that are in accordance with the professional requirements, and to organize the speech patterns adapted to the professional environment.

Course contents:

Lectures

CV – basic properties, models, elements, writing rules. Motivational letter – purpose, properties and elements. Business correspondence – job application, elements of the business letter, writing a response to an official letter. Job interview. Presentation and oral exposition. Abstract and synthesis – properties, writing styles.

Practical classes

CV preparation. Writing of a motivational letter. Writing of a business letter on the basis of presented elements. Job interview simulation. Oral presentations on selected topics of the pharmaceutical profession. Practical classes on structural reconstruction of the text towards abstract and synthesis.

Recommended literature:

1. Mirić M. Francuski jezik u akademskoj i profesionalnoj komunikaciji, nerecenzirana skripta.
2. Penfornis JL. Vocabulaire Progressif des affaires, 200 Exercices, Collection: Progressive. Paris: CLE International; 2004.
3. Exemples de C.V. et quelques conseils. ANPE avec le soutien du Fonds Social Européen; dostupno na: http://www.metiersducommerce.fr/pdf/exemples_de_cv-2.pdf.
4. Exemples de lettres de motivation. Réponses à des annonces et candidatures spontanées. ANPE avec le soutien du Fonds Social Européen; dostupno na: http://www.metiersducommerce.fr/pdf/exemples_de_lettres_de_motivation-2.pdf
5. Jovanović AS. Savremeni fracusko-srpski rečnik sa gramatikom. Beograd: Prosveta; 2005.

The total of active learning classes

Lectures: 15	**Practical classes:** 15

Teaching methods:

interactive lectures, group work, simulations, individual assignments

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	0-5	Practical	
Practical classes	0-30	Written	15-30
Colloquia		Oral	
Seminars			
Other activities	0-30		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Pharmacotherapy

Teachers: Ugrešić D. Nenad, Stepanović-Petrović M. Radica, Savić M. Miroslav, Ilić V. Katarina, Novaković N. Aleksandra, Tomić A. Maja

Course status: mandatory

Semester: VII and VIII	**Year of studies:** IV
ECTS points: 9	**Course code:**

Prerequisite for attending course: Pathophysiology 1, Pathophysiology 2, Pharmacology 1, pharmacology 2, Pharmacology 3

Course aims:

To offer to student:

- Information necessary for recapitulation certain disease and understanding of appropriate therapeutic possibilities
- Knowledge necessary for critical evaluation of signs and symptoms of certain diseases
- Modern proofs about efficiency and safety of drugs used in certain diseases
- Knowledge necessary for critical evaluation of drugs and giving advise to the patient in pharmacy related to proper drug administration and drug side effects

Course outcomes:

After passed exam, student is expected to be capable to:

- Understand and differ pathophysiology, clinical picture, clinical flow, prognosis and pharmacological and nonpharmacological treatment of different diseases
- Compare therapeutic effect/potential of causing side effects relationship of some drugs meant for the same disease
- Present patients and health officers facts based information or advice about drug use.

Course contents:

Lectures

Pharmacotherapy of cardiovascular diseases (artery hypertension, dyslipidemia, ischemic heart disease, arrhythmia, heart insufficiency, anemia, blood coagulation disorders). Pharmacotherapy of respiratory diseases (chronic obstructive pulmonary disease, bronchial asthma, pneumonia, infections of upper respiratory tract, allergic rhinitis, tuberculosis). Pharmacotherapy of digestive tract diseases (peptic ulcer, gastroezophageal reflux, inflammatory bowel disease, nausea, vomiting, diarrhea and constipation). Pharmacotherapy of urinary tract diseases. Pharmacotherapy of neural diseases (epilepsy, neurodegenerative diseases, pain and headache). Pharmacotherapy of psychiatric diseases (affective, psychotic and anxiety disorders, sleep disorders, disorders caused by abuse of psychoactive substances). Pharmacotherapy of endocrine diseases and metabolism diseases (diabetes, hormone contraceptives and hormonal substitution therapy). Pharmacotherapy of diseases of musculoskeletal system (osteoporosis and rheumatic diseases). Pharmacotherapy of skin diseases. Pharmacotherapy of infective and oncological diseases (HIV, viral hepatitis, fungal infections, breast cancer).

Practical training

Case study analysis (pathophysiology of disease, clinical picture, clinical flow and disease prognosis, pharmacological and nonpharmacological measures according to current guidelines) with themes of cardiovascular diseases, respiratory diseases, digestive tract diseases, neural diseases, urinary tract diseases, neurological and psychiatric diseases, endocrine diseases and metabolism diseases, diseases of musculoskeletal system, skin diseases, infective and oncological diseases.

Recommended literature:

1. Ugrešić N, Stepanović-Petrović R, Savić M. Farmakoterapija za farmaceute. 1. izdanje. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2011.
2. Ugrešić N. Farmakoterapijski vodič 5. Beograd: Agencija za lekove i medicinska sredstva Srbije; 2011.
3. DiPiro JT, Talbert RL, Yee GC, Matzke GR, Wells BG, Posey LM. Pharmacotherapy: A Pathophysiologic Approach. 8th ed. New York: The McGraw-Hill Companies Inc.; 2011.
4. Koda-Kimble and Young's Applied Therapeutics: The Clinical Use of Drugs**.** 10th ed. Philadelphia: Wolters Kluwer, Lippincott Williams & Wilkins, 2012.

The total of active learning classes:

Lectures: 30	**Practical training:** 30

Teaching methods: lectures, problem orientated seminars

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	
Exercises	10	Written	60
Colloquia	30	Oral	Student may be invited to the oral exam according to the teacher's evaluation.
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmacokinetics

Teachers: Miljković R. Branislava, Vezmar Kovačević D. Sandra, Vučićević M. Katarina

Course status: mandatory

Semester: VII	**Year of studies: IV**
ECTS points: 6	**Course code:**

Requirements: Physiology 2, Pharmaceutical Chemistry 1, Pathophysiology 1, Pharmacology 1

Course aims:

Understanding of the pharmacokinetic processes that are undergone by the drug in the organism; knowledge of the various types of pharmacokinetic data analysis methods for the assessment and calculation of pharmacokinetic parameters; understanding of the importance, principles and the methods of conduction of bioavailability and bioequivalence studies for medicines; understanding of the pharmacokinetic interactions and knowledge of adverse reactions to drugs being a consequence of pharmacokinetic interactions upon simultaneous usage of medicines.

Course outcomes:

Upon completion of the course the student is expected: to know the pharmacokinetic processes and influencing factors, to understand metabolic changes of drugs and the importance of studying of metabolism during the development and application of medicines, to be familiar with different approaches to pharmacokinetic data analysis, to assess/calculate pharmacokinetic parameters upon single or repeated dose of the drug following intravenous or oral application, to know the factors influencing variability of the therapeutical outcome, to know the methods of bioavailability and bioequivalence testing, to understand and predict drugs interactions based on their pharmacokinetic properties, to be familiar with adverse reactions to drugs being a consequence of pharmacokinetic interactions upon simultaneous usage of medicines.

Course contents:

Lectures

Pharmacokinetic processes undergone by the drug in the organism: absorption, distribution, metabolism and excretion of drugs – ADME system. Design of the preclinical and clinical pharmacokinetic studies. Contribution of the metabolism to development, application of medicines and achievement of the therapeutical outcome. Pharmacokinetic analysis of the data from the plasma and calculation of the pharmacokinetic parameters upon intravenous and oral application of medicines: departmental, non-departmental, population data analysis, pharmacokinetic-pharmacodynamic and physiological models. Pharmacokinetics of the repeated dosing – steady state upon intravenous and oral application of medicines. Pharmacokinetics of the modified release preparations. Pharmacokinetic analysis of the urine data. Bioavailability/bioequivalence of medicines. Factors influencing pharmacokinetic variability. Pharmacokinetic interactions and adverse reactions to drugs.

Practical classes

Biological materials for *in vitro* and *in vivo* pharmacokinetic analysis. Investigation of the drug metabolism *in vitro* and *in vivo*. Controlled pharmacokinetic studies. Determination of the bioavailability/bioequivalence of medicines. Population pharmacokinetic studies. Case studies of calculation of pharmacokinetic parameters upon single and repeated dosing, and intravenous and oral application of medicines, using plasma or urine as biological materials.

Recommended literature:

1. Pokrajac M. Farmakokinetika. 4. izdanje. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2012.
2. Pokrajac M. Farmakokinetika - Priručnik za praktičnu nastavu. 3. izdanje. Beograd: Biograf; 2008.

<table>
<tr><td colspan="4">3. Ritchel W, Kearns G. Handbook of basic pharmacokinetics including clinical applications. 7th ed. Washington: American Pharmacists Association; 2009.
4. Jambhekar SS, Breen PJ. Basic pharmacokinetics. 2nd ed. London: Pharmaceutical Press; 2012.</td></tr>
<tr><td colspan="4">The total of active learning classes</td></tr>
<tr><td colspan="2">Lectures: 45</td><td colspan="2">Practical classes: 45</td></tr>
<tr><td colspan="4">Teaching methods: interactive lectures, workshops, case studies, problem based learning, patient oriented learning</td></tr>
<tr><td colspan="4">Grading system:</td></tr>
<tr><td>Exam prerequisites</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Active participation in lectures</td><td>0-5</td><td>Practical</td><td></td></tr>
<tr><td>Practical classes</td><td></td><td>Written</td><td>70</td></tr>
<tr><td>Colloquia</td><td>25</td><td>Oral</td><td></td></tr>
<tr><td>Seminars</td><td></td><td></td><td></td></tr>
<tr><td>Other activities</td><td></td><td></td><td></td></tr>
</table>

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmaceutical Technology 2

Teachers: Đurić R Zorica, Milić R Jela, Savić D Snežana, Vasiljević D Dragana, Krajišnik R Danina, Grbić V Sandra

Course status: mandatory

Semester: VII	**Year of studies: IV**
ECTS points: 5	**Course code:**

Requirements: Pharmaceutical Technology 1

Course aims:

Acquisition of knowledge relating to the types, formulation, properties, compounding or manufacturing methods and pharmaceutical technical procedures used for the various dosage forms for parenteral, ophthalmic, inhalation, rectal or vaginal application; biopharmaceutical properties of the formulation development and quality testing of the dosage forms for parenteral, ophthalmic, inhalation, rectal or vaginal application.

Course outcomes:

Student is familiar with the types, formulation, compounding or manufacturing methods, pharmaceutical technical procedures and pharmacopeial specifications for the dosage forms for parenteral, ophthalmic, inhalation, rectal or vaginal application; is competent to formulate the above-mentioned dosage forms), knows the types, properties and roles of excipients in the preparation of dosage forms; knows and understands principles related to the influence of the biopharmaceutical properties (biological, physicochemical and pharmaceutical-technical) factors on processes of release and absorption of the active substance from the above-mentioned dosage forms; and provides the appropriate information to patients/general public.

Course contents:

Lectures

Biopharmacy, basic principles and definition. Influence of the biological properties on absorption of active substances depending on the route of application of the dosage form. Influence of the physicochemical properties on the release and absorption of active substances; general approach and specific details related to the dosage forms for parenteral, ophthalmic, inhalation, rectal or vaginal application.

Basic principles of formulation of dosage forms for parenteral, ophthalmic, inhalation, rectal or vaginal application, in order to achieve the appropriate release of the active substance, stability, therapeutic effect and patient compliance.

Types, properties, formulation, compounding/manufacturing methods, quality requirements and pharmaceutical technical procedures for the dosage forms for rectal or vaginal application. Types, properties, formulation, compounding/manufacturing methods, quality requirements and pharmaceutical technical procedures for the dosage forms for parenteral or ophthalmic application. Sterilization and sterilization methods in compounding/manufacturing of the pharmaceutical preparations. Quality requirements and pharmaceutical technical procedures for the dosage forms for parenteral or ophthalmic application. Types of excipients used for the formulation of parenteral and ophthalmic preparations, and factors influencing selection of excipients. Immunobiological preparations for active and passive immunization (pharmaceutical-technical aspects). Properties of biological products/biopharmaceutics and methods of their preparation (recombinant DNA technology); biopharmaceutics of the first and second generation – examples of insulin. Radiopharmaceutical preparations – pharmaceutical-technical aspects. Types, properties, formulation and testing of the preparations for inhalation.

Practical classes

Preparation of the necessary equipment and utensils, containers/primary packaging and environmental conditions required for the compounding of the ophthalmic and parenteral preparations. Compounding and quality control of the ophthalmic and parenteral dosage forms (selected examples); sterilization, methods of sterilization and sterilization equipment; preparations for inhalation – pharmaceutical technical procedures. Compounding and quality control of suppositories and pessaries (selected examples).

Recommended literature:

1. Đurić Z. Farmaceutska tehnologija sa biofarmacijom. I deo. Zemun: Nijansa; 2004.
2. Krajišnik D, Grbić S, Petrović J, Đekić Lj, Vasiljević D, Kovačević A, Čalija B. Farmaceutska tehnologija II. (practical coursebook). Beograd: Univerzitet u Beogradu, Farmaceutski fakultet; 2012.
3. Allen LV, Popovich NG, Ansel HC. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. Philadelphia: Lippincot Williams &Wilkins; 2005.
4. Remington: The Science and Practice of Pharmacy. 22nd ed. Gurnee: Pharmaceutical Press; 2012.
5. Aulton ME. Aulton's Pharmaceutics: The Design and Manufacture of Medicines. Edinburgh: Churchill Livingstone, 2007.

The total of active learning classes

Lectures: 45	**Practical classes:** 45

Teaching methods: lectures, interactive lectures, practical classes, problem based teaching, calculations

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	0-3	Practical	
Practical classes	3-5	Written	31-60
Colloquia	17-32	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Toxycology with Analytics

Teachers: Matović J. Vesna, Vujanović L. Dragana, Đukić M. Mirjana, Antonijević M. Biljana, Bulat L. Zorica, Đukić-Ćosić D. Danijela

Course status: mandatory

Semester: VII	**Year of studies:** IV
ECTS points: 7	**Course code:**

Prerequisite for attending course: none

Course aims:

Introduction to, acquisition, understanding, implementation, analysis and evaluation of knowledge and skills about general toxicology and most important representatives of poisons from different areas of toxicology (forensic toxicology, professional toxicology, clinic toxicology, toxicology of food, toxicology of drugs, ecotoxycology, analytic toxicology…).

Course outcomes:

Possibility of qualified work of masters of pharmacy in different fields: toxic effect of drugs and substances of abuse, professional poisoning, environmental pollution, regulations in toxicology, whereby pharmacist represents on of the most important link of preservation of population health.

Course contents:

Lectures

Principles of general toxicology: history, poison definition, dose-response relationship, toxicity factors, chemical structure-toxicity relationship, poison kinetics, toxicity mechanisms, basic principles of poisoning treatment and antidotes, selection and material preparation, qualitative and quantitative methods of poison analyzing in toxicological practice, interpretation of obtained results. Studying of the most important gas poisons (carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen oxides, chlorine, etc.), volatile (cyanides, alcohols, chlorinated carbohydrates, benzene and benzene derivates, persistent organic pollutants), mineral (lead, mercury, cadmium, manganese, arsenic, fluorides, acids, alkalis, etc.) and herbal and synthetic poisons (most important alkaloids, heterosides, pesticides, drugs, substances which create addiction, etc.). Basics of metal radioactivity and plastic masses. Drug poisoning (salicylates, barbiturates, benzodiazepines, phenothiazines, beta blockers and others). Basics of ecotoxycology and the most important atmosphere and hydrosphere pollutants). Principles of toxicological risk assessment. Regulative in toxicology.

Practical training

Practical training is integrated extension of lectures and it is designed with the goal that students master problem of complete procedure of toxicological analysis. Students are introduced to methods of material preparation and qualitative and quantitative analysis of the most important poisons throughout individual and laboratory work, as well as through demonstrations.

Recommended literature:

1. Matović V, Đukić M, Antonijević B, Vujanović D, Plamenac-Bulat Z. Praktikum iz toksikologije s analitikom. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2012.
2. Matović V. Toksikologija metala. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2010.
3. Jokanović M. Toksikologija. Beograd: Elit Medika, 2001.
4. Timbrell J. Introduction to Toxicology. 3rd ed. New York: Taylor & Francis; 2001.
5. Casarett & Doull's Toxicology: The Basic Science of Poisons. 7th ed. Klaassen CD, editor. New York:

McGraw-Hill Professional; 2008.			
The total of active learning classes			
Lectures: 60		**Practical training:** 45	
Teaching methods: lectures, laboratory work in groups			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical training	15	Written	20
Colloquia	20	Oral	40
Seminars			
Other activities	5		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Phytotherapy

Teachers: Kovačević N. Nada, Petrović D. Silvana, Maksimović A. Zoran, Kundaković D. Tatjana

Course status: mandatory

Semester: VII	**Year of studies: IV**
ECTS points: 4	**Course code:**

Requirements: Pharmacognosy

Course aims:

Gathering knowledge on the place and purpose of the phytotherapy in the system of primary healthcare and self-medication. Rational and safe application of herbal medicines in the treatment of prevention of illness and improvement of health.

Course outcomes:

Student is familiar with the basic principles of rational phytotherapy and herbal medicines – the active principles and mechanism of action. Student is capable of providing relevant information of the application of herbal medicines, and can critically evaluate selected natural products from the market.

Course contents:

Lectures

Phytotherapy; rational and traditional phytotherapy. The place and purpose of the phytotherapy in the system of primary healthcare and self-medication. Definition and types of herbal medicines (herbal medicines, traditional herbal medicines); introduction to the appropriate regulations. Active principles and mechanisms of action of herbal products. Safe usage of herbal medicines: indications, dosage, contraindications, adverse effects, precautions, remarks, interactions; assessment of the risk to benefit ratio. Application of the herbal medicines in functional disorders and diseases related to the central nervous system, cardiovascular system, respiratory, gastrointestinal and urogenital tract, skin, skin mucosa; bone, connective and muscle tissue, as well as metabolism disorders. Application of the herbal medicines with immunomodulation, adaptogenic or antioxidative properties.

Practical classes

Analysis and comments on the composition and information contained in the patient information leaflets of the herbal medicines from the market. Analysis of the case studies in order to gain competencies for the counseling on the rational and safe usage of the herbal medicines. Discussion on the control of the quality of herbal drugs and herbal drug preparations used as the active principles of herbal medicines.

Recommended literature:

1. Schulz V, Hänsel R, Blumenthal M, Tyler VE. Rational phytotherapy. A reference guide for physicians and pharmacists. 5th ed. Berlin, Heidelberg: Springer-Verlag; 2004.
2. ESCOP Monographs. 2nd ed. supplement 2009. Exeter: The European Scientific Cooperative on Phytotherapy; Stuttgart: Georg Thieme Verlag; New York: Thieme New York; 2009.
3. ESCOP Monographs. 2nd ed. Exeter: The European Scientific Cooperative on Phytotherapy; Stuttgart: Georg Thieme Verlag; New York: Thieme New York; 2003.
4. Blumenthal M, Hall T, Goldberg A, Kunz T, Dinda K, eds. The ABC clinical guide to herbs. 1st ed. Austin, Texas: American Botanical Council; New York: Thieme New York; Stuttgart: Thieme International; 2003.
5. European Medicines Agency. EMA/HMPC Community herbal monographs. http://www.ema.europa.eu.

The total of active learning classes

Lectures: 30	**Practical classes:** 30

Teaching methods: lectures, interactive lectures, practical classes			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	2-5	Practical	
Practical classes	12-20	Written	31-60
Colloquia		Oral	
Seminars	10-15		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Selected Chapters of Pharmaceutical Chemistry

Teachers: Vujić B. Zorica, Erić M. Slavica, Brborić S. Jasmina, Čudina A. Olivera, Marković D. Bojan

Course status: elective

Semester: VII	**Year of studies:** IV
ECTS points: 4	**Course code:**

Prerequisite for attending course: none

Course aims: Student is expected to obtain expanded knowledge about medicinal chemistry, to get introduced to modern drugs, which are new with aspects of chemical structure and mechanisms of action and which are created as a product of drug design of a leading compound; student is expected to obtain knowledge about diagnostic agents and radiopharmaceutics.

Course outcomes: Student is expected to have a grater fund of knowledge in the studied area, to adopt essential facts related to studied groups of medicines and their physicochemical properties, reactivity and stability of molecules, to analyze the relationship between chemical structure and biological activity of molecules, to understand chemical interactions of drugs, drug-receptor interactions and chemical aspects of drug metabolism.

Course contents:

Lectures

Lectures include 5 teaching areas from the field of chemistry of new drugs which are used in modern pharmacotherapy: innovative drugs in antimicrobial therapy (chronological review of antibiotic development and reference to latest and the most safe drugs); Chemistry of natural and synthetic compounds that create addiction; Selectivity and toxicity of antineoplastics; Steroid hormones-anabolics and anticoncipiens; Diagnostics (contrast) agents, properties and usage. Radioisotopes and radiopharmaceutics in nuclear medicine: synthesis, properties and application *in vivo* and *in vitro* diagnostics and in therapy.

Remark: The title itself indicates the fact that listed contents can be changed (in order to modernize subject matter, and in accordance with interests of students and needs of adequate education of pharmacist), so that teachers can, for each next school year, amend or partly change existing contents if he consider it necessary.

Recommended literature:

1.Foye's Principles of Medicinal Chemistry. 7th ed. Williams DA, Lemke TL, editors. Baltimore: Lippincott Williams & Wilkins; 2013.

2. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry. 12th ed. Beale JM, Block JH, editors. Philadelphia: Lippincott Williams & Wilkins; 2011.

3. Burger's Medicinal Chemistry & Drug Discovery. 7th ed. Hoboken, New Jersey: John Wiley & Sons; 2010.

4. Gopal B. Saha. Fundamenals of Nuclear Pharmacy. 6th ed. Springer; 2010.

The total of active learning classes

Lectures: 45	**Practical training:** 0

Teaching methods: oral lectures, interactive teaching, seminar paper

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	10	Practical	
Practical training		Written	40
Colloquia	50	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Laboratory Diagnostics of Metabolism Disorders

Teachers: Spasojević-Kalimanovska V. Vesna, Kotur-Stevuljević Jelena, Bogavac-Stanojević Nataša

Course status: elective

Semester: VIII	**Year of studies:** IV
ECTS points: 5	**Course code:**

Prerequisite for attending course: Pathophysiology

Course aims:

Acquisition of broader knowledge in the field of laboratory diagnostics and therapy monitoring of the most common chronic diseases: diabetes and dyslipidemia, related to themes within mandatory course Medicinal Biochemistry.

Course outcomes:

Student will be capable to do and interpret results of analysis which are used in laboratory diagnostics, as well as in monitoring of pharmacological and nonpharmacological therapy of diabetes and hiperlipidemia. Students will be able to determine atherosclerosis risk to the patients based on nonlipid and lipid risk factors.

Course contents:

Lectures

Integration and hormonal regulation of metabolism in liver, muscles, adipose tissue and brain. Metabolism in good nutritional status. Obesity. Biochemical aspects of starvation. Metabolic disorders which occur in different types of diabetes and laboratory diagnostics and therapy monitoring. Disorders in lipoproteins metabolism and atherosclerosis. Classification of dyslipidemia. Laboratory diagnostics of lipid metabolism disorders. Introduction to recommendation of national and international organization related to interpretation of laboratory diagnostics and monitoring of diabetes, lipid status and atherosclerosis risk.

Practical training

Analytical methods which are used in diagnostics and monitoring of therapy of diabetes and hipelipoproteinemia. Characteristics and use of glucometers which work on principle of biosensors. Lipid and nonlipid factors of risk for atherosclerosis appearance through learning based on problem. Calculation of atherogenic index and application of algorithm in interpretation of risk from atherosclerosis and cardiovascular-disease with case studies. The importance of preanalytical and analytical variytions in biochemical parameters determination throughout case studies.

Recommended literature:

1. Spasić S, Jelić-Ivanović Z, Spasojević-Kalimanovska V. Medicinska Biohemija, 2003.
2. Burtis CA, Ashwood ER, Bruns DE. Tietz Textbook of Clinical Chemistry and Molecular Diagnosis, W.B. Saunders Company, 2012.
3. Rifai N, Warnick GR, Dominiczak MH. Handbook of Lipoprotein Testing. AACC Press, 2000.
4. Kaplan LA, Pesce AJ, Kazmierczak S. Clinical Chemistry, 5th Edition - Theory, Analysis, Correlation, W.B. Saunders Company, 2010.
5. Dopunska literatura: pregledni članci iz časopisa, delovi iz Nacionalnih vodiča kliničke prakse

The total of active learning classes

Lectures: 15	**Practical training:** 30

Teaching methods: oral lectures, workshops, experimental work in laboratory, e-learning, case study analysis, learning based on problem.

Grading system:

Exam prerequisites	Points	Final exam	Points

Active participation in lectures	10	Practical	
Practical training	30	Written	40
Colloquia	10	Oral	
Seminars			
Other activities	10		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Substances of Abuse with Analytics

Teachers: Matović J. Vesna, Vujanović L. Dragana, Đukić M. Mirjana, Antonijević M. Biljana, Bulat L. Zorica, Đukić-Ćosić D. Danijela

Course status: elective

Semester: VII	**Year of studies:** IV
ECTS points: 4	**Course code:**

Prerequisite for attending course: none

Course aims:

Acquisition, adoption, analysis and implementation of knowledge about mechanism of action and toxicity of substances which cause addiction, a social aspect of their abuse, therapy and prevention and society strategies in order to reduce the number of addicts.

Course outcomes:

Qualification of masters of pharmacy to be a part of multidisciplinary team dealing with problem of abuse of substances that create addiction, and especially in terms of education and prevention of abuse particularly among young population

Course contents:

Lectures

History. Classification of agents that create addiction, i.e. psychoactive controlled substances. Addiction theories. Basic characteristics of substances that create addiction. The most important substances that create addiction. Alcohol. Opiate (opium, morphine, heroine). Cocaine. Amphetamine. Cannabis (marihuana, hashish). LSD. Drugs of abuse (methadone, selective inhibitors of serine reuptake, barbiturates, benzodiazepines, anabolics...). New “street drugs”: synthetic cannabinoides, benzylpiperazine, GHB. Legislative. The most used psychoactive controlled substances in Serbia.

Practical training

Practical training is integrated follow-up of lectures and it is designed with the goal that students master problem of psychoactive controlled substances. Case study of poisoning with representatives of group psychoactive controlled substances which were processed during lectures. case study analysis. It is conducted throughout Moodle platform for e-learning.

Recommended literature:

1. Đukić M, Đukić-Ćosić D. Sredstva koja izazivaju zavisnost s analitikom. Priručnik za praktičnu nastavu. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2009.
2. Blachford S, Krapp K. Drugs and Controlled Substances Information for Students. Blachford S., Krapp K, editors.Michigan: Gale; 2002.
3. Joseph DE. Drugs of Abuse. Wahington: U.S. Department of Justice. Drug Enforcement Administration; 2003.
4. Cole MD. The Analysis of Controlled Substances, Chichester: Wiley; 2003.
5. Emmett D, Nice G. Understanding Street Drugs. Philadelphia: Jessica Kingsley Publishers; 2006.

The total of active learning classes

Lectures: 30	**Practical training:** 15

Teaching methods: lectures, case study analysis, Moodle (e-learning platform)

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	10	Practical	
Practical training		Written	50

Colloquia	10	Oral	
Seminars			
Other activities (Moodle)	30		

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Dietetics

Teachers: Šobajić S. Slađana, Stanković M. Ivan, Đorđević I. Brižita

Course status: mandatory

Semester: VIII	**Year of studies: IV**
ECTS points: 4	**Course code:**

Requirements: Bromatology

Course aims:

Providing information regarding the existing guidances, recommendations and other tools used to design dietary regimens; information of specific nutritive needs for certain age groups and during the course of therapy or prevention of illnesses; information on specific groups of dietary products adapted to the needs of specific age groups; food and drugs interactions.

Course outcomes:

Student is capable to provide appropriate interpretation of dietary recommendations; to give general advice on the healthy nutrition of the general population as well as advices on nutrition to patients suffering from noncontagious illnesses whose nutrition serves as a co-therapy; to provide basic information on dietary products, and food and drugs interactions.

Course contents:

Lectures

The role of food; principles of rational nutrition and tools for the implementation of the rational nutrition; recommendations of daily intake of nutriments – RDA and DRI values; upper tolerable level of nutriments intake; human energy requirements; methods and types of testing nutrition and nutritional status; biologically active ingredients of food; basic rules for improvement of nutrition for population groups of special sensitivity; nutrition during the various periods of life; specifics of nutritive needs of athletes; allergies and food intolerances; eating disorders; food fortification, functional food, dietary products, dietary supplements; food for special medical needs – specifics of the application and formulation; interactions of food with drugs and other nutriments.

Practical classes

Examples of calculation of energy requirements; calculations of fractions of fat, carbohydrates and proteins in the total daily energy consumption; calculation of the energy value of foods; methods for assessment of the quality of nutrition and nutritional status; examples of usage of food composition tables; analysis of energy and nutritive value of dietary products; interpretation of declarations of dietary foodstuffs; seminar.

Recommended literature:

1. Grujić R, Miletić I. Nauka o ishrani čovjeka. Knjiga prva. Banja Luka; 2006.
2. Grujić T, Stanković I, Miletić I. Nauka o ishrani čovjeka. Knjiga druga. Banja Luka; 2007.
3. Barasi ME. Human Nutrition. A health perspective. London: Hodder Arnold Publishers; 2003.
4. Present knowledge of nutrition. Ziegler EE, Filer LJ, eds. Washington DC: ILSI Press; 1996.
5. Izvodi sa predavanja (handouts)

The total of active learning classes

Lectures: 30	**Practical classes:** 30

Teaching methods: lectures, seminar, assignments

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	0-7	Practical	
Practical classes	9-18	Written	

Colloquia		Oral	30-60
Seminars	8-15		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmaceutical Technology 3

Teachers: Primorac M. Marija, Parojčić V. Jelena, Ibrić R. Svetlana, Grbić V. Sandra, Đuriš D. Jelena, Đekić M. Ljiljana

Course status: mandatory

Semester: VIII	**Year of studies: IV**
ECTS points: 6	**Course code:**

Requirements: Pharmaceutical Technology 1

Course aims:

Acquisition of knowledge related to the types, formulation, properties, compounding/manufacturing methods and pharmaceutical technical procedures for solid dosage forms for (per)oral use and preparations with modified release for various routes of application; biopharmaceutical aspects of the formulation development and quality testing for the dosage forms for various routes of application.

Course outcomes:

Student is familiar with the types, formulation, compounding/manufacturing methods, pharmaceutical technical procedures and pharmacopeial specifications for solid dosage forms for (per)oral use; is competent to formulate the above-mentioned dosage forms and knows the types, properties and roles of excipients in compounding/manufacturing of solid dosage forms; knows and understands the principles related to the influence of the biological, physicochemical and pharmaceutical-technical factors on processes of release and absorption of the active substance from the solid dosage forms for (per)oral use and dosage forms with the modified release; and provides the appropriate information to patients/general public.

Course contents:

Lectures

Approach to formulation of the solid dosage forms for (per)oral use in order accomplish the appropriate release of the active substance, stability, therapeutic effect and patient compliance. Biopharmaceutical aspects in the formulation and quality assessment of the pharmaceutical preparations.

Solid dosage forms. Properties of powders significant for the preparation of solid dosage forms. Hard and soft capsules: excipients, compounding/manufacture and quality control. Pellets. Excipients used for preparation of the solid dosage forms. Tablets (types, definitions, properties, general characteristics). Tableting methods: direct compression and different granulation methods. Coating of tablets. Quality control of tablets. Modified release preparations for (per)oral use: types, properties, excipients and compounding/manufacturing methods. Therapeutic systems for various routes of application – basic principles.

Biopharmaceutical properties of or (per)oral application of dosage forms. Biopharmaceutical classification system. Dissolution testing for solid dosage forms (method development, application, pharmacopeial and regulatory requirements and recommendations).

Practical classes

Preparation and characterization of granules, capsules, tablets and modified release preparations. Fluidized-bed system granulation. Characterization of granules (particle size distribution, moisture content, flowability and density). Direct compression of tablets using the excenter tablet press. Testing of tablets hardness, friability, and disintegration time for tablets and capsules. Dissolution test for tablets. Biopharmaceutical characterization of pharmaceutical preparations. Investigation of the influence of pH value and surface active agent concentration on the solubility of the model active substance. Determination of the partition coefficient. Classification of model active substances

according to the Biopharmaceutical classification system.			
Recommended literature: 1. Đurić Z. Farmaceutska tehnologija sa biofarmacijom. I deo. Zemun: Nijansa; 2004. 2. Krajišnik D, Grbić S, Petrović J, Đekić Lj, Vasiljević D, Kovačević A, Čalija B. Farmaceutska tehnologija II. (practical coursebook). Beograd: Univerzitet u Beogradu, Farmaceutski fakultet; 2012. 3. Allen LV, Popovich NG, Ansel HC. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. Philadelphia: Lippincot Williams &Wilkins; 2005. 4. Aulton ME. Aulton's Pharmaceutics: The Design and Manufacture of Medicines. Edinburgh: Churchill Livingstone, 2007. 5. Gibson M. Preformulacija i formulacija lekova. Drugo izdanje. Ibrić S, Parojčić J, editors of the Serbian edition. Beograd: Univerzitet u Beogradu, Farmaceutski fakultet; 2012.			
The total of active learning classes			
Lectures: 45		**Practical classes:** 60	
Teaching methods: lectures, interactive lectures, practical classes (practical and demonstrative), educational films, calculations, workshops			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0-2	Practical	
Practical classes	2-6	Written	31-60
Colloquia	14-25	Oral	
Seminars	4-7		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmaceutical legislation and ethics

Teachers: Krajnović M. Dušanka, Marinković D. Valentina, Tasić M. Ljiljana

Course status: mandatory

Semester: VIII	**Year of studies: IV**
ECTS points: 3	**Course code:**

Requirements: none

Course aims:

Understanding of the national and international legal regulations in the field of pharmacy. Mastering the basics of applied ethics in pharmacy which are necessary to analyze and solve problems in the field of pharmaceutical health services, biomedical research, marketing, and industrial production. Development of the critical thinking in the process of ethical analysis of problems in specific situations of the pharmaceutical practice.

Course outcomes:

Student is aware of, and knows how to apply laws, by-laws and professional legal documents regulating all aspects of the pharmaceutical practice. The student is able to deal with ethical issues in the pharmaceutical care through application of ethical analysis; knows the difference between legal and ethical problems that pharmacists deal with in the course of professional work.

Course contents:

Lectures

European and international legislation on medicines - basic guidelines. National health policy and regulations in fields of medicine and pharmacy (Laws on healthcare, health insurance, healthcare associations, medicines and medical devices). Medicines and Medical Devices Agency of Serbia, its purpose, assignments, structure and activities. The procedure of granting a marketing authorization for medicines or medical devices. Pharmaceutical regulations (national by-laws and professional legal documents). Professional organizations (national and international). Serbian pharmaceutical chamber. Pharmacists working license. Court of Honor. Normative ethics in pharmacy. Ethical theories (principles) that are foundation for the pharmaceutical ethics. Ethical analysis of case studies from the pharmaceutical practice ethical standards and moral values, wrong judgment and patients' rights. Errors in pharmacy - moral and criminal responsibility of pharmacists. Ethics in preclinical and clinical drug trials. The role and importance of the ethics committee. Ethical issues in biomedical research. Ethics in advertising of medical services and pharmaceuticals. Current bioethical issues.

Lectures

Analysis and discussion of case studies (generation and critical evaluation of information and data). Problem-based learning (problem solving using the appropriate explanation of the ethical concept and the legal framework). Panel discussions, application of the law and ethics on current issues. Homework.

Recommended literature:

1. ICH regulativa i regulativa Evropske unije koje se odnose na sve aspekte leka i medicinskog sredstva.
2. Aktuelni zakoni i podzakonska akta Republike Srbije iz oblasti zdravstva i farmacije
3. Parojčić D. Razvoj etike u farmaciji od teorije do savremene prakse. Beograd: Konstisi; 2006.
4. Veatch R. Haddad A. Case Studies in pharmacy ethics. New York: Oxford University Press; 2008.
5. Gosić N. Bioetičke perspektive. Zagreb: Pergamena; 2011.

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: lectures, seminars, workshops, calculations, case studies (homework), discussion

Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical classes	35	Written	50
Colloquia	10	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Selected Chapters of Pharmacokinetics

Teachers: Miljković R. Branislava, Vezmar Kovačević D. Sandra, Vučićević M. Katarina

Course status: elective

Semester: VIII	**Year of studies:** IV
ECTS points: 4	**Course code:**

Prerequisite for attending course: Pharmacokinetics

Course aims:

Understanding of variability in therapeutic response as a consequence of pharmacokinetic variability and application of principles of clinical pharmacokinetics in interpretation and individualization of dosage regimen based on measured concentrations of drug in patient's plasma.

Course outcomes:

Application of population pharmacokinetic models in selection of optimal therapeutic dosage regimen. Recognition of variability of therapeutic response as a consequence of pharmacokinetic variability and application of principles of clinical pharmacokinetics in interpretation of measured drug concentrations in patient's plasma with recognition of need for dosage regimen correction based on individual pharmacokinetic parameters.

Course contents:

Lectures

Principles of clinical pharmacokinetics. Pharmacokinetic parameters which are important for setting and correction of dosage regimen. Population pharmacokinetic models as a basis in selection of optimal therapeutic dosage regimen. Standard monitoring of drugs (therapeutic drug monitoring, TDM). Variability of therapeutic response as a consequence of pharmacokinetic variability of drug. Correction of dosage regimen based on individual values of pharmacokinetic parameters. Clinical pharmacokinetics of some drug groups: lithium, digoxin, aminoglycoside antibiotics, teophylline, antiepileptics, immunosuppressants. Clinical pharmacokinetics of drugs in special patient populations: patients with renal impairment, liver impairment, geriatric, pediatric patients population, women, pregnant women, breastfeeding women, obese, patients on combined therapy.

Practical training

Application of principles of clinical pharmacokinetics in setting and correction of dosage regimen. Average (population)/individual values of pharmacokinetic parameters. Interpretation of measured drug concentrations in biological fluids of patients obtained during standard drug monitoring. Setting and correction of dosage regimen based on calculated individual values of pharmacokinetics parameters using appropriate pharmacokinetic programs. Application of clinical pharmacokinetics principles in problem solving related to setting and correcting dosage regimen some drug groups: lithium, digoxin, aminoglycoside antibiotics, teophylline, antiepileptics, immunosuppressants.

Recommended literature:

1. Dhillon S, Kostrzewski A, eds. Clinical pharmacokinetics. 1st ed. London: Pharmaceutical Press; 2006.
2. Winter M. Basic clinical pharmacokinetics. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2009.
3. Murphy J. Clinical pharmacokinetics – pocket reference. 5th ed. Maryland: American Society of Health-System Pharmacists; 2011.
4. Bauer LA. Applied clinical pharmacokinetics, 2nd ed. London: McGraw-Hill Medical; 2008.

The total of active learning classes

Lectures: 30	**Practical training:** 15

Teaching methods: classes are conducted during one semester through interactive lectures,

workshops, seminar paper, case study analysis, problem based learning, patient centered learning.			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0-4	Practical	
Practical training	0-6	Written	50
Colloquia	40	Oral (only if the teacher assesses student may be invited to oral examination)	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Veterinary dosage forms

Teachers: Parojčić V. Jelena, Vasiljević D. Dragana, Grbić V. Sandra

Course status: elective

Semester: VIII	**Year of studies: 4**
ECTS points: 4	**Course code:**

Requirements: Pharmaceutical Technology 1

Course aims:

Introduction to the specificity of the application of pharmaceutical products in the veterinary medicine, pharmaceutical dosage forms for veterinary application, legal and regulatory requirements and guidances related to the development, compounding/manufacturing, marketing authorization issuing, and assessment of the quality of veterinary dosage forms.

Course outcomes:

Student is able to recognize the specifics of the application of drugs in the veterinary medicine; is aware of the pharmaceutical-technical properties, as well as the biopharmaceutical aspects of the dosage forms being used for the various animal species; knows the legal regulations and guidances related to the development, compounding/manufacturing, marketing authorization issuing, and assessment of the quality of veterinary dosage forms; critically evaluates the selection of the appropriate dosage form according to the animal species and pharmacotherapeutic goal.

Course contents:

Lectures

Specifics of the application of drugs in the veterinary medicine (simultaneous application of the dosage form to multiple number of animals, routes of drug application, pharmaceutical dosage forms, taste and odor masking, dosing); biopharmaceutical aspects of the veterinary dosage forms; pharmaceutical-technical properties of the pharmaceutical dosage forms for the application in the veterinary medicine; approaches to the formulation development of the dosage forms applied in the veterinary medicine; compounding of the veterinary dosage forms; legal regulations and regulatory guidances related to the development compounding/manufacturing, marketing authorization issuing and assessment of the quality of veterinary dosage forms.

Practical classes

Review of regulations and the professional references related to the compounding/manufacturing, storage and dispensing of the veterinary dosage forms; approaches to compounding of the veterinary dosage forms; review of the pharmaceutical dosage forms of veterinary medicines used for various animal species.

Recommended literature:

1. Kayne CB, Jepson MH. Veterinary Pharmacy. London: Pharmaceutical Press; 2004.
2. Bishop Y. The Veterinary Formulary. 6th ed. London: Pharmaceutical Press; 2004.
3. Baggot DJ. Veterinary Dosage Forms. In: Swarbrick J, Boylan JC. Encyclopedia of Pharmaceutical Technology. 2nd ed. New York, Basel: Marcel Dekker Inc.; 2002.
4. Nacionalni registar veterinarskih lekova, ALIMS, 2011.

The total of active learning classes

Lectures: 15	**Practical classes:** 30

Teaching methods: lectures, interactive lectures, discussion on case studies, preparation of the seminar

Grading system:

Exam prerequisites	Points	Final exam	Points

Active participation in lectures	0-3	Practical	
Practical classes	0-7	Written	36-70
Colloquia		Oral	
Seminars	0-20		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Design and Synthesis of Drugs

Teachers: Erić M. Slavica, Savić M. Vladimir

Course status: elective

Semester: VIII	**Year of studies:** IV
ECTS points: 5	**Course code:**

Prerequisite for attending course: Pharmaceutical Chemistry 1

Course aims:

is to student obtain knowledge in the field of drug discovery, rational drug design, methods in computational drug design, chemical development of new compounds, as well as in the field of biological evaluation of chemical active compounds.

Course outcomes:

Student is expected to understand basic molecular mechanism of drug action; to analyze relationships/quantitative relationships of structure, properties, effects and selectivity of pharmacologically active compounds in order to optimize their properties and activity; to understand basic methods of discovery, design and synthesis of new drugs.

Course contents:

Lectures

Approaches in drug discovery: accidental discovery, optimization of existing drugs, optimization of drug side effects, privileged structures; rational drug design, disease selection, validation of biological target, discovery of leading molecules using high-throughput screening, virtual screening, NMR and computational drug design; approaches in chemical development of pharmaceutical compounds: optimization of leading compound obtained from natural sources and in chemical synthesis, set compound testing, optimization of existing drugs, fragment method; chemical approaches in design and synthesis of derivatives; weak interactions and defining of interaction ligand-receptor, structure-activity relationship analysis; combinatorial chemistry; methods of computational drug design: establishment of quantitative structure, properties and effects of drugs, pharmacophore mapping, modeling of homologues of target and docking studies; patents and their role, sterochemical aspects of drugs in patent rights; examples of drug design and synthesis.

Practical training

Approach examples in discovery and design of new drugs; computational drug design: application of molecular descriptores, design based on structure of ligands and targets, pharmacophore mapping.

Recommended literature:

1. Patrick GL. Introduction to Medicinal Chemistry. 4th ed. Oxford: Oxford University Press; 2009.
2. King FD. Medicinal Chemistry, Principles and Practice. London: Springer; 2002.
3. Taylor JB, Triggle DJ. Comprehensive Medicinal Chemistry II, Volume 3. Drug Discovery Technologies. London: Elsevier Ltd.; 2007.
4. Silverman R. The Organic Chemistry of Drug Action and Drug Design. 2nd ed. London: Elsevier Academic Press; 2004.
5. Klebe G. Drug Design: Methodology, Concepts and Mode of Action. London: Springer; 2009.

The total of active learning classes

Lectures: 30	**Practical training:** 15

Teaching methods: lectures, interactive teaching, seminar papers, workshops

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures		Practical	

Practical training	10	Written	50
Colloquia	20	Oral	
Seminars	20		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Human Health Risk Assessment

Teachers: Matović J. Vesna, Vujanović L. Dragana, Antonijević M. Biljana, Bulat L. Zorica, Đukić-Ćosić D. Danijela

Course status: elective

Semester: VIII	**Year of studies: IV**
ECTS points: 4	**Course code:**

Requirements:

Course aims:

Gathering, application, analysis and evaluation of the knowledge and skills in the field of identification of hazards, assessment of the ratio of dose-response, assessment of the exposition and risk characterization, risk evaluation methodology and risk reduction measures.

Course outcomes:

Student is qualified to work in the field of human health risk assessment, risk reduction measures and the appropriate legislative whereby the pharmacist becomes one of the important links in preservation of the general population health.

Course contents:

Lectures

Risk assessment – definition and importance. Problem formulation. Hazard identification. Assessment of the dose-response ratio. Exposition assessment. Risk characterization. Deterministic and probabilistic methods in the risk assessment. Application of biomarkers and toxicokinetic models in the risk assessment. Interpretation of the risk – variability and uncertainty. Reference values, exposition border values. Cumulative and aggregative approach in the risk assessment. Examples of the human health risk assessment for specific toxic substances, drugs and cosmetic ingredients. Legislation. Criteria for classification and notation of chemicals.

Practical classes

Professional exposition and the risk calculation. Assessment of the general public exposure, as well as certain subpopulations (the assessment of the exposition of school children to fluorides, cumulative risk assessment of the exposition to organophosphorus insecticides and dioxins using the equivalent factor of toxicity, etc.). Calculation of the total risk and risk interpretation upon exposure to various substances (POPs compounds, toxic metals, medicines). Physiologically based toxicokinetic model of dermal absorption. Application of the contemporary software programs for the risk calculation. Classification and notation.

Recommended literature:

1. Antonijević B, Ćurčić M. Toksikološka procena rizika. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2012.
2. Paustenbach DJ. Human and Ecological Risk Assessment. Paustenbach DJ, editor. New York: Wiley, 2002.
3. Derelanko MJ, Hollinger MA. Handbook of toxicology. 2nd ed. Derelanko MJ, Hollinger MA, editors. Boca Raton: CRC Press; 2000.
4. Casarett & Doull's Toxicology: The Basic Science of Poisons. 7th ed. Klaassen CD, editor. New York: McGraw-Hill Professional; 2008.
5. Greim H, Snyder R. Toxicology and Risk Assessment: A comprehensive Introduction. Greim H, Snyder R., editors. Weinhiem: Wiley-Interscience; 2008.

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: lectures, case studies, workshops

Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	10	Practical	
Practical classes	20	Written	50
Colloquia	20	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Ecotoxicology

Teachers: Matović J. Vesna, Vujanović L. Dragana, Đukić M. Mirjana, Antonijević M. Biljana, Bulat L. Zorica

Course status: elective

Semester: VIII	**Year of studies: IV**
ECTS points: 4	**Course code:**

Requirements:

Course aims:

Introduction, gathering of knowledge, understanding, application, analysis end evaluation of the knowledge and skills in the field of ecotoxicology with the special emphasis on the most important pollutants and their global effect on people and environment.

Course outcomes:

Student will gain competencies to be a part of multidisciplinary team that deals with the problems of the environment pollution, as well as with the health of people, from the point of view of prevention of the environment pollution.

Course contents:

Lectures

Basic concepts of ecotoxicology as a science. Pollution of the environment and the global changes. The fate of toxicants in the environment (mobility, biodegradability, bioaccumulation, biomagnification, persistency, transfer through the biosphere). Response of the unit, population, aggregation, and ecosystem to toxic substance(s) (molecular, physiological and behavioral level). Biomonitoring and bioindicators of the environment pollution. The most significant pollutants of the atmosphere and their global effects: global warming, acid rains, ozone layer destruction. Pollutants of the hydrosphere (oil, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, etc.) and their effects on the living world. Ecotoxicological risk assessment. Effects of the environment on the human health.

Practical classes

Case studies and analysis of the most important environment pollutants. Eco-toxicity tests. Ecological catastrophes.

Recommended literature:

1. Walker CH, Hopkin SP: Principles of Ecotoxicology. 2nd ed. Walker CH, Hopkin CH, Sibly RM, Peakall DB, editors. London: Taylor and Francis; 2001.
2. Newman MC, Unger MA. Fundamentals of Ecotoxicology. 2nd ed. Boca Raton: Lewis Publishers; 2003.
3. Hoffman DJ, Rattner BA, Burton GA, Cairns J. Handbook of ecotoxicology. 2nd ed. Boca Raton: Lewis Publishers, 2003.
4. Conell D, Lam P, Richardson B, Wu R. Introduction to Ecotoxicology. Oxford: Blackwell Science, 1999.
5. Paustenbach DJ. Human and Ecological Risk Assessment. Paustenbach DJ, editor. New York: Wiley, 2002.

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: lectures, case studies, workshops

Grading system:

Exam prerequisites	Points	Final exam	Points

Active participation in lectures	10	Practical	
Practical classes	20	Written	30
Colloquia	20	Oral	20
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Sports Pharmacy

Teachers: Ivanović P. Darko, Stojanović S. Biljana, Malenović M. Anđelija, Dopsaj B. Violeta, Tomić A. Maja, Đorđević I. Brižita

Course status: elective

Semester: VIII	**Year of studies: IV**
ECTS points: 3	**Course code:**

Requirements:

Course aims:

Introduction of students to the role and significance of a pharmacist in monitoring of drug abuse in sports: being a part of the team, by counseling and educating; doping prevention; training for work in control laboratories; rational design of dietary plans; medicines supply; monitoring and analysis of the influence of medicines on biochemical and hematological parameters.

Course outcomes:

Student can apply the acquired knowledge to monitor the use of medicines in sports. Acquaintance with the legal regulations in sports. Prevention and control of doping. Education of active and recreational athletes on use and abuse of medicines in sports. Monitoring of the effects of rational use of dietary supplements – sources of nutrients. Application of knowledge on the influence of medicines on biochemical and hematological parameters.

Course contents:

Lectures

Role and significance of pharmacists in anti-doping. Requirements of international and national regulatory bodies. Methods for discovering of usage of doping agents. Pharmacologically active substances and methods forbidden to be used prior to and during sports competitions. Influence of medicines on biochemical and hematological parameters. Influence of the physical exercising on biochemical and hematological parameters. Samples analysis – collection, storage and preparation of samples; qualitative, quantitative and screening test, methods review. Pharmacological action of drugs used for doping. Rational application of dietary supplements.

Practical classes

Application of HPLC method in qualitative and quantitative analysis of prohibited substances in dietary supplements and their experimental determination. HPLC methods in analysis of prohibited substances in biological material – screening of biological material on the presence of specific groups of drugs used for doping, with the appropriate quantitative analysis. Basic parameters of validation of method for quantitative and qualitative analysis. Selection of method, possibilities of method application and interpretation of the obtained results. Examples of analyses. Problem solving. Calculation of energy requirements using the coefficient of physical activity.

Recommended literature:

1. World Anti–Doping Code. Kanada: World Anti–Doping Agency (WADA); 2009.
2. Paul D. A Guide to the World Anti–Doping Code. Cambrige: Cambrige University Press; 2008.
3. The World Anti–Doping Code, International Standard for Laboratories. Canada: World Anti–Doping Agency (WADA); 2009.
4. The World Anti–Doping Code. Identification Criteria for Qualitative Assays. Technical Document. Montreal: World Anti–Doping Agency (WADA); 2010.
5. Viru A, Viru M. Biochemical monitoring of sport training. Champaign, IL: Human Kinetics; 2001.

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: lectures, practical classes, interactive lectures, internet

Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical classes	25	Written	60
Colloquia	10	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Clinical Pharmacy

Teachers: Miljković R. Branislava, Vezmar Kovačević D. Sandra, Vučićević M. Katarina

Course status: mandatory

Semester: IX	**Year of studies: V**
ECTS points: 6	**Course code:**

Requirements: Pharmacotherapy, Pharmacokinetics

Course aims:

Gathering knowledge on the importance of the clinical pharmacy in the primary, secondary and tertiary healthcare. Introduction to the pharmaceutical care and methods of improvement of therapeutical outcomes of patients through the monitoring of interactions, adverse reactions and adherence. Understanding of the role of pharmacoeconomy in the assessment of the rational therapy with medicines.

Course outcomes:

Upon completion of the course student will be able to apply: the concept of evidence based medicine/pharmacy; pharmacoeconomic principles in decision making in rational therapy; concept of the problem identification and solution of problems related to the application of medicines, monitoring and counseling of patients regarding the application of medicines and monitoring and evaluation of the therapy in order to assure the desired outcomes of the therapy.

Course contents:

Lectures

Introduction to the clinical pharmacy. The role of the pharmacist in the advancement of the therapy outcomes. Clinical studies of medicines and evidence based medicine/pharmacy. Sources of information on medicines, critical evaluation of the published researches. Pharmacoeconomic aspects of the rational pharmacotherapy. Concept of the pharmaceutical healthcare in the primary, secondary and tertiary healthcare. Problem identification, preparation of the therapy plan and monitoring of the therapy outcomes. Interpretation of the laboratory results. Communication skills and development of the trusting relationship between the patient and the pharmacist. Medicines interactions. Compliance, adherence and concordance. The importance of the patient counseling to the improvement of the adherence level. The assessment of the therapy safety. The importance of monitoring of adverse reactions – pharmacovigilance.

Practical classes

Searching for the reliable information on medicines and therapies. Critical evaluation of the sources of information on medicines. Critical evaluation of the pharmacoeconomic studies. Case studies of identification of problems in therapy. Preparation of the therapy plan. Monitoring of the therapy outcomes. Patient counseling. Assessment of interactions, adverse reactions and adherence level. Application of the pharmaceutical healthcare principles on examples of multimorbid patients from the primary, secondary and tertiary healthcare (case studies). Modalities in the improvement of the pharmaceutical healthcare services in the primary, secondary and tertiary healthcare.

Recommended literature:

1. Rovers JP, Currie JD. A Practical Guide to Pharmaceutical Care: A Clinical Skills Primer. 3rd ed. Washington: American Pharmaceutical Association; 2007.
2. Cipolle RJ, Strand L, Morley P. Pharmaceutical Care Practice: The Clinician's Guide. 2nd ed. New York: McGraw-Hill Medical; 2004.
3. Rickles NM, Wertheimer AI, Smith MC. Social and Behavioral Aspects of Pharmaceutical Care. 2nd ed. Boston: Jones & Bartlett Learning; 2009.
4. Sexton J, Nickless G, Green C. Pharmaceutical Care Made Easy: Essentials of Medicines

<table>
<tr><td colspan="4">Management in the Individual Patient. 1st ed. London: Pharmaceutical Press; 2006.
5. Walker R, Whittlesea C. Clinical Pharmacy and Therapeutics. 5th ed. London: Churchill Livingstone; 2012.</td></tr>
<tr><td colspan="4">The total of active learning classes</td></tr>
<tr><td colspan="2">Lectures: 45</td><td colspan="2">Practical classes: 60</td></tr>
<tr><td colspan="4">Teaching methods: interactive lectures, workshops, case studies, problem based learning, patient centered learning</td></tr>
<tr><td colspan="4">Grading system:</td></tr>
<tr><td>Exam prerequisites</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Active participation in lectures</td><td>5</td><td>Practical</td><td></td></tr>
<tr><td>Practical classes</td><td>5</td><td>Written</td><td>70</td></tr>
<tr><td>Colloquia</td><td>20</td><td>Oral</td><td></td></tr>
<tr><td>Seminars</td><td></td><td></td><td></td></tr>
<tr><td>Other activities</td><td></td><td></td><td></td></tr>
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University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Industrial Pharmacy

Teachers: Đurić R. Zorica, Parojčić V. Jelena, Ibrić R. Svetlana, Đuriš D. Jelena

Course status: mandatory

Semester: IX	**Year of studies: V**
ECTS points: 5	**Course code:**

Requirements: Pharmaceutical Technology 2 and Pharmaceutical Technology 3

Course aims:

Introduction to, and understanding of principles and specific aspects of industrial manufacturing of pharmaceutical preparations with respect to: formulation development, product stability, regulatory requirements related to development, manufacture and storage of drug products; requirements of Good Manufacturing Practices; assurance of the appropriate conditions for manufacturing of pharmaceutical products; characteristics and selection of the optimal equipment used for the manufacturing of pharmaceutical products; quality systems and quality assurance.

Course outcomes:

Knowledge and understanding of research and development in the pharmaceutical industry; notion of the regulatory requirements for research, manufacturing, storage, marketing authorization for drug products, and requirements related to the pharmaceutical quality system in manufacturing of drug products; knowledge of principles of operation and types of equipment used in the manufacturing of drug products; thereby student is qualified for many job positions in the pharmaceutical industry in fields of research and development, manufacturing and quality assurance.

Course contents:

Lectures

Regulations regarding development, manufacturing and storage of drug products in the European Union and republic of Serbia. International and national guidances and regulations related to the quality assurance and accomplishment of requirements for all aspects from drug development to marketing of the product. Importance of standardization and standards used in the pharmaceutical industry. Good practices in drug products manufacturing. Requirements of Good manufacturing practices for medicinal products for human and veterinary use. Pharmaceutical quality system. Risk management in the pharmaceutical industry – significance and applications. Preformulation and formulation research and development in the pharmaceutical industry. Application of Quality by Design principle in the pharmaceutical formulation. Stability of drug products. Influence of the formulation factors and manufacturing methods on the stability of the drug product. Methods for stabilization of the drug products. Marketing authorization application. Conditions, documentation and procedures for approval of variations or additions to the marketing authorization. Chemical-pharmaceutical-biological documentation. Variations. Review of unit operations used in the pharmaceutical industry. Properties of equipment used in the manufacturing of various dosage forms. New concepts in the pharmaceutical industry: continuous production, process analytical technique (and Quality by design).

Practical classes

Formulation development of pharmaceutical preparations. Principles of stabilization of drug products and prediction of the shelf-life (calculations). Requirements of Good manufacturing practice. Unit operations: principles of operation and application of laboratory scale equipment; principles of operation and application of industrial scale equipment.

Recommended literature:

1. Jovanović M, Đurić Z. Osnovi industrijske farmacije. Zemun: Nijansa; 2005.
2. Gibson M. Preformulacija i formulacija lekova. Drugo izdanje. Ibrić S, Parojčić J, editors of the

<table>
<tr><td colspan="4">Serbian edition. Beograd: Univerzitet u Beogradu, Farmaceutski fakultet; 2012.
3. Guidelines for good manufacturing practices for medicinal products for human and veterinary use. Volume 4. (http://www.ec.europa.eu).
4. Parojčić J, Ibrić S, Đuriš J, Aleksić I, Čalija B. Odabrane farmaceutsko-tehnološke operacije. (multimedia publication). Beograd: Univerzitet u Beogradu, Farmaceutski fakultet; 2013.
5. Huynh-Ba K, Ed. Handbook of Stability Testing in Pharmaceutical Development: Regulations, Methodologies, and Best Practices. New York: Springer; 2009.</td></tr>
<tr><td colspan="4">The total of active learning classes</td></tr>
<tr><td colspan="2">Lectures: 45</td><td colspan="2">Practical classes: 45</td></tr>
<tr><td colspan="4">Teaching methods: lectures, interactive lectures, practical classes (practical and demonstrative), educational films, usage of multimedia publication, calculations, seminars, workshops</td></tr>
<tr><td colspan="4">Grading system:</td></tr>
<tr><td>Exam prerequisites</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Active participation in lectures</td><td>0-3</td><td>Practical</td><td></td></tr>
<tr><td>Practical classes</td><td>0-7</td><td>Written</td><td>31-60</td></tr>
<tr><td>Colloquia</td><td>0-15</td><td>Oral</td><td></td></tr>
<tr><td>Seminars</td><td>0-15</td><td></td><td></td></tr>
<tr><td>Other activities</td><td></td><td></td><td></td></tr>
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University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Pharmaceutical Analysis

Teachers: Ivanović P. Darko; Zečević L. Mira; Malenović M. Anđelija; Stojanović S. Biljana

Course status: mandatory

Semester: IX	**Year of studies:** V
ECTS points: 6	**Course code:**

Prerequisite for attending course: Pharmaceutical Chemistry

Course aims: Acquisition of knowledge and skills related to officinal procedures of drug quality examination and methods used during those procedures. Enabling students for selection of appropriate method in drug control. Introducing students to basic principles of new method development for drug quality control, as well as to validation of methods. Professional knowledge acquisition about structure of certificates of analysis and basic regulatory demands in drug control sector.

Course outcomes:

After derived classes in this course students are expected to apply obtained knowledge in routine control of pharmaceutical substances and pharmaceutical dosage forms, to select appropriate method for drug control, demonstrate and explain the significance of development and validation of new method, as well as to explain and apply current demands in drug control.

Course contents:

Lectures

Officinal examination for pharmaceutical substances control: identification of pharmaceutical substances, examination pharmaceutical substances purity degree, related substances examination, as well as other examinations provided in officinal monographs of current pharmacopoeia. Sample preparation of pharmaceutical substances and pharmaceutical forms for qualitative and quantitative analysis. Application of extractions in sample preparation-the most frequently used types of extraction in drug analysis. Application of titrimetric methods in drug analysis. UV/VIS spectrophotometry application and infra red (IR) spectroscopy in drug analysis. Application of chromatographic methods (dividing, affinity, gel…) in drug analysis. Analysis of different modifications of stationary and mobile phase in different drug analysis. Chromatographic method development. Derivatisation in HPLC and chiral drug analysis. Analytics of selected groups of organic, inorganic and biological drugs. Analysis certificate for active pharmaceutical substances. Analysis certificate for pharmaceutical dosage forms-general and specific examinations according to current pharmaceutical pharmacopoeia. Validation methods parameters, documentation for validation of methods and regulatory demands. Documentation of pharmaceutical-chemical-biological drug examination.

Practical training

Spectrophotometric methods validation. Evaluation and presentation of results. Application of HPLC methods which are officinal in European Pharmacopoeia, as internally validated methods for related substances analysis in active pharmaceutical substances and pharmaceutical dosage forms. Examination of degree of purity using thin layer chromatography. Semiquatitative determination of water content. Solid-liquid extraction for preparation of pharmaceutical forms.

Recommended literature:

1. European Pharmacopoeia seventh Edition, Strasbourg: Council of Europe, 2011;
2. Watson D. Pharmaceutical analysis: A Textbook for Pharmacy students and Pharmaceutical Chemists. London: Churchill Livingstone; 1999;
3. Lee DC, Webb ML, editors. Pharmaceutical Analysis. Boca Raton: Blackwell, CRC Press; 2003.
4. Kazakevich Y, Lobrutto R, editors. HPLC for pharmaceutical scientist. New York: John Wiley & Sons,

Inc.;2007. 5. Malenović A, Stojanović B. Farmaceutska analiza, praktikum. Beograd: Farmaceutski fakultet, Univerzitet u Beogradu; 2010.			
The total of active learning classes			
Lectures: 60		**Practical training:** 60	
Teaching methods: lectures, practical laboratory training, interactive teaching			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical training	15	Written	70
Colloquia	10	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Cosmetology

Teachers: Vuleta M. Gordana, Savić D. Snežana, Vasiljević D. Dragana

Course status: mandatory

Semester: IX	**Year of studies: V**
ECTS points: 4	**Course code:**

Requirements: Pharmaceutical Technology 1

Course aims:

Introduction to regulations regarding cosmetic products and dermocosmetic preparations, the most significant materials for preparation of the cosmetic and dermocosmetic preparations, carriers for the cosmetic active ingredients, types, forms, compounding/manufacturing methods, quality control and effects of cosmetic and dermocosmetic products on skin and skin adnexes; appropriate counseling and recommendations regarding usage and potential side effects of cosmetic and dermocosmetic products.

Course outcomes:

Knowledge of regulations regarding cosmetic products and dermocosmetic preparations, types, forms, compounding/manufacturing methods, quality control and effects of cosmetic and dermocosmetic products; critical evaluation of marketing information regarding effects of the cosmetic products and counseling on the appropriate product selection and application; awareness of the potential side effects of different cosmetic products.

Course contents:

Lectures

Topic definitions, relation of cosmetology to pharmacy and medicine, regulations on cosmetic products and dermocosmetic preparations in the countries of European Union and Republic of Serbia; requirements for the quality of cosmetic ingredients and products and dermocosmetic preparations; novel carriers of cosmetic active ingredients in cosmetic and dermocosmetic preparations; cosmetic products for cleaning/washing, care and protection of the skin; antidandruff shampoos; dermocosmetic preparations for prevention and treatment of the skin ageing, for the dry and other types of skin, for the treatment of the acne skin, for the sun protection, care and protection of children skin; deodorants and antiperspirants; properties and requirements for the quality of the organic and natural cosmetic products; compounding/manufacturing methods and quality control of cosmetic and dermocosmetic products, assessment of their effects and safety.

Practical classes

Formulation, compounding and quality control of selected cosmetic products for cleaning, care and protection of the skin and skin adnexes; deodorant and antiperspirant products and selected dermocosmetic products; discussion on the formulation of selected commercial cosmetic/dermocosmetic products; critical evaluation of marketing information regarding effects of the cosmetic products and training to recommend to patient/user the appropriate product.

Recommended literature:

1. Vasiljević D, Savić S, Đorđević Lj, Krajišnik D. Priručnik iz kozmetologije. Beograd: Nauka; 2009.
2. Schlossman ML. Chemistry and Manufacture of Cosmetics: Cosmetic Specialties and Ingredients. Illinois: Allured Publishing; 2010.
3. Rieger MM. Harry's Cosmeticology. 8th ed. New York: Chemical Publishing; 2000.
4. Kemper FH, Luepke N-P, Umbach W. Blue List: Cosmetic Ingredients. Aulendorf: ECV - Editio-Cantor-Verlag; 2000.
5. Regulation (EC) No 1223/2009 of the European Parliament and of the Concil of 30 November 2009 on cosmetic products. Official Journal of the European Union 2009; L342/59-L342/209.

The total of active learning classes			
Lectures: 30		**Practical classes:** 30	
Teaching methods: lectures, interactive lectures, practical classes, seminars, problem based teaching			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0 or 3	Practical	
Practical classes	3-5	Written	25-50
Colloquia	12-22	Oral	
Seminars	10-20		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Introduction to Pharmaceutical Management

Teachers: Tasić M. Ljiljana, Marinković D. Valentina, Krajnović M. Dušanka, Lakić M. Dragana

Course status: mandatory

Semester: IX	**Year of studies: V**
ECTS points: 2	**Course code:**

Requirements: none

Course aims:

Introduction of students to the general and basic principles of contemporary business/management, and the need for development of the proper work organization; mastering of healthcare system management and the organization of the whole pharmaceutical sector; management of skills required for pharmaceutical business and provision of pharmaceutical services.

Course outcomes:

Student understands the specifics of the pharmaceutical businesses in relation to the healthcare system and the economy; their interrelationships and significance to the general public, pharmacies/medicines manufacturers and patients/individuals; has mastered the basic skills of organization/management of pharmaceutical work processes by knowing the basic working standards; knows and understands the concepts of supply chain and the lifecycle of medicines.

Course contents:

Lectures

Introduction to pharmaceutical management. Basic theories on organization principles; quality system management; organizational changes; organizational models. Healthcare system management; healthcare policy. National drug policy; logistics and supply of the public healthcare system. Pharmaceutical market and businesses of originator, innovative and generic medicines; medicines on the free market and the social concept of medicines. Principles of pharmaceutical marketing. Standards in pharmaceutical businesses; performances and quality. Supply chain (vendor – supplier – healthcare institution). Management of resources in the pharmacy; processes of pharmaceutical care (process maps/algorithms). Management of projects in the pharmaceutical practice; information and communications technologies in pharmacy; assessment of competition in the pharmaceutical businesses.

Practical classes

Panel discussion on topics of processes and management functions – case studies from the industry and pharmacies. Panel discussion and analysis of examples of the national drug policy and procedures of the open procurement of medicines. Analysis of the healthcare organizations from the point of view of legislation, finances, human resources and needs of patients/public. Workshop – examples of strategies of development of businesses according to the selected therapeutic groups of medicines and markets. Homework – analysis and scoring of the good pharmaceutical practices; proposition of concepts for improvement of the pharmaceutical care and industry. Process maps creation.

Recommended literature:

1. Winfield AJ. Pharmaceutical Practice. 3th ed. Churchill Livingstone; 2004.
2. Tasić LJ. Farmaceutski menadžment i marketing. 2. izdanje. Beograd: Placebo; 2007.
3. Smith F. Research Methods in Pharmacy Practice. London: Pharmaceutical Press; 2005.
4. Kayne SB. Pharmacy business management. New York: Pharmaceutical Products Press; 2005.
5. Remington: Science and Practice of Pharmacy. 23st ed. Philadelphia: Lippincott Williams and Wilkins; 2012.

The total of active learning classes

Lectures: 15		**Practical classes:** 15	
Teaching methods: interactive lectures, panel discussions, workshop, homework			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical classes	25	Written	50
Colloquia	20	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmaceutical Marketing

Teachers: Tasić M. Ljiljana, Marinković D. Valentina

Course status: elective

Semester: IX	**Year of studies: V**
ECTS points: 3	**Course code:**

Requirements: none

Course aims:

Widening the knowledge in the field of pharmaceutical marketing; familiarization with the contemporary methods of marketing strategies; awareness of the communication processes taking place in the marketing activities; promotion of the integration of pharmaceutical sciences and management skills.

Course outcomes:

Student will understand the pharmaceutical market and the importance of the appropriate selection of business methods oriented towards the social values; master the analytical methods for the assessment of market conditions (SWOT and portfolio analyses); understand the concept of added value in the strategic pharmaceutical marketing.

Course contents:

Lectures

General concepts in marketing. Strategic marketing, management and development of medicines. General principles of pharmaceutical marketing; marketing mix, models, methods and marketing techniques. Marketing and its purpose. Market segmentation. Strategy and tactics. Analysis of the client needs (medicines prescriber, financier, end users – patients). Marketing research methods. Post approval monitoring of medicines. Marketing of the public health (the social marketing). Legislation and ethics in advertising and marketing of the pharmaceutical products and services. Integrated marketing communications. The value chain and cost effectiveness of medicines.

Practical classes

Investigation, analysis and discussion on the practical examples of the topics presented in lectures. Workshops with case studies on marketing strategies and methods in selected groups of medicines for selected markets. Market research with various methods: strength, weaknesses, opportunities and threats (SWOT), Boston Consulting Group (BSG) matrix. Analysis of the position of selected products and services and comparison to the competitor products/services (benchmarking). Analysis of outer and inner influential factors (situational analysis). Preparation and presentation of the seminar.

Recommended literature:

1. Kotler F. Marketing menadžment. Beograd: Data status; 2006.
2. Tasić LJ. Farmaceutski menadžment i marketing. Beograd: Placebo; 2007.
3. Spilker B. Multinational Pharmaceutical Companies: principles and practices. 2nd ed. Boston: Ravens press; 1994.
4. Dogramatzis D. Pharmaceutical Marketing a Practical Guide. Denver: Interpharm Press; 2002.
5. Dimitris D. Pharmaceutical Marketing a Practical Guide. Denver: Interpharm Press; 2001.

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: interactive lectures, panel discussions, workshops, homework

Grading system:

Exam prerequisites	**Points**	**Final exam**	**Points**

Active participation in lectures	10	Practical	
Practical classes	40	Written	
Colloquia		Oral	50
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Medicines Supply Management

Teachers: Marinkovic D. Valentina, Lakić M. Dragana

Course status: elective

Semester: IX	**Year of studies: V**
ECTS points: 3	**Course code:**

Requirements: none

Course aims:

Introduction of students to: legal regulations and processes related to the selection, procurement (public procurement), distribution and usage of medicines. Student is also familiarized with the basic principles in selection of medicines, methods of public procurement; and good practices in medicines procurement, storage, distribution and transport, as well as with procedures in assurance of traceability of medicines and medical devices, and principles in usage/consumption of medicines.

Course outcomes:

Student is able to understand the principles and definitions related to the good medicines supply. The acquired knowledge enables: understanding of activities in selection, procurement, and usage/consumption of medicines, as well as the working principles related to the sources of supplies, procurement, storage and medicines distribution; gaining skills in analysis, organization and working in the field of medicines and medical devices supply management.

Course contents:

Lectures

Principles and regulations related to the field of wholesales of medicines; principles and regulations related to the public procurements in the healthcare; medicines supply cycle; selection of medicines (guides and formularies, medicines, medical devices and equipment); principles of medicines and medical devices procurement and methods of public procurement (quantification of medicines and medical devices; basic qualitative and quantitative analyses, management of the tender process, tender documentation, medicines donations); assurance of the quality of medicines public procurements; assurance of the quality in the wholesales of medicines; distribution (management of the distribution, transport, storage); organization of the storage and distribution; transport and the cold chain principles; analysis of the medicines usage – aspects of the wholesalers and healthcare institutions.

Practical classes

Examples and analyses of the procedure of qualification and quantification of medicines and medical devices for the public procurements; examples of the work organization and assurance of the quality in companies dealing with the medicines supply; examples of procedures related to the complaints and product recalls from the market. Seminar.

Recommended literature:

1. World Health Organization. Managing Drug Supply. 2nd ed. Connecticut: Kumarian Press; 1997.
2. World Health Organization. Quality assurance of pharmaceuticals, vol. 1 and 2. Connecticut: Kumarian Press; 1999.
3. Zakoni, propisi i tehnička uputstva od značaja za upravljanje snabdevanjem lekovima i medicinskih sredstava.
4. Lilja J, Salek S, Alvarez A, Hamilto D. Pharmaceutical system. Chichester: John Wiley & Sons. 2008.

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: lectures, seminars, visits to medicines wholesalers, problem based learning

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	5	Practical	
Practical classes	25	Written	50
Colloquia		Oral	
Seminars	20		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmacoeconomics and Pharmacoepidemiology

Teachers: Tasić M. Ljiljana, Lakić M. Dragana

Course status: elective

Semester: IX	**Year of studies: V**
ECTS points: 3	**Course code:**

Requirements: none

Course aims:

Introduction to the basic principles in the fields of pharmacoeconomy and pharmacoepidemiology. Training for the critical assessment of information in the fields of pharmacoeconomy and pharmacoepidemiology. Introduction to research methods in these fields. In order to accomplish this, student is familiarized with the different types of pharmacoeconomic and pharmacoepidemiologic methods.

Course outcomes:

Upon completion of this course, student will be able to critically evaluate pharmacoeconomic and pharmacoepidemiologic problems, to use databases related to the usage of medicines, to apply the basic methods in pharmacoepidemiology, to recognize methods of pharmacoeconomic analyses, to critically evaluate expenses and outcomes of usage of medicines and medical devices.

Course contents:

Lectures

The importance of pharmacoeconomy and pharmacoepidemiology. Rational usage of medicines. Basic principles of pharmacoepidemiologic methods of collection, processing and analysis of data related to the usage of medicines and medical devices. Methods of detection of adverse and useful effects of medicines, including spontaneous reporting, *ad hoc* epidemiological studies and by using the databases. Study designs. Cross section studies, observational studies (cohort studies and case-control studies) and clinical studies. Medicines usage studies. Favoritism. Healthcare economy and the quality of life related to the health. Healthcare technologies and assessment of suitability. Health, social and economic aspects and outcomes of medicines usage. Basic principles in pharmacoeconomic methods of collection, processing and analysis of data. CMA, CEA, CBU and CUA studies.

Practical classes

Usage of pharmacoeconomic and pharmacoepidemiologic databases. Analysis of pharmacoepidemiologic studies. Analysis of pharmacoeconomic studies. Assessment and selection of the pharmacoeconomic method for the selected therapeutical procedures – case studies. Calculation of expenses for the prevention, diagnostics and treatment. Application of the quality of life measurements – case studies.

Recommended literature:

1. Strom BL. Pharmacoepidemiology. 4th ed. Chichester: John Wiley & Sons; 2005.
2. Hartzema AG , Porta M, Tilson HH, editors. Pharmacoepidemiology. An Introduction. 3th ed. Cincinnati: Harvey Whitney Books Company; 1998.
3. Drummond M, OBrien B, Stoddart G, Torance G. Methods for the Economic Evaluation of Health Care Programmes. 2nd ed. Oxford: Oxford University Press; 1997.
4. Novaković T. Priručnik za farmakoekonomske evaluacije. Beograd: EAR; 2006.
5. Bootman J, Townsend R, McGhan W. Principles of Pharmacoeconomics. 3rd ed. Cincinnati: Harvey Whitney Books Company; 2005.

The total of active learning classes

Lectures: 30	**Practical classes:** 15

Teaching methods: lectures, seminars, workshops, calculations, case studies (homework), discussion			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical classes	30	Written	30
Colloquia		Oral	20
Seminars	15		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Pharmaceutical Practice

Teachers: Tasić M. Ljiljana, Krajnović M. Dušanka, Marinković D. Valentina, Lakić M. Dragana

Course status: mandatory

Semester: X	**Year of studies: V**
ECTS points: 3	**Course code:**

Requirements: Pharmacotherapy

Course aims:

Gaining of the knowledge, basic concepts and the skills of pharmaceutical practice at all levels of the healthcare system. Introduction to the essential and the current medicines list; classification of medicines and medical devices; sources of information on medicines and medical devices. Mastering of all aspects of medicines usage; processes of dispensing of the finished medicines (with or without the prescription); administrative processes; concepts of medicines safety and medicines usage.

Course outcomes:

Student is familiar with the pharmaceutical healthcare system; knows the classification of medicines, medical devices and pharmaceutical services. Student correctly searches for information on medicines; analyzes information; properly handles prescriptions and orders; performs basic calculations; is familiar with the basic logistic processes of the pharmacy; understands and accepts the concepts of: clinical practice, management of the safety and risks related to medicines, as well as the health promotion.

Course contents:

Lectures

Pharmaceutical sector and the healthcare system; concept of the essential, national, hospital list of medicines. Pharmaceutical practice in the public and hospital pharmacies in the healthcare system (management of activities: planning, procurement, storage, dispensing, and distribution of medicines). Medicines – classification, groups, dosage forms. Medical devices and healthy products. Proscription – the structure and dispensing of the finished medicines and medical devices. Resources od information: types of information, sources, levels, information management. The role of the public pharmacy in the promotion of health and prevention of illnesses. Patient counseling. Clinical practice – basic concepts of improvement of therapy and outcomes in both public and hospital pharmacies.

Practical classes

Analysis of the healthcare and pharmaceutical legislative related to the pharmaceutical practice. Independent work and solving of the presented case study from the pharmaceutical practice. Critical analysis of case studies – selected working activities in the public and hospital pharmacy; simulation of working procedures with prescription or order, calculations; simulation of patient counseling; working with the pharmaceutical sources of information; classification of information and preparation of report. Monitoring of the safe usage of medicines. Workshop on the selected topic from the pharmaceutical practice. Dispensing of over the counter medicines. The role of pharmacist in self-medication. The role of pharmacists in the promotion of health and prevention of illnesses

Recommended literature:

1. Winfield AJ, Richards RME, eds. Pharmaceutical practice. 3rd ed. Philadelphia: Churchill Livingstone; 2004.
2. Taylor K, Harding G. Pharmacy Practice. New York: Taylor & Francis London; 2001.
3. Nerecenzirana skripta za predmet Farmaceutska praksa, 2012.
4. Remington: Science and Practice of Pharmacy. 21st ed. Philadelphia:Lippincott Williams and Wilkins; 2005.

5. Tasić LJ, Krajnović D, Petrić M, Lakić D, Tadić I. Farmaceutska praksa. Praktikum. Beograd: Univerzitet u Beogradu - Farmaceutski fakultet; 2009.			
The total of active learning classes			
Lectures: 30		**Practical classes:** 30	
Teaching methods: interactive lectures, panel discussions, workshop, homework			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0 or 2	Practical	0 or 3
Practical classes	15	Written	60
Colloquia	20	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Introduction to the pharmaceutical biotechnology

Teachers: Savić D. Snežana, Milić R. Jela, Živković P. Lada, Savić M. Miroslav, Stojić-Vukanić M. Zorica, Antić-Stanković A. Jelena, Stojanović S. Biljana

Course status: elective

Semester: X	**Year of studies: V**
ECTS points: 4	**Course code:**

Requirements: Biology with human genetics, Pharmaceutical microbiology, Immunology, Pharmaceutical chemistry, Pharmaceutical technology 1 and Pharmaceutical technology 2

Course aims:

Introduction to the possibilities of application of recombinant DNA technology and DNA hybridoma technology in biomedicine, specifically for development of biological drugs/biopharmaceutics; acquainting with the formulation, manufacturing and therapeutical application of peptides, proteins and monoclonal antibodies; encouragement of the critical evaluation of information on biological products, usage of professional references and preparation of written or verbal reports.

Course outcomes:

Knowledge of the basic principles in development of the biological drug product and manufacturing of recombinant peptides, proteins and monoclonal antibodies for therapeutical application; awareness of the most significant biological products which are registered or are undergoing clinical studies; encouragement of the critical evaluation, application and transfer of knowledge of biological products to patients and other healthcare providers.

Course contents:

Lectures

Molecular biotechnology – recombinant DNA technology (DNA transfer, sources of DNA, synthetic DNA, cDNA, sequencing of DNA, DNA hybridization). Cell cultures. Expression systems. Review of techniques used for preparation and refinement of proteins. Monoclonal antibodies – types and preparation techniques. Protein characterization techniques. Stability of proteins. Excipients used for the formulation of biological products/biopharmaceutics for parenteral and other routes of application. Formulation and biopharmaceutical aspect of biological drug products. Manufacturing of biological products, with special emphasis on the liophylization process. Improvement of stability and pharmacokinetic profiles of biological products and reduction of their immunogenic potential – mutagenesis on the primary sequence, PEG-illation techniques, and encapsulation/adsorption in/on specific carriers: biodegradable microspheres, colloidal/nanoparticulate systems for delivery of proteins and monoclonal antibodies, and mechanisms of targeted protein release. Examples of biological products/biopharmaceutics: insulin, erythropoietin, coagulation factors, colony stimulating factors, therapeutic monoclonal antibodies. Shelf-life of protein drugs, storage of biopharmaceutics. Legal regulations for marketing of biological products/biopharmaceuticals and biologically similar drugs. Dispensing and application of biological drugs.

Recommended literature:

1. Kayser O, Warzecha H. Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications. 2nd ed. Weinheim: Wiley-VCH Verlag GmbH&Co. KGaA; 2012.
2. Groves MJ. Pharmaceutical Biotechnology. 2nd ed. Boca Raton: CRC Press Taylor&Francis Group; 2006.
3. Allen LV, Popovich NG, Ansel HC. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 8th ed. Philadelphia: Lippincott Williams&Wilkins; 2010.
4. Walsh G. Pharmaceutical Biotechnology - Concepts and Applications. NJ: John Wiley & Sons, 2007.
5. Selected publications from: Journal of Biotechnology, Nature Biotechnology, Trends in Biotechnology, Current Pharmaceutical Biotechnology, Journal of Industrial Microbiology and

Biotechnology, Journal of Biomedicine and Biotechnology.			
The total of active learning classes			
Lectures: 30		**Practical classes:** 15	
Teaching methods: lectures, seminars, interactive discussion with experts from the field			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0-5	Practical	
Practical classes		Written	36-70
Colloquia		Oral	
Seminars	10-25		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Acute Drug Poisoning with Analytics

Teachers: Matović J. Vesna, Vujanović L. Dragana, Đukić M. Mirjana, Antonijević M. Biljana, Bulat L. Zorica

Course status: elective

Semester: X	**Year of studies:** V
ECTS points: 4	**Course code:**

Prerequisite for attending course: none

Course aims:

Acquisition, adoption, synthesis and implementation of knowledge about toxicity of most important medicine groups which are causers of poisoning both at home and abroad and about detection and determination of drugs and their metabolites in biological material.

Course outcomes:

Qualification of masters of pharmacy to detect and determine assay of drug-causer of poisoning in biological material which is significant for toxicological analysis and to follow drug kinetics during the therapy, and especially to, considering that he is in direct contact to the patient, point out on toxic effects of drugs at overdose which is significant in the terms of prevention of drug poisoning.

Course contents:

Lectures

Epidemiological aspect of drug poisoning. General principles of drug poisoning treatment. Mono and polymedicament poisoning. Benzodiazepines-the most common causers of drug poisoning. Other drug groups: nonopioid analgesics (nonsteroidal anti-inflammatory drugs and paracetamol), antibiotics (the penicillins, cephalosporins, aminoglycoside antibiotics, tetracyclines, chloramphenicol…), drugs affecting CNS (barbiturates, benzodiazepines, antidepressants, antipsychotics, antiepileptics), drugs affecting CVS (beta blockers, Ca-channel blockers, cardiotonic glycosides), oral antidiabetics, antihistaminics, antineoplastics (aliklating agents, antimetabolites, cytotoxic antibiotics, plant derivatives), antiretroviral agents.

Practical training

Practical training is integrated extension of lectures and it is designed with the goal that students master problem of acute drug poisoning. Case study of poisoning with representatives of group of drugs which were processed during lectures. Case study analysis.

Recommended literature:

1. Matović V, Bulat Z, Buha A. Trovanja lekovima-odabrana poglavlja. Beograd: Univerzitet u Beogradu-Farmaceutski fakultet; 2013.
2. Olson KR. Poisoning & Drug Overdose. 4th ed. Olson RK, editor. New York: McGraw-Hill Medical; 2004.
3. Joksović D. Akutna trovanja lekovima, Beograd: Rivel , 1999.
4. Barile FA. Clinical Toxicology-Principles and Mechanisms. London: Informa Healthcare; 2007.
5. Moffat AC, Osselton MD, Widop B. Clark□s analysis of drugs and poisons in pharmaceutical, body fluids and post-mortem materials. 3rd ed. London: Pharmaceutical Press; 2004.

The total of active learning classes

Lectures: 30	**Practical training:** 15

Teaching methods: lectures, case study analysis

Grading system:

Exam prerequisites	Points	Final exam	Points

Active participation in lectures	10	Practical	
Practical training	20	Written	50
Colloquia	20	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Pharmaceutical Regulations in Drug Control

Teachers: Zečević L. Mira; Malenović M. Anđelija; Stojanović S. Biljana

Course status: elective

Semester: X	**Year of studies:** V
ECTS points: 4	**Course code:**

Prerequisite for attending course: none

Course aims: Acquisition of knowledge about current regulations in drug control. Enabling students for interpretation of regulative demands which influence on efficiency, quality and safety of drugs.

Course outcomes:

After derived classes in this course student is capable to apply obtained knowledge in drug control laboratory. Demonstrates and conduct drug control procedure according to appropriate regulation demands in the phases of research and development, during the manufacturing procedure and during the release phase. Analyses structure of the Drug master file and participates in preparation of documentation for drug registration.

Course contents:

Lectures

Demands of Good manufacturing practice for drug control and actives pharmaceutical substances, demands of Good laboratory practice and Good control laboratory practice. Standard operative procedures. Classification of active compounds, basic characteristics of European file on active pharmaceutical substances and certificates about compatibility to European Pharmacopoeia Monograph. Development and certification confirmation for active pharmaceutical substances and pharmaceutical form. General examination and specific examination for different pharmaceutical form. Regulatory demands for biotechnological drugs quality. Organic impurities, inorganic impurities and residual solvents in active pharmaceutical substances and pharmaceutical forms, regulytory demands and examination methods. Genotoxic impurities, origin, classification and examination methods. Forced degradation studies, conducting of study, method development for stability tracking, interpretation and analysis of results. Basic stability studies, frequency and conditions of performance, method for stability testing and results analysis. Significance of stability in drug expiring date determination. Examination and regulatory demands which are significant for packing material. Composition of drug documentation. Ways and procedures of drug registration.

Practical training

Laboratory quality control of different pharmaceutical forms according to defined specification. Discussion of compatibility of results to specification for active pharmaceutical substances and pharmaceutical forms. Consideration of potential ways of degradation of active pharmaceutical substances. Expiring date evaluation-procedures and computing tasks.

Recommended literature:

1. International Conference on Harmonization Guidance (dostupno na http://www.ich.org).
2. Smith RJ, Webb ML. Analysis of drug impurities. Oxford: Blackwell Publishing; 2007.
3. Juran JM, Blanton GA. Juran□s Quality Handbook. 5th ed. New York: McGraw–Hill; 1999.
4. Baertschi SW, editor. Pharmaceutical Stress Testing: Predicting Drug Degradation. Boca Raton: Taylor & Francis;2005.
5. Ahuja C, Scypinski C. Handbook of modern Pharmaceutical analysis. Volume 3. San Diego: Academic press; 2010.

The total of active learning classes

Lectures: 30	**Practical training:** 15

Teaching methods: lectures, practical laboratory training, interactive teaching, workshops

Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	5	Practical	
Practical training	25	Written	60
Colloquia	10	Oral	
Seminars			
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Novel dosage forms

Teachers: Primorac M. Marija, Ibrić R. Svetlana, Đekić M. Ljiljana

Course status: elective

Semester: X	**Year of studies: V**
ECTS points: 4	**Course code:**

Requirements: Pharmaceutical Technology 2, Pharmaceutical Technology 3

Course aims:

Introduction to types, formulation and properties of the novel dosage forms/therapeutic systems for peroral, parenteral, transdermal, pulmonal, buccal, ophthalmic, intravaginal, intrauterine and nasal application; introduction to the specific properties of colloidal carriers of drug substances; presentation of the specific points related to the influence of the physicochemical, biological and pharmaceutical-technical factors on processes of the drug release and absorption from the novel dosage forms/therapeutic systems.

Course outcomes:

Knowledge of the types, formulation and properties of the novel dosage forms/therapeutic systems for peroral, parenteral, transdermal, pulmonal, buccal, ophthalmic, intravaginal, intrauterine and nasal application; as well as the specific properties of colloidal carriers of drug substances; knowledge and understanding of the specific points related to the influence of the physicochemical, biological and pharmaceutical-technical factors on processes of the drug release and absorption from the novel dosage forms/therapeutic systems.

Course contents:

Lectures

Approach to the formulation of the novel dosage forms/therapeutic systems, and mechanisms of the active substance release. Novel dosage forms/therapeutic systems for peroral, parenteral, transdermal, pulmonal, buccal, ophthalmic, intravaginal, intrauterine and nasal application – types, formulation and properties. Novel dosage forms/therapeutic systems with the targeted drug release. Chronotherapeutic systems. Colloidal carriers of the drug substances: liposomes, nanoparticles, nanoemulsions and microemulsions – properties and applications.

Practical classes

Novel dosage forms/therapeutic systems for peroral, parenteral, transdermal, pulmonal, buccal, ophthalmic, intravaginal, intrauterine and nasal application – examples and assignments related to the drug release profiles. Self-dispersing carriers of drug substances for peroral application – classification, formulation and elaboration of the selected examples. Colloidal carriers of the drug substances – preparation, pharmaceutical-technical and biopharmaceutical characterization (selected examples). Preparation of the seminar.

Recommended literature:

1. Allen LV, Popovich NG, Ansel HC. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. Phyladelphia: Lippincot Williams &Wilkins; 2005.
2. Swarbrick J, Boylan JC. Encyclopedia of Pharmaceutical Technology. Second edition. Vol. 1-3. New York, Basel: Marcel Dekker Inc; 2002.
3. Rathbone MJ, Hadgraft J, Roberts MS. Modified-Release Drug Delivery Technology. New York, Basel: Marcel Dekker Inc; 2003.
4. Allen L. Remington: The Science and Practice of Pharmacy. 22nd edition. London: Pharmaceutical Press; 2012.

The total of active learning classes

Lectures: 15	**Practical classes:** 30

Teaching methods: lectures, interactive lectures, practical classes (practical and demonstrative), preparation of the seminar, educational films, calculations			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures	0-3	Practical	
Practical classes	8-12	Written	36-70
Colloquia		Oral	
Seminars	7-15		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Medical devices

Teachers: Malenović M. Anđelija, Vasiljević D. Dragana, Drobac M. Milica

Course status: elective

Semester: X	**Year of studies: V**
ECTS points: 3	**Course code:**

Requirements: Pharmaceutical technology 1

Course aims:

Introduction to the legal regulations related to the manufacturing, quality control, safety assessment, procedure of conformance assessment, entry in the register of medical devices and marketing of medical devices. Acquaintance with the types, composition, structure and basic functional properties of specific categories and classes of medical devices.

Course outcomes:

Student is capable of application of gathered knowledge in order to provide professional information regarding medical devices, as well as the appropriate recommendations and advices, according to the needs of patient and presented diagnosis. Student is capable of working on job positions of entering in the register of medical devices, monitoring the sales of medical devices, assessment of quality through documentation, and vigilance on medical devices.

Course contents:

Lectures

Laws and regulations in the field of medical devices, national and European legislative. Categorization of medical devices, quality and safety requirements for the general medical devices, *in vitro* diagnostic medical devices and active implantable medical devices. Rules for classification of the general medical devices. Clinical studies, biocompatibility assessment, biological tests for the assessment of biocompatibility. Materials for manufacturing of medical devices – types, properties, stability and application. Requirements regarding manufacturing of medical devices. Structure of the technical document. Procedure of the assessment of conformance of medical devices, selection of the procedure according to the category and class of the medical device. Application of the risk management principles for medical devices. Marketing authorization and vigilance of medical devices. Types, composition, compounding/manufacture and properties of selected groups of medical devices from the market.

Practical classes

Acquaintance with the general properties of the medical devices available in pharmacies. Case studies of classification of selected medical devices. Procedure of the entry in the register of medical devices – case study. Laboratory practical classes: determination of the blood sugar level using the self-test apparatus, testing and interpretation of results obtained using strips for urinalysis.

Recommended literature:

1. Zakon o lekovima i medicinskim sredstvima. Službeni glasnik RS 30/2010 i 107/2012.
2. Directive 90/385/EECof the European parliament and of the council on active implantible medical devices, 1990L0385 — EN— 11.10.2007.
3. Directive 98/79/EC of the European parliament and of the council on in vitro diagnostic medical devices, 1998L0079 — EN — 20.11.2003.
4. Directive 93/42/EEC of the European parliament and of the council concerning medical devices, 1993L0042 —EN—11.10.2007.
5. Gad SC, McCord MG. Safety Evaluation in the Development of Medical Devices and Combination Products. New York: Informa Healthcare; 2008.

The total of active learning classes

Lectures: 30		**Practical classes:** 15	
Teaching methods: lectures, interactive lectures, practical classes, seminars			
Grading system:			
Exam prerequisites	**Points**	**Final exam**	**Points**
Active participation in lectures		Practical	
Practical classes	3-10	Written	70
Colloquia		Oral	
Seminars	12-20		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study program: Pharmacy

Course title: Experimental Design in Pharmacy

Teachers: Zečević L. Mira; Malenović M. Anđelija; Stojanović S. Biljana, Ibrić L. Svetlana

Course status: elective

Semester: X	**Year of studies:** V
ECTS points: 3	**Course code:**

Prerequisite for attending course: none

Course aims: Introduction to the significance and application of experimental design in different phases of method development and validation which are used in drug control, as well as in formulation development of formulations of different pharmaceutical forms.

Course outcomes:

After derived classes in this course student is capable to apply obtained knowledge in selection of appropriate experimental design in certain phases of pharmaceutical development, perform experiments according to selected design and to interpret and analyze obtained results.

Course contents:

Lectures

Experimental design-significance and application. Basic term and definitions. Experiments with one factor and experiments with multiple factors. Tabular and graphical display of experimental plan. Area of answer and interpretation. Application of different types of experimental design in screening phase of experiment (full factor and fraction factor design). Optimization with application of experimental design (Central-compositional, Box-Behnken as well as other types of design). Method robust evaluation using Plackett-Burman and fractional factor design with appropriate graphical and statistical evaluation of factor significance. Defining boundaries for the convenience of the system from results obtained in robust evaluation process. Defining of appropriate mathematical model and statistical evaluation of model adequacy. Application of experimental design in different phases of drug manufacturing and control (development and optimization of methods for product control, development of optimal formulation, etc).

Practical training

Creating of experiment plan for different types of experimental design using appropriate software package. Performing of experiment, data entry and interpretation of obtained results. Analysis of different examples from the field of method development and formulation development. Task solving, displaying and presentation of obtained results with certain theoretical analyisis.

Recommended literature:

1. Deming SN, Morgan SL. Experimental design: a chemometric approach. Amsterdam: Elsevier; 1993.
2. Hinkelmann K, Kempthorne O. Design and analysis of experiments. New Jersey: John Wiley & Sons; 2005.
3. Wu JCF, Hamada MS. Experiments: planning, analysis, and optimization. New Jersey: John Wiley & Sons; 2009.
4. Vander Heyden Y, Nijhuis A, Smeyers-Verbeke J, Vandeginste BGM, Massart BGM. Guidance for Robustness/Ruggedness Tests in Method Validation. J Pharm Biomed Anal. 2001; 24: 723–53.
5. Ermer J, Miller JHMcB Editors: Method Validation in Pharmaceutical Analysis. Weinheim: WILEY-VCH Verlag GmbH & Co. KgaA; 2005.

The total of active learning classes

Lectures: 30	**Practical training:** 15

Teaching methods: lectures, laboratory training, interactive teaching

Grading system:

Exam prerequisites	Points	Final exam	Points
Active participation in lectures	5	Practical	
Practical training	25	Written	50
Colloquia		Oral	
Seminars	20		
Other activities			

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy

Course title: Students Professional Practice

Teachers:

Course status: mandatory

Semester: X	**Year of studies: V**
ECTS points: 10	**Course code:**

Requirements: finished courses (passed final exams) from the first four years of studies

Course aims:

Application and specialization of knowledge acquired during the studies. Gathering and development of the new knowledge and skills from the fields of pharmacotherapy, pharmaceutical technology, pharmaceutical practice, pharmaceutical healthcare, clinical pharmacy, pharmaceutical administration, regulations and professional legislative. Development of the personal and professional attitude, conduct and responsibility.

Course outcomes:

Upon completion of the professional practice, under supervision of the pharmacist, student is expected to be capable of conducting supply, receive and storage of medicines and medical devices; to check the appropriateness of the medicine prescription; to perform extemporaneous compounding of medicines; to dispense medicines; to identify problems related to the usage of medicines; to monitor and register adverse reactions to medicines; to perform administrative data elaboration and keep the professional records. It is also expected that the student will develop skills of communication with patients, colleagues and physicians.

Course contents:

Students professional practice is held at the public and hospital pharmacy which are the study bases of the Faculty of Pharmacy. Professional practice is organized, conducted and monitored by the responsible teachers from the Faculty, in cooperation with mentors from the praxis, assigned by the Faculty.

The public pharmacy

The division of tasks and responsibilities of employees; the look, layout and purposes of rooms; contemporary professional literature; properties of the software used by employees; work instructions for operational work; rules of conduct and dress code of employees at the pharmacy.
Planning, supply, receiving and storage of medicines and medical devices. Extemporaneous compounding. Medicines dispensing. Pharmaceutical healthcare. Conduct of administrative activities.

The hospital pharmacy

The division of tasks and responsibilities of employees; the look, layout and purposes of rooms; contemporary professional literature; properties of the software used by employees; work instructions for operational work; rules of conduct and dress code of employees at the pharmacy; organizational units within the hospital that cooperate with the hospital pharmacy.
Planning, supply, receiving and storage of medicines and medical devices. Dispensing and distribution of medicines. Extemporaneous compounding. Clinical pharmacy/pharmaceutical healthcare. Conduct of administrative activities.

The total of active learning classes

Lectures:	**Practical classes:** 300

Teaching methods:

Inclusion in the work processes of the public/hospital pharmacy, consultations and preparation of the journal of activities performed by the student during the professional practice.

Grading system:

Certification of the student's journal of the professional practice, by the responsible teachers and mentors responsible for organization, conduction and monitoring of the professional practice.

University of Belgrade Faculty of Pharmacy	Integrated academic studies of PHARMACY	

Study programme: Pharmacy	
Course title: Final Work	
Semester: X	**Year of studies: V**
ECTS points: 10	**Course code:**
Requirements: finished all courses of the study programme, in the total of 290 ECTS	

Course aims:

Student is capable to apply basic, theoretically methodological, scientific and professional and professionally applicative knowledge and methods for solution of specific problems relative to the selected topic of the final work. Through the preparation of the final work the student, by studying representative references or by conducting experiments, studies specific problem, its structure and complexity, and based on the performed analysis makes conclusions on possible methods of its solution. Furthermore, student is trained on how to write the final work, present in the specified time frame, and discuss on the matter with the experts.

Course outcomes:

Student has gained competencies to, based on the knowledge and skills gained during the studies, conduct experiments or bibliographic analysis of the references, write the work and present it in front of the competent commission.

Course contents:

Final work represents research activities of the student enabling therefore introduction to the methodology of research in all fields related to pharmacy. Final work topic can be either experimental or bibliographic. Upon conduction of the research, student prepares the final work that contains the following elements: introduction, theoretical part, experimental part (if the final work is experimental), results and discussion, conclusion and references. Defense of the final work consists of the oral presentation of the work by the student, followed by interrogation and discussion with the competent commission.

Teaching methods:

During preparation of the final work, mentor provides the necessary instructions to student, directs him to the specific references, helps with the selection of the research method, analyses and elaboration of the obtained results, and drawing of the appropriate conclusions. In this stage of the preparation of the final work, student can have additional consultations with the mentor or other teachers dealing with the topics related to the final work, if necessary. If the final work requires conduction of experiments, mentor introduces the student to the work in the laboratory, selection of chemicals, protection measures, handling with instruments, etc.

Grading system:

Grade for the final work represents the sum of points related to:

- Conducted experiments (if the final work is experimental)
- Written work
- Presentation of the work
- Responses to interrogation by the competent commission