University of Kragujevac

Faculty of Medical Sciences

Pharmacy - Integrated academic studies

Study program

FIRST YEAR

General and inorganic chemistry
Pharmaceutical biology with genetics
Fundamentals of human morphology
Analytical chemistry
Organic chemistry
Introduction to pharmaceutical technology
Fundamentals of human physiology
Statistics in pharmacy

SECOND YEAR

Fundamentals of human biochemistry
Pharmaceutical technology 1
Pharmaceutical microbiology
Fundamentals of pathological human physiology
Medical chemistry 1
Methods of instrumental analysis
Pharmaceutical communication skills
Pharmacology 1
Pharmaceutical chemistry 1
Introduction to pharmaceutical practice
Fundamentals of physical chemistry
Processing of measurement results
Medical biochemistry

THIRD YEAR

Pharmacology 2
Immunology
Pharmaceutical chemistry 2
Bromatology
Medicinal chemistry 2
Pharmacognosy
Toxicology
Dispensing drugs in pracitice
Pharmaceutical technology 2
Clinical propaedeutics for pharmacists
Pharmaceutical ethics with international regulative
Nutritional supplements
Research in basic pharmaceutical science
Radiopharmacy

FOURTH YEAR

Clinical pharmacy 1
Phytotherapy
Industrial pharmacy with cosmetology
Biopharmacy
Treatment of infective diseases
Pharmaceutical biotechnology
Social pharmacy
Clinical pharmacy 2
Sports pharmacy

Immunization and vaccination
Drug addiction and drug abuse
Research in clinical pharmacology

FIFTH YEAR
Clinical pharmacy 3
Pharmacovigilance
Pharmacoepidemiology
Pharmacokinetics
Applied pharmaceutical biotechnology
Professional student practice
Final work-research
Final work-design and defense

Table 5.2. Course specification

Study program: Pharmacy – Integrated academic studies

Course unit: GENERAL AND INORGANIC CHEMISTRY

Teachers: Marija Živković, Ratomir Jelić, Gordana Radić

Course status: Mandatory

ECTS: 9

Prerequisites: Enrolled in first year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring the basic knowledge and skills of atomic and molecular structure and of chemical changes, chemical bonds, general properties of solutions, general features of the reactions and the main parameters which affect these properties, elements of thermodynamics and kinetic as well as understanding the chemistry of elements and their compounds together with the laws of chemical periodicity.

Learning outcomes of course unit:

Knowledge and understanding basic terms in the field of general and inorganic chemistry:

Physical properties of a substance, substance state and changes, pure substance – mixture, elements – compounds, atoms – molecules, chemical formulae – reactions, stoichiometry laws, a mole unit, and calculations with concentrations and other chemical quantities, atomic structure, chemical bonding, gases, liquids, and solids, properties of solutions, electrolytes, thermochemistry and electrochemistry, chemical equilibrium, chemical kinetics, acids and bases, inorganic chemistry fundamentals and nomenclature, general properties and reactions of representative elements and their important compounds.

Acquiring knowledge and skills with all important stoichiometry calculations and with experimental skills in a chemical laboratory, in relation with certain general chemistry contents.

Course unit contents:

Theoretical classes

A short introduction to the development of chemistry. Matter and energy. The laws of stoichiometry. Models of atomic structure. Electronic configuration and the periodic system of elements. Chemical bonds and theories of chemical bonds. Intermolecular interactions. State of matter and aggregate states. Laws of ideal gas behavior. Types of chemical reactions. Oxidation-reduction equations. Energy changes in chemical reactions. Basic thermochemical laws. Basic types and properties of inorganic compounds. Coordination compounds. Basic concepts: central atoms, ligands, stability, biological importance. Disperse systems. Solutions and quantitative composition of solutions. Colligative properties of the solution. Chemical kinetics. Chemical equilibrium. Electrolytes. Acids and bases. Equilibria in electrolyte solutions. Ionic product of water. pH value of the solution. Buffers and the role of buffers in the body. Equilibria in heterogeneous systems. Hydrolysis.

Chemistry of the elements of the periodic system: elements in nature, main applications, properties of elements, important compounds, and their application in pharmacy.

Practical classes

Chemical calculations and practical work in a chemical laboratory, in relation with certain general chemistry contents.

Literature:

Chang R. Chemistry. Tata Mcgraw-Hill Publishing Company Limited, 1998.

Silberberg MS, Amateis P. Chemistry: The molecular nature of matter and change. St. Louis, Missouri, USA: Mosby; 1996.

McMurry J, Hoeger C, Peterson V, Ballantine D. Fundamentals of General, Organic, and Biological Chemistry, 7th Edition. Pearson Education. 2013.

Number of active teaching hours:	Lectures: 60	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)			
Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**70**
practical classes/tests		written examination	
Seminars/homework			
Project			
Other			

Grading system		
Grade	**No. of points**	**Description**

10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL BIOLOGY WITH GENETICS

Teachers: Marina Gazdić Janković, Vladislav Volarević

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in first year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills in pharmaceutical biology and genetics.

Learning outcomes of course unit:

Knowledge about cell structure; differences between prokaryotic and eukaryotic cells and between plant and animal cells; the morphology and role of the cellular organelles; transport of matter across the cell membrane; organization and function of plant tissues and organs; reproduction of unicellular and multicellular organisms; Knowledge of the human karyotype; organization and function of the human genome, DNA and genes; mechanism of DNA replication; processes in protein synthesis and regulatory mechanisms of gene expression; chromosomal aberrations and mutations; types of inheritance; the basic principles of genetic engineering.

Course unit contents:

Theoretical classes

Organization of prokaryotic and eukaryotic cells. Plant and animal cells. Cell organelles. Cell membrane - structure, transport of molecules through the cell membrane. Plant tissues and organs. Reproduction of unicellular and multicellular organisms. Gametogenesis. Organization and function of the human genome. Chromosomes of eukaryotes. Nucleic acids - structure and functions. DNA replication. Protein synthesis - transcription and translation. Regulation of transcription and translation. Gene mutations. Basics of pharmacogenetics and teratogenic agents. Chromosomal aberrations: structural and numerical. Patterns of inheritance. Genetic engineering - recombinant DNA technology.

Practical classes

Differences between prokaryotic and eukaryotic cells. Differences in the structure and function of plant tissues and their connection within plant organs and the whole organism. Gametogenesis: solving problems for gametogenesis. Methods in human cytogenetics: direct and short-term cultivation methods. Peripheral blood lymphocyte culture. Methods of human chromosome staining: analysis of human chromosomes stained with ordinary dye and G technique. Tests in genotoxicology. Mendel's inheritance - solving problems. Non-Mendelian inheritance - polygenic and multifactorial inheritance. Recombinant DNA methods in medicine.

Literature:

Robinson TR. Genetics for dummies. John Wiley & Sons; 2010.
Russell PJ. iGenetics: A Molecular Approach, 2nd Edition. Reed College; 2006.
Strachan T, Read A. Human molecular genetics. New York:Garland Science; 2010.
Turnpenny P, Ellard S. Emery's Elements of Medical Genetics, 15th Edition. Elsevier Science. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**40**	oral examination	
practical classes/tests		written examination	**60**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: FUNDAMENTALS OF HUMAN MORPHOLOGY

Teachers: Ivana Živanović-Mačužić, Zoran Milosavljević, Marina Jovanović

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in first year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills in human anatomy, cytology and histology

Learning outcomes of course unit:

After successfully completing the course, students will be able to:

Fundamentals of human morphology part 1:

identify and describe the anatomical structures of skeletal, muscular, cardiovascular, respiratory, gastrointestinal, urogenital, nervous and endocrine systems; identify and describe the anatomy of the sensory organs; demonstrate sufficient knowledge about the structure and function of the human body; develop a vocabulary of appropriate terminology to effectively communicate anatomy-related information to future coworkers.

Fundamentals of human morphology part 2:

use common microscopic methods to study cells, tissues and organs in the laboratory; describe different types of cells, especially human cells; functional and structural similarities and dissimilarities between them; describe structure and function of nuclei, organelles and other cellular components; understand fundamental facts regarding structure, cellular arrangement and microscopic anatomy features of human tissues; understand fundamental characteristic about structure and basic function of human organs within the organ systems.

Course unit contents:

Theoretical classes

Fundamentals of human morphology PART 1: Basic anatomical nomenclature. Anatomical planes and lines. Anatomy of skeletal, muscular, cardiovascular, respiratory, gastrointestinal, urogenital, nervous and endocrine systems. Anatomy of the sensory organs.

Fundamentals of human morphology PART 2: begins with a brief introduction to histological methods for light microscopy and describes the general principles of tissue preparation and examination. The course then goes on to discuss the basic characteristic of the cell structure, morphology of various cell types, cellular arrangements that form the four primary tissues (epithelium, connective tissue, muscle, nerve), and the fundamental microscopic anatomy of human organs within organ systems.

Practical classes

Fundamentals of human morphology PART 1: Basic anatomical nomenclature. Anatomical planes and lines. Anatomy of skeletal, muscular, cardiovascular, respiratory, gastrointestinal, urogenital, nervous and endocrine systems. Anatomy of the eye and the ear.

The laboratory component of the course generally parallels and reinforces lecture concepts through the use of models, skeletal materials and cadaver demonstration.

Fundamentals of human morphology PART 2: Microtechniques and microscopy, Cytoplasm and nucleus, Epithelial tissue and glands, Connective tissue, Muscular tissue, Nervous tissue, Digestive System, Cardiovascular System, Respiratory System, Urinary System, Endocrine System, Female Reproductive System, Male Reproductive System, Eye and Ear, Nervous System

Literature:

Olson T. A.D.A.M. Students Atlas of Anatomy. Baltimore:William & Wilkins; 1996.

Mathews A, Steptoe A. Functional Histology. Edinburgh:Churchill Livingstone; 1988.

Mescher A. Junqueira's Basic Histology: Text and Atlas, 15th Edition (International edition). McGraw Hill. 2018.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Practical work in laboratory, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**70**
practical classes/tests		written examination	
Seminars/homework			
Project			
Other			

Grading system		
Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: ANALYTICAL CHEMISTRY

Teachers: Marija Živković, Ratomir Jelić, Gordana Radić

Course status: Mandatory

ECTS: 9

Prerequisites: Enrolled in first year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills of Analytical chemistry and laboratory practice.

Learning outcomes of course unit:

Knowledge about Analytical chemistry and laboratory practice:

The fundamentals of analytical chemistry and steps of a characteristic analysis, demonstrate and compare qualitative and quantitative analyses methods; identification of ions or compounds in a sample; defining the different volumetric and gravimetric methods, solving volumetric and gravimetric calculations; determination of the detection limits, evaluation, and interpretation of the analytical data, determination of the sources of random errors.

Course unit contents:

Theoretical classes

Introduction to analytical chemistry and its significance. Theoretical fundamentals of chemical methods of analysis. Solutions (concentrations and activity). Chemical equilibrium. Acid-base reactions. Complexation reactions. Deposition reactions. Redox reactions. Qualitative chemical analysis – analysis of cations and anions. Quantitative chemical analysis. Volumetric methods of analysis. Calculations in volumetry. Acidimetry and alkalimetry. Complexometry. Precipitation titrations. Oxidimetry and reductometry. Application of redox titration. Gravimetric methods of analysis.

Practical classes

Introduction to experimental work. Preparation of a specific concentration solution. Calculations tasks. Identification reactions of cations of the first and second analytical groups. Identification reactions of cations of the third, fourth and fifth analytical groups. Identification reactions of anions. Preparation of standard solutions. Calculations in volumetry. Acid-base titrations. Complexometry titrations. Precipitation titrations. Redox titrations. Some examples of gravimetric determinations. Calculations in gravimetry.

Literature:

Chang R. Chemistry. Tata Mcgraw-Hill Publishing Company Limited, 1998.

Silberberg MS, Amateis P. Chemistry: The molecular nature of matter and change. St. Louis, Missouri, USA: Mosby, 1996.

Somenath M. Sample preparation techniques in analytical chemistry. John Wiley & Sons, Inc. 2003.

McMurry J, Hoeger C, Peterson V, Ballantine D. Fundamentals of General, Organic, and Biological Chemistry, 7th Edition. Pearson Education. 2013.

Atkins P, de Paula J, Keeler J Atkins' Physical Chemistry, 11th Edition.. Oxford University Press. 2017.

Ansel H, Stockton J. Pharmaceutical Calculations. LWW Lippincott Williams and Wilkins. 2016.

Number of active teaching hours:	Lectures: 60	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Practical work laboratory, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**20**	oral examination	
practical classes/tests	40	written examination	40
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**

6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: ORGANIC CHEMISTRY

Teachers: Marija Živković, Ratomir Jelić, Gordana Radić

Course status: Mandatory

ECTS: 9

Prerequisites: Enrolled in first year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills in organic chemistry.

Learning outcomes of course unit:

Knowledge about fundamentals of Organic chemistry and its significance for Pharmaceutical chemistry; Structure of atom; Bonding in organic compounds; Chemistry of the functional groups; Hydrocarbons; Alkyl- and aril- halides; Alcohols and ethers; Aldehydes and ketones, reactions of the carbonyl group; Carboxylic acids and derivatives; α, β-unsaturated carbonyl compounds; Heterocyclic compounds; Organic nitrogen compounds; Carbohydrates; Amino acids; Proteins and nucleic acids; Lipides and oils; Mechanism of reactions in Organic chemistry; Protocol of the organic synthesis and their significance in the biological system and medicinal chemistry; On this course students will learn new skills and improve their knowledge about practical laboratory work.

Course unit contents:

Theoretical classes

Fundamentals of Organic chemistry and its significance for Pharmaceutical chemistry; Structure of atom; Bonding in organic compounds; Chemistry of the functional groups; Hydrocarbons; Alkyl- and aril- halides; Alcohols and ethers; Aldehydes and ketones, reactions of the carbonyl group; Carboxylic acids and derivatives; α,β-unsaturated carbonyl compounds; Heterocyclic compounds; Organic nitrogen compounds; Carbohydrates; Amino acids; Proteins and nucleic acids; Lipides and oils. Mechanism of reactions in Organic chemistry; Mechanism of the organic synthesis and their significance in the biological system and medicinal chemistry. Structure of organic compounds. Organic reactions. Electronic effects in organic molecules. Electrometric effects. Hyperconjugation. Aromaticity. Stereochemistry. Stereochemistry of acyclic compounds. Stereochemistry of unsaturated and cyclic compounds. Intermolecular forces. Acid-base equilibrium systems in organic chemistry. Basicity (alkalinity) of organic compounds. Nomenclature, general principles of heterocycle synthesis. Five-member heterocycles with one heteroatom. Six-member heterocycles with one heteroatom. Benzopyridines. Five-member heterocycles with two heteroatoms. Six-member heterocycles with two heteroatoms.

Practical classes

Laboratory glassware and equipment; Distillation of organic compounds; purification and drying of the solvent; Qualitatively detection of different organic compounds; Mechanism of free-radical substitution of alkane; Reactions of addition; Synthesis and characterization of acetylene; Mechanism of electrophilic aromatic substitution; Preparation of organic alkyl- and aril- halides; Differences between S_n1 и S_n2 nucleophilic substitution mechanisms; Differences between E1, E2 и $E1_{св}$ elimination mechanisms; Preparation of alcohols, Chemical properties of alcohols; Synthesis of aromatic ethers; Evidence reactions for aldehydes and ketones; Preparation of carboxylic acids; Preparation of esters; Using carbanion in the reactions of condensation; Organometallic compounds; Evidence reactions for amines; Reactions of amines and nitric acid; Proving mechanisms of some reactions; Planning of organic synthesis; Examples of nucleophilic and electrophilic reagents; Chromatography; Using of cyclization reactions in the preparation of natural products and physiologically active compounds. Structure of organic compounds. Organic reactions. Chemical bonds. Electronic effects in organic molecules. Stereochemistry. Stereochemistry of acyclic, cyclic, and unsaturated compounds. Intermolecular forces. Acid-base equilibrium systems in organic chemistry. Heterocyclic compounds with one and two heteroatoms.

Literature:

Lemke T. Foye's Principles of Medical Chemistry. Philadelphia: Wolters Kluwer, 2013.
Gebelein CG. Chemistry and our world. Dubai: Wm.C.Brown Publishers, 1997.
McMurry J, Hoeger C, Peterson V, Ballantine D. Fundamentals of General, Organic, and Biological Chemistry, 7th Edition. Pearson Education. 2013.

Number of active teaching hours:	Lectures: 60	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Practical work laboratory, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	No. of points:	Final exam	No. of points:
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system		
Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: INTRODUCTION TO PHARMACEUTICAL TECHNOLOGY

Teachers: Snežana Cupara, Marina Tomović, Jovana Bradić

Course status: Mandatory

ECTS: 9

Prerequisites: Enrolled in first year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring basic knowledge and skills in Pharmaceutical Technology

Learning outcomes of course unit:

Definition of pharmacy, medical prescription, pharmacopoea, pharmaceutical dosage forms in pharmaceutical technology; Compunding as part of pharmaceutical technology; Type of compounding procedures, specific equipment and methods; National legislation requirements for compounding prescriptions; Type of medical prescription; Use of foreign and national reference literature; Different pharmaceutical formulations for compounding; Methods used in preparation of different dosage forms; Necessary skills for extemporaneous dispensing; Skills for choosing appropriate packaging and labeling in compounding.

Course unit contents:

Theoretical classes

Guide to general good practice requirements; Equipment; Avoidance of contamination; Record keeping; Product formulae; Complete discussion of different prescription formulations: powders, solutions, suspensions, emulsions, suppositories, extractive preparations, creams and ointments; Antimicrobial protection of compunding prescriptions.

Practical classes

General method preparation, Solubility, Stability, Oral solutions, Drops, Gargles and mouthwash; Diffusible suspensions, Indiffusible suspensions, Formulation of suspensions, Additives, Suspensions for external use; Formulation of emulsions, Continental and dry gum method of preparation, Calculation methods for emulsifying agent, Wet gum method, Emulsions for external use; Methods and general principles in cream preparation, Levigation, Incorporation of solids or liquids into cream; Ointment bases, Methods and general principles for preparation of ointments, Pastes; Historical value of suppositories and pessaries, Suppository mold calibration, Displacement values; Calculations used displacement values, Formulae for calculations of necessary quantities; Bulk powders for external use, Formulations of dusting powders, Bulk powders for internal use; Individual unit dose powders, Unit dose capsules; Infusion, Decocts, Extracts (dry, liquid and semisolid), Syrups, Tinctures; Protection need for antimicrobial agents in compounding, Products and materials vulnerable to spoilage, Sources and control of microbial contamination, Selection of preservatives.

Literature:

Marriott JF, Wilson KA, Langley CA, Belcher D. Pharmaceutical Compounding and Dispensing, Pharmaceutical Press, London 2006.
Flegeer C. Handbook of pharmaceutical manufacturing formulations. Washington: CRC Press, 2004.
Loyd A. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 11th Edition. LWW Lippincott Williams and Wilkins. 2017.
Ansel H, Stockton J. Pharmaceutical Calculations. LWW Lippincott Williams and Wilkins. 2016.
Lester Elder D. A Practical Guide to Contemporary Pharmacy Practice and Compounding, 4th Edition. LWW Lippincott Williams and Wilkins. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 45	Other active classes: 0

Teaching methods: Lectures, Discussion, Practical work laboratory, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**5**	oral examination	
practical classes/tests	**45**	written examination	**50**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**

10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: FUNDAMENTALS OF HUMAN PHYSIOLOGY

Teachers: Vladimir Jakovljević, Vladimir Živković, Ivan Srejović

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in first year of Pharmacy – Integrated academic studies

Course unit objective:

Introducing students with basic physiological processes and the mechanisms of their development in the body.

Learning outcomes of course unit:

Knowledge about the basic physiological principles of functioning of cells; Knowledge about the basic physiological principles of functioning of main organic systems (nervous system and excitable tissues, cardiovascular system, hematopoietic system and hemostasis, respiratory system, urogenital system, gastrointestinal system, endocrine system and reproduction); Skills about measurement of basic body functional parameters (blood pressure, ECG, spirometry, blood types, blood sugar and insulin levels, nervous reflexes).

Course unit contents:

Theoretical classes

Review of cell physiology in medical physiology. Transport across the cell membrane. Excitation and contraction of skeletal, smooth and cardiac muscle. Neuromuscular transmission. Sensory nervous system. Physiology of the senses. General features of reflexes. Motor nervous system. Autonomic nervous system. Awake-sleep cycle. Cardiac physiology. Electrical activity of the heart. Mechanical events in the cardiac cycle. Arterial pulse. Physiology of the circulatory system. Structural and biophysical characteristics of circulation. Circulation in arteries and arterioles, capillaries and veins. Circulation in certain regions of the body. Blood physiology; Bone marrow. Leukocytes. Platelets. Erythrocytes. Chemical reactions of hemoglobin. Blood groups. Physiology of the respiratory system. Kidney function. Renal circulation. Glomerular filtration and tubular function. Countercurrent mechanism. Physiology of the gastrointestinal system. Liver function. Hormone secretion, transport and action. Principles of feedback control. Hypothalamic-pituitary axis. Thyroid hormones. Hormones of adrenal gland. Calcium and phosphorus metabolism. Parathyroid hormone and calcitonin. Biosynthesis, effects and regulation of insulin and glucagon secretion. Male and female reproductive system.

Practical classes

Mitochondrial diseases. Lysosomal diseases. Development of new drugs that act on G-protein-coupled receptors. Demyelinating diseases. Myasthenia gravis. Vitamin A deficiency. Hearing loss. Odor detection disorders. Taste detection disorders. Spinal cord injury. Cerebral paralysis. Parkinson's disease. Multiple system atrophy. Organophosphates: pesticides. Electrocardiography. Hypertension. Myocardial infarction. Shock. Cystic fibrosis. Obstructive asthma. Proteinuria. The role of renin in hypertension. Peptic ulcer. Ileus. Constipation. Fever. Hypothyroidism. Hyperthyroidism. Osteoporosis. Diabetes mellitus. Chromosomal disorders. Hyperprolactinaemia.

Literature:

Gunstream SE, Benson HJ, Talaro A, Talaro KP. Anatomy and Physiology Laboratory Textbooks. New York: McGraw-Hill, 1989.
Vander A, Sherma J, Luciano D. Human physiology: the mechanisms of body function. Boston: McGraw-Hill, 1998.
Walter FB. Medical physiology: a cellular & molecular approach. Philadelphia: Elsevier, 2005.
Hall J. Guyton & Hall Textbook of Medical Physiology, 14th Edition, International Edition. Elsevier Science. 2020.
Webster-Gandy J, Madden A, Holdsworth M.Oxford Handbook of Nutrition and Dietetics, 3rd Edition. Oxford University Press. 2020.

Number of active teaching hours:	Lectures: 60	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**15**	oral examination	
practical classes/tests	**15**	written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**

10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: STATISTICS IN PHARMACY

Teachers: Nebojša Zdravković

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in first year of Pharmacy – Integrated academic studies

Course unit objective:

Training students to work on a computer, communicate via a computer network, and search biomedical databases on the Internet. Training of students in overcoming statistical problems that they will encounter in pharmaceutical practice, introduction to the preparation of medical papers (data collection and processing) for students and other congresses.

Learning outcomes of course unit:

Upon completion of the course in Statistics in Pharmacy, students are expected to acquire basic knowledge:

Know the basics of Windows 7, Skills in using computer systems in word processing (MS Word), Data processing skills in crosstab tables (MS Excell), Skill of graphical presentation of research results (MS PowerPoint).

At the end of the course in Pharmacy Statistics, the student is expected to master the following skills:

The skill of searching biomedical databases (PubMed, etc.) and collecting and processing scientific information, Knowledge of data types, data collection and presentation methods, Knowledge of descriptive statistics methods, Knowledge of probability theory and normal distribution, Knowledge of significance tests, and how to compare the meanings of small samples, Knowledge of regression and correlation, Knowledge of non-parametric methods.

Course unit contents:

Theoretical classes and Practical classes

Basics of Windows 7. Word Processors. Program for spreadsheets. Presentation program. Web. Email and security. Viruses. Database overview. PubMed; Types of Data. Frequency distributions. Histograms and other frequency graphs. Medians and quantiles. Environment. Variance. Significant figures. Charts. Probability traits. Binomial distribution. Normal distribution. Sample distributions. Confidence intervals. Hypothesis testing. Principles of significance tests. Significance levels and error types; Comparison of large sample means. t distribution. Regression. Correlation. Non-parametric methods. Mann-Whitney test. Wilcoxon test. Spearman's correlation. Chi-square test.

Literature:

Field A. Discovering statistics using SPSS. London: Sage, 2009.

Motulsky H. Inventive biostatistics. New York: Oxford University Press, 2010.

Joanes D. Pharmaceutical Statistics. London:Pharmaceutical Press, 2005.

Good P. Common errors in statistic and how to avoid them. New York: John Wiley & Sons, 2009.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 15

Teaching methods: Lectures, Discussion, Seminar, Practical application of acquired knowlege

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: FUNDAMENTALS OF HUMAN BIOCHEMISTRY

Teachers: Marina Mitrović, Ivana Nikolić, Sanja Stanković

Course status: Mandatory

ECTS: 5

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

This one-semester course is design for students enrolled in Integrated academic studies of Pharmacy at Faculty of medical science. It provides an overview of the main aspects of biochemistry by relating molecular interactions to their effects on the organism as a whole, especially related to human biology, including regulation of metabolic processes.

Learning outcomes of course unit:

Knowledge about the organization of macromolecules such as proteins, carbohydrates, lipids, nucleic acids and their hierarchical structure and understanding how their assembly into complexes is responsible for specific biological processes. Understand protein functions including enzyme kinetics, activators and inhibitors; coenzymes and prosthetic groups; allosteric enzymes and isozymes; clinical significance of serum enzymes level. Describe major metabolic pathways and their interconnection into tightly regulated networks in the whole human body. Discuss clinical significance of major biochemical parameters used for the diagnosis of various human disease.

Course unit contents

Theoretical classes

Enzymology, Regulation of enzyme activity, Clinical enzymology, Vitamins and coenzymes, Oxidative phosphorylation, ROS - free radicals, Carbohydrates, Lipid metabolism, Cholesterol and lipoproteins, Nucleic acids, Amino acids and proteins, Protein synthesis, Biochemistry of hormones, Metabolism of water and bioelements, The biochemistry of the tissues, Integrative metabolism, Clinical biochemistry.

Practical classes

Enzymology, Regulation of enzyme activity, Clinical enzymology, Vitamins and coenzymes, Oxidative phosphorylation, ROS - free radicals, Carbohydrates, Lipid metabolism, Cholesterol and lipoproteins, Nucleic acids, Amino acids and proteins, Protein synthesis, Biochemistry of hormones, Metabolism of water and bioelements, The biochemistry of the tissues, Integrative metabolism, Clinical biochemistry.

Literature

Alberts, Bruce. Molecular biology of the cell. N.York: Garland Science. 2015.

Peter J. Russell. Genetics. A Molecular approach. San Francisco: Benjamin Cumm i tigs. 2006.

Boron, Walter F. Medical physiology: a cellular & molecular approach. Phyladelphia:Elsevier. 2005.

Walker, Matthew R. Molecular & Antibody probes in Diagnosis. New York: John Wiley&Sons. 1993.

Martin Silberberg Madelyn E. Logan Dorothy B. Kurland Donna G. Friedman. Chemistry: The Molecular Nature of Matter and Change. BostonMcGraw-Hill. 1996.

Baynes J, Dominiczak M. Medical Biochemistry, 5th Edition. Elsevier Science. 2018.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, practice classes, clinical problems solving

Examination methods (maximum 100 points)

Exam prerequisites	No. of points:	Final exam	No. of points:
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system		
Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL TECHNOLOGY 1

Teachers: Snežana Cupara, Marina Tomović, Ana Barjaktarević

Course status: Mandatory

ECTS: 7

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

To enable students to acquire knowledge and skills in the formulation of liquid, semi-solid and solid medicinal preparations through the selection of compatible active and auxiliary medicinal substances, the appropriate dosage form and the application of an adequate pharmaceutical-technological procedure. Train students to use reference literature in order to formulate preparations with adequate dosing, packaging, labeling and storage conditions.

Learning outcomes of course unit:

Upon completion of the course in Pharmaceutical Technology 1, students are expected to acquire basic knowledge: determining the properties and roles of individual components of the pharmaceutical preparation, pharmaceutical-technological manufacturing procedures, dosing, packaging, signaling and quality control of dosage pharmaceutical forms. At the end of the course in Pharmaceutical Technology 1, students are expected to master the following skills: knowledge and skills for independent production of the following pharmaceutical forms: powder and solution for internal and external use, extract, suspension and emulsion for oral and dermal use, ointments, creams, gels and suppositories.

Course unit contents

Theoretical and practical classes

Introduction to pharmaceutical technology, Extractive powder solutions Preparations, Packaging. Isotonization, Sterilization methods, Emulsion suspensions, Semi-solid preparations. Solid dosage forms Rheology, Ophthalmic preparations.

Literature

Howard Ansel. Pharmaceutical Dosage Forms and Drug Delivery Systems. Baltimore: Williams & Wilkins. 1995.

European Pharmacopeia Convention. European Pharmacopoeia 4th edition. Strasbur: Council of Europe. 2002.

Raymond C Rowe. Handbook of Pharmaceutical Excipients. London:Pharmaceutical Press. 2003.

James E. F. Reynolds. Martindale The Extra Pharmacopoeia. London: The pharmaceutical press. 1993.

Pharmacy Department. Paediatric Pharmacopeia. Melbourne: Royal Childrens Hospital. 1998.

Marriot, John. Pharmaceutical compounding and dispensing. London: Pharmaceutical Press. 2006.

P.H.List. Phytopharmaceutical Tehnology. New York: Heiden & Son Co. 1989.

Swarbrick, James. Encyclopedia of Pharmaceutical Technology-volume 1. New York:Marcel Dekker. 2002.

Loyd A. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 11th Edition. LWW Lippincott Williams and Wilkins. 2017.

Ansel H, Stockton J. Pharmaceutical Calculations. LWW Lippincott Williams and Wilkins. 2016.

Lester Elder D. A Practical Guide to Contemporary Pharmacy Practice and Compounding, 4th Edition. LWW Lippincott Williams and Wilkins. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Teaching is held through the following forms: problem-oriented teaching, lectures and exercises.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**

9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL MICROBIOLOGY

Teachers: Dejan Baskić

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

Understanding the basic characteristics of pathogens, modes of transmission and mechanisms of tissue damage in bacterial, parasitic, fungal and viral infections important in pharmacy. Introducing students to the treatment and prevention of infectious diseases.

Learning outcomes of course unit:

Upon completion of the course Pharmaceutical Microbiology, students are expected to acquire basic knowledge: Bacterial cell biology, principles of sterilization and disinfection, mechanisms of antibiotic action and mechanisms of bacterial resistance to antibiotics; main characteristics of the pathogens, mode of transmission and mechanisms of tissue damage in bacterial infections; Structure and classification of viruses, their replication and types of viral infections; main characteristics of the pathogen, mode of transmission and mechanisms of tissue damage in viral infections. Basic characteristics of protozoa, helminths and fungi, mode of transmission and mechanisms by which they induce tissue damage; Medically the most important pathogens and diseases they cause; At the end of the course Pharmaceutical Microbiology, students are expected to master the following skills: Independently perform analyzes and synthesis of relevant data, identify and solve problems, make decisions and apply the acquired knowledge in practice team work.

Course unit contents

Theoretical and practical classes

Basic characteristics of bacterial cells. Basic characteristics of viruses, protoses, helminths and fungy. Infection, pathogenicity and virulence. Pathogenesis of infectious disease.Prevention and diagnosis of infectious diseases. Therapy of infectious diseases. Bacteria causing pyogenic infection. Gram positive and gram negative cocci and coccobacilli. Bacteria causing diareal syndromes. Enterobacteria and other gram negative bacilli. Bacteria causing tuberculosis, lephra and diphtheria. Anaerobic and sporogenic bacteria. Bacteria causing zoonosis and sexually transmitted diseases. Spiral and intracellular bacteria. Viruses causing diareal syndrome and respiratory tract infections. Picornaviridae, reoviridae, orthomyxoviridae, paramyxoviridae and others. Viruses causing rash fevers. Arbovirus infections and viral zoonosis. Herpesviridae, papovaviridae, parvoviridae, adenoviridae. Hepatitis viruses. Retroviruses and prions. Medically important parasites: Protozoa. Nematodes Medically important parasites and fungy: Cestodes and Trematodes. Fungy.

Literature

Wreghitt,T.G. Elisa in the clinical microbiology laboratory. London:Public Health Laboratory service. 1990.
Lansing M. Prescott John P. Harley Donald A. Klein. Microbiology. New York:McGraw-Hill,Inc. 2000.
W.B. Hugo. Pharmaceutical Microbiology. Oxfrod: Blackwell Scientific Publications. 2003.
Kenneth, Rayan. Sherris medical microbiology. New York: Mc Graw-Hill. 2010.
Kenneth, Rayan. Sherris medical microbiology (a introduction to infectious diseases). New York: Mc Graw-Hill. 2004.
Stokes E. Joan et al. Clinical Microbiology. London: Edward Arnold. 1993.
Cooke F, Török E, Moran E. Oxford Handbook of Infectious Diseases and Microbiology 2nd Edition. Oxford University Press. 2016.
Abbas A, Lichtman A, Pillai S. Basic Immunology: Functions and Disorders of the Immune System, 6th Edition. Elsevier Science. 2019.
Levinson W. Review of Medical Microbiology and Immunology, 16th Edition, International Edition. McGraw Hill. 2020.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures and small group work (PBL)

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**40**	oral examination	
practical classes/tests		written examination	**60**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**

10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: FUNDAMENTALS OF PATHOLOGICAL HUMAN PHYSIOLOGY

Teachers: Ilija Jeftić

Course status: Mandatory

ECTS: 4

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

The main goal of the course is to acquaint students with the causes and mechanisms of disease (including expected changes in laboratory indicators of organ function), as well as treatment options, based on understanding the pathophysiological mechanisms and target points for drug action.

Learning outcomes of course unit:

Upon completion of the course in Fundamentals of Pathological Human Physiology, students are expected to acquire basic knowledge: main etiological factors of pathophysiological processes, molecular and cellular bases of disorders of various organs and organ systems, mechanisms of cell damage and death, tumor formation, inflammatory reactions, etiology and pathogenesis of basic metabolic and functional disorders of human organs and systems, interconnections and influence of pathophysiological process in one organ on other organs and organism as a whole, significance of laboratory and functional tests for diagnosis and etiopathogenetically conditioned therapy of various diseases, basic mechanisms of action of chemical agents and drugs, possible sites of therapeutic interventions based on the recognition of the pathophysiological process. At the end of the course in Fundamentals of Pathological Human Physiology, students are expected to master the following skills: application of acquired theoretical knowledge in the identification of individual diseases and their causal factors, acquired knowledge is the basis for understanding Pharmacology, Pharmacotherapy, Clinical Pharmacy and Toxicology.

Course unit contents

Theoretical and practical classes

General pathological physiology, special pathological physiology 1, special pathological physiology 2.

Literature

Copstead, Lee-Ellen C. Pathophysiology. St.Louis: Saunders, Elsevier. 2010.
McPhee, Stephen J. Pathophysiology of Disease: An Introduction to Clinical Medicine. N.York: McGraw Hill. 2010.
Braun, Carie A. Pathophysiology: A Clinical Approach. Philadelphia: Lippincot Williams & Wilkins. 2011.
Bruyere, Harold J. 100 case studies in pathophysiology. Baltimore: Lipppincott, Williams & Wilkins. 2009.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures and small group work.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: MEDICAL CHEMISTRY 1

Teachers: Slobodan Novokmet, Isidora Milosavljević, Jovana Jeremić

Course status: Mandatory

ECTS: 7

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

Introduction to the general properties of drug molecules important for maintaining stability and predicting metabolic pathways, as well as an introduction to the rational design of drug molecules and different approaches (knowledge of enzyme and receptor properties) for the development of new drug molecules.

Learning outcomes of course unit:

Knowledge about: Influences of physico-chemical properties of drug molecules (hydrophobic properties, electronic effect of various substituents, lipophilicity, polarity and steric properties) and biological factors on the drug in the body and stability; The role of drug metabolism, reactions of the first and second phase of biotransformation, division and properties of prodrugs; the role of medical chemistry in the discovery and design of new drug molecules, the importance of the use of active substances from natural resources in drug design, the impact of changes in the structure of existing drug molecules, as well as the principles of agonist and antagonist design based on molecular recognition of protein effector, changes in the structure of drug molecules in terms of substituents and stereoelectronic properties. Skills about: Assessment of physico-chemical properties based on the structure (functional groups) of drug molecules; calculation of the degree of ionization, solubility and lipophilicity; Predicting the biotransformation of drug molecules, as well as metabolic pathways in the body based on the structure of drug molecules; Methods to increase the stability of drug molecules; search of databases of enzyme and receptor structures with the aim to localize active sites for substrate binding and obtaining information necessary for rational design of drug molecules. Attitudes that students will acquire after mastering the program: the importance and influence of physico-chemical properties of drug molecules on the fate of the drug in the body, stability and biodegradation reactions; as well as the importance of knowing the structures of the protein effector for the design of new or analogues of existing drug molecules.

Course unit contents

Theoretical classes

Properties of drug molecules from the aspect of medical chemistry. Metabolic pathways and drug stability. Medical chemistry in the design of new drug molecules.

Practical classes

Examples of physico-chemical properties of drug molecules, Ionization, Solubility, Metabolic pathways of drugs, Drug stability, Biotransformation of drug molecules. Experimental and theoretical methods for determining the partition coefficient. Development of new drug molecules from natural resources. Drug design based on the structure and approach of the active analogue.

Literature

Lemke, Thomas. Foye's Principles of Medicinal Chemistry. Philadelphia: Wolters Kluwer. 2013.
Shalom Sarel et al. Trends in Medicinal Chemistry '90. Oxford: Blackwell Scientific Publications. 1992.
Nogrady Thomas. Medicinal Chemistry. A Biochemical Approach. Oxford: Oxford University Press. 1988.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, laboratory practice

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**

7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: METHODS OF INSTRUMENTAL ANALYSIS

Teachers: Nedeljko Manojlović

Course status: Mandatory

ECTS: 5

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

Enable students to master knowledge and skills in the field of pharmaceutical analysis and spectroscopy, or to familiarize themselves with the methods used in pharmaceutical analysis, the basics of UV-VIS spectroscopy, IR spectroscopy, NMR spectroscopy, mass spectrometry and combined separation and identification instrumental methods; to learn how to analyze the spectra and how they determine the structure of the pharmaceuticals substances; to learn how to conduct a quantitative pharmaceutical analysis using spectroscopic and chromatographic methods.

Learning outcomes of course unit:

Student is qualified (both theoretically and practically) to choose the appropriate instrumental method tocomplete the required task in accordance with the specificity of the pharmaceutical profession. Student is able to solve theproblems with basic instruments and apparatus using the supplied manuals.

Course unit contents

Theoretical classes

Methods used in pharmaceutical analysis; the basics of UV-VIS spectroscopy; interpretation of UV-VIS spectra; analysis of spectra of pharmaceutical substances with acid-base properties and tautomers; methods for determining content pharmaceutical substances in pharmaceutical preparations; basics of IR spectroscopy; application in pharmaceutical analysis; IR spectra of certain classes of chemical compounds; basics of NMR spectroscopy; ^{1}H and ^{13}C NMR spectroscopy; two-dimensional NMR; basics of mass spectrometry; characteristics of mass spectra of particular classes compounds; basics of chromatography; basics of high performance liquid chromatography; basics of gas chromatography; characteristics of chromatograms.

Practical classes

Planck's law; displaying energy level diagrams; estimate λmax for conjugate systems; analysis of the UV-VIS spectra of some pharmaceutical substances; interpretation of IR spectra; analysis of the IR spectra of some pharmaceutical substances; interpretation of 1H NMR spectra; chemical shift, multiplicity of the signal and the ratio of the number of protons; Analysis 1H NMR spectra of some pharmaceutical substances; analysis of 13C NMR spectra of some pharmaceutical substances; determination molecular ions, basic ions, metastable ions and other fragmentation ions in the mass spectrum; determination the presence of isotopes in the mass spectrum; presentation of fragmentation processes and analyzes of mass spectra of some pharmaceutical compounds; determining the structure of the compounds based on their UV-VIS, IR, NMR and mass spectra.

Literature

Watson DG. Pharmaceutical analysis: a textbook for pharmacy students and pharmaceutical chemists. Elsevier Health Sciences; 2015.

Ahuja S. and Scypinski S. Handbook of modern pharmaceutical analysis (Vol. 10). Academic press; 2010.

Lee, David. Pharmaceutical Analisys. Oxford:Blackwell Scientific Publications. 2003.

Thomas M. Ultraviolet and visible spetroscopy. New Jersay: John Willey and Sons. 1996.

Atkins P, de Paula J, Keeler J Atkins' Physical Chemistry, 11th Edition.. Oxford University Press. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lecture, Discussion, Problem solving, Cooperative learning.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**

9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL COMMUNICATION SKILLS

Teachers: Dušan Djurić, Dragana Ignjatović-Ristić, Milica Borovčanin

Course status: Mandatory

ECTS: 4

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

To enable students to understand the scope of practical work of pharmacists and its place in disease prevention, as well as the provision of rational pharmacotherapy in the system of pharmaceutical health care. Developing of rational approach to problems in practice, based on evidence derived from scientific research**.**

Learning outcomes of course unit:

Knowledge about: Introduction to the basic principles of rational drug use, understanding the needs and perspectives of patients in order to provide advice to the patient to maintain health, as well as the proper use of drugs, which contributes to the improvement of rational pharmacotherapy; knowledge of the principles of critical evaluation of drug information in order to provide reliable, clear and understandable, evidence-based drug information; knowledge of the basic principles of drug-drug interactions, as well as drugs with food and herbal products; knowledge of adverse drug reactions; knowledge of the principles of critical assessment about the patient and the symptoms of the disease in order to provide advice to the patient for the prevention or treatment of the disease; knowledge of the basic principles of safe self-medication. Skills about: ability to recognize drug interactions, side-effects and toxicities; the skill of communication with colleagues and patients in order to gather the necessary information about the patient and the symptoms of the disease; the ability to recognize the symptoms of the disease and determine the degree of symptoms significance; the skill of choosing therapy based on reliable efficacy data; patient counseling skills; ability to rationally solve practical problems in the pharmaceutical industry.

Course unit contents

Theoretical classes

Counseling and education of patient. Sociological and ethical responsibility in pharmaceutical communication. Rational drug use. Drug dosage. STOP-START Toolkit Supporting. The role and responsibility of pharmacists in the application and monitoring of drugs according to individual patient needs. A new method to improving the use of drugs: concordance, adherence in relation to compliance. Beers Criteria. Patient Counseling Checklist.

Practical classes

Practical examples of patients counseling and education. Patient in focus. Marketing communications. Patient counseling as an interactive process in different acute and chronical diseases.

Literature

Berger BA. Communication skills for pharmacist: Building Relationships, Improving Patient Care.Published by American Pharmacists Assotiation, 2005.

Troy,B.David (editor). Remington: The Science and Practice of Pharmacy. Philadelphia:Lippincot Williams&Wilkins. 2006.

Malone P, Malone M, Park S. Drug Information: A Guide for Pharmacists, 6th Edition. McGraw Hill. 2017.

Hilal-Dandan R, Brunton L. Goodman And Gilman Manual Of Pharmacology And Therapeutics, Second Edition, (Int'l Ed). McGraw Hill. 2014.

Trevor A, Katzung B. Basic and Clinical Pharmacology, 15th Edition, International Edition. McGraw Hill. 2020.

Chisholm-Burns M, Schwinghammer T, Wells B, Malone P, Dipiro J, Kolesar J. Pharmacotherapy Principles and Practice, 4rd Edition. McGraw Hill. 2016.

Number of active teaching hours:	Lectures: 15	Practice: 30	Other active classes: 0

Teaching methods: Lectures and small work group.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	No. of points	Description
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACOLOGY 1

Teachers: Nataša Đorđević, Radiša Pavlović, Tamara Nikolić-Turnić

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

Understanding of the basic principles of general pharmacology, as well as acquainting students with the pharmacological characteristics and methods of administration of drugs that act on the central nervous system, autonomic nervous system, cardiovascular and respiratory systems.

Learning outcomes of Course unit:

Upon completion of the course in Pharmacology 1, students are expected to acquire the knowledge about: mechanisms of drug absorption, distribution, metabolism and elimination; concepts of the volume of distribution, clearance, *elimination* half-life; receptor theory and mechanisms of action of drugs; indications, drug forms, drug dosing, prescriptions; drug-drug interactions; important adverse drug reactions; pharmacological properties of cholinergic and anticholinergic drugs, adrenergic and antiadrenergic drugs; psychopharmacology and neuropharmacology (antipsychotics, antidepressants, mood stabilizers, antiepileptics, opioids, sedatives, anxiolytics, hypnotics, anesthetics, muscle relaxants…); pharmacology of drugs that *act* on the *cardiovascular system* (antihypertensives, vasodilators, diuretics, cardiotonics, antilipemics, antiarrhythmics, etc.); pharmacology of drugs that *act* on the respiratory system (antiasthmatics, antitussives, expectorants, mucolytics, oxygen therapy). At the end of the course in Pharmacology 1, in this domain of pharmacology, students are expected to master the skills of: making appropriate drug choices and tailoring dosage regimens according to the needs of patients; determining the prescribed indications and *calculating drug dosages* recognizing the optimal route of drug administration; determining causality and reporting adverse drug reactions; analyzing benefits/potential risks of pharmacotherapy.

Course unit contents

Theoretical classes:

Basics of pharmacokinetics, pharmacodynamics and pharmacovigilance; central nervous system pharmacology; autonomic pharmacology; cardiovascular pharmacology, respiratory pharmacology.

Practical classes:

Calculation of the pharmacokinetic parameters; practical aspects of pharmacodynamics; causal interpretation of adverse events; principles of tailoring dosage regimens according to a patient's needs; solving problems related to the use of drugs that act on the central nervous system, autonomic nervous system, cardiovascular and respiratory systems.

Literature

Katzung B. Basic and Clinical Pharmacology. San Francisko:California. 2003.

Katzung B. Basic and Clinical Pharmacology. New York:McGraw-Hill,Inc. 2004.

Offermans, Strefan. Encyclopedia of Molecular Pharmacology, vol.1. Verlag: Springer. 2008.

Offermans, Strefan. Encyclopedia of Molecular Pharmacology, vol.2. Verlag: Springer. 2008.

Troy, B. David (editor). Remington: The Science and Practice of Pharmacy. Philadelphia:Lippincot Williams&Wilkins. 2006.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Problem-based learning.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**70**
practical classes/tests		written examination	
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**

9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL CHEMISTRY 1

Teachers: Nevena Jeremić, Sanja Stanković

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

The aim of this course is for students of the Integrated Academic Studies of Pharmacy to master modern scientific and professional knowledge in the field of drug chemistry.

Learning outcomes of Course unit:

Upon completion of the course in Pharmaceutical Chemistry 1, students are expected to acquire basic knowledge: on the method of preparation, chemical properties, degree of purity, stereochemistry, chemical interactions and metabolism of biologically active compounds (antivirals, antineoplastics, analgesics, antitussives and secretolytics, antidepressants, agonists and antagonists of serotonin receptors, anxiolytics, antihypertensives, hypnotics, general and local anesthetics, vitamins (hydrosoluble and liposoluble). At the end of the course in Pharmaceutical Chemistry 1 students are expected to master the following skills: during the course, students will acquire the skill to recognize the dependence of the molecular structure and chemical properties of medicinal substances important for modern pharmacotherapy; the acquired knowledge will enable future pharmacists to rationally approach the design, production, storage and distribution of medicinal preparations; based on the acquired knowledge, students will be able to explain a certain biological activity in vitro and in vivo on the basis of electronic effects, chemical reactivity, but also on the basis of the present functional groups.

Course unit contents

Theoretical and practical classes:

Antivirals. Antineoplastics. Analgesics. Antidepressants. Serotonin receptor agonists and antagonists. Anxiolytics and hypnotics. Antiepileptics and analeptics (anorexics). General and local anesthetics. Antitussives and secretolytics. Vitamins.

Literature

Lemke, Thomas. Foye's Principles of Medicinal Chemistry. Philadelphia: Wolters Kluwer. 2013.

Shalom Sarel et al. Trends in Medicinal Chemistry '90. Oxford: Blackwell Scientific Publications. 1992.

Nogrady Thomas. Medicinal Chemistry. A Biochemical Approach. Oxford: Oxford University Press. 1988.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 15

Teaching methods: Lectures, seminars, exercises.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**70**
practical classes/tests		written examination	
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: INTRODUCTION TO PHARMACEUTIC PRACTICE

Teachers: Olivera Milovanović, Aleksandra Stojanović, Milena Jurišević

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills of different areas of pharmaceutical practice. To enable students to understand the scope of the pharmacist's practical work and its roles and activities as in the health care system as also in industrial pharmacy, in the field of research of new drugs as also in special regulations process which are aimed to obey and implement procedures for the quality, safe and efficacious medicinal products and medical devices to the population.

Learning outcomes of Course unit:

Knowledge about history of pharmacy, organization of health care system in Republic of Serbia and European Union, knowledge and understanding of needs from patients perspective within health care system, knowledge about new roles and responsibilities of the pharmacist in modern health care system. Knowledge about processes of discovering of new drugs, organization of pretclinical and clinical trials, knowledge about role of pharmacist in regulative procedures of registration of new drugs, knowledge about roles of clinical pharmacist in processes of managing of drugs within hospitals, knowledge about role of pharmacist as in researches from pharmacoepidemiology, pharmacoeconomics and pharmacovigilance as also in applying skills and knowledge from this scientific disciplines in order to improve health care system, knowledge about radiopharmacy, knowledge about drug interactions. Knowledge about evidence based pharmacy, skills in working in computer programs as WORD and POWER POINT are, knowledge and skills about processes of searching web basis dedicated to pharmacy and medicine, knowledge about procedures of validating different studies: therapeutic, diagnostic studies, systematic reviews, meta analysis.

Course unit contents

Theoretical classes:

Theoretical classes include lessons about history of pharmacy, health policy and health care system. Principles of communications pharmacis-patient. Pharmacology as discipline. Discovering of new drugs, basic from preclinical and clinical studies and processes of authorization of new drug. Basics of pharmacoepidemiology, pharmacovigilance and pharmacoeconomics. Basics of therapeutic drug monitoring. Basics of radiopharmacy, preparing of cytotoxic drugs and radiopharmaceuticals. Basics of evidence based pharmacy. The role of pharmacist in health care system and interaction of pharmacist and other health care professionals in managing health care.

Practical classes

Communications with patients. Work in WORD, POWER POINT program. Preparing Smpc file. Analysis of law on medicine and medical devices. Analysis of role of pharmacist in preclinical studies and clinical trials. Identifying individual drug using ATC code. Analysis of drug consumption and utilization using ATC DDD concept. Casual interpretation of adverse event of drugs. Analysis of pharmacoeconomics characteristics of new drugs. Discovering potential drug-drug interactions, drug-food interactions. Analysis of role and responsibilities of pharmacist in preparing of cytotoxic drugs and radiopharmaceuticals.

Literature

Troy,B.David (editor). Remington: The Science and Practice of Pharmacy. Philadelphia:Lippincot Williams&Wilkins. 2006.
Katzung B. Basic and Clinical Pharmacology. New York:McGraw-Hill,Inc. 2004.
Stephens, Martin. Hospital Pharmacy. London:Pharmaceutical Press. 2003.
A.J.Winfield. Pharmaceutical practice. Edinburgh: Churchill Livingstone. 1998.
Malone P, Malone M, Park S. Drug Information: A Guide for Pharmacists, 6th Edition. McGraw Hill. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, practice in a clinic, clinical problems solving.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**70**
practical classes/tests		written examination	
Seminars/homework			
Project			
Other			

Grading system		
Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: FUNDAMENTALS OF PHYSICAL CHEMISTRY

Teachers: Nedeljko Manojlović, Ratomir Jelić

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

This one-semester course aims to enable students to acquire knowledge about basic physicochemical concepts, and their importance and application to biological systems. This course will provide students with knowledge of various physicochemical processes involved in the functioning of the living world.

Learning outcomes of Course unit:

The students will gain knowledge about: physical states of matter and basic physical quantities, SI units and prefixes; basic physicochemical concepts and laws describing ideal and real gas state; electrostatic and intermolecular forces, the concept of ionic and covalent bonds, hydrogen bonding; thermodynamic properties that characterize the real thermodynamic systems and chemical equilibrium in systems; concepts of oxidation and reduction, balancing redox reactions, EMF and its measurement; the kinetics of chemical reactions, the theoretical basis of molecular structures change with time, practical examples and calculations of chemical changes and enzyme kinetics the types, properties, application and importance of colloidal systems.

Course unit contents

Theoretical classes:

Physical states of matter and basic physical quantities. Gaseous And Liquid States. Electrostatic interactions. Intermolecular interactions. Thermochemistry. The first law of thermodynamics. Entropy and Gibbs free energy. Chemical equilibrium and equilibrium constant. Bioenergetics. Thermodynamic of mixtures, solutions and osmosis. Electrochemistry. Electrochemical cells. Concentration cells. Chemical kinetics. Catalysis. Dispersion systems.

Practical classes:

Calculation of basic physical quantities (velocity, force, pressure, work, energy, forms of energy). Determination and calculation of basic physical-chemical properties such as colligative properties, molar mass, the heat of physical and chemical changes, and constant equilibrium. Describing and deriving the basic laws of electrochemical processes. Calculating the rate and the rate constant of chemical reaction, identifying and explaining the factors affecting the rate of reactions: concentration, temperature, pressure and catalyst. Describing the types and explaining the properties of colloidal systems. Illustrating the wide range of the application and usability of colloidal systems in science, pharmacy and everyday life.

Literature

Atkins P., de Paula J. Physical Chemistry for the Life Science. Oxford university press. 2006.
Atkins P, de Paula J, Keeler J Atkins' Physical Chemistry, 11th Edition.. Oxford University Press. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, practice in laboratory

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PROCESSING THE MEASUREMENT RESULTS

Teachers: Nedeljko Manojlović, Ratomir Jelić, Slobodan Novokmet

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills in laboratory and measuring techniques, as well as in the proper processing and interpretation of the measurement results.

Learning outcomes of Course unit:

Knowledge about: basic measuring instruments and their basic properties (range, readability, accuracy, precision), units of measurement, measurement flasks; proper collecting, processing and interpretation of experimental data, and their presentation; defining measurement errors and interpret the results obtained; basic principles of instrumental methods, spectroscopic methods and instrumental chromatographic methods, solving spectroscopic and chromatographic calculations.

Course unit contents

Theoretical classes:

Introduction to basic measuring instruments and their properties. Calculations in pharmaceutical technology. Antropometric measurements of significance in the pharmaceutical praxis. Proper collecting, processing and interpretation of experimental results. Introduction to basic instrumental methods. PCR – application in diagnostics, application methodology, sample preparation,the results detection(electrophoresis). Basis of chemometric data analysis. Multivariate data analysis. Application of PCA (Principal Component Analysis) with examples. Experimental design in pharmaceutical analysis.Central compositional design and Box-Behenken design.

Practical classes

Introduction to basic measuring instruments and their properties. Collection, processing and interpretation of experimental data. Presentation of experimental data. Determination of significant figures, calculation of absolute and relative error, proper rounding of measurement results. Calculations in spectrophotometry and gaseous and liquid chromatography. Calculations of bioavailability of drugs and AUC (Area Under the Curve). Potenciometric and spectrophotometric titrations and the interpretation of the results obtained. Introduction to PCA (Principal Component Analysis), Central compositional design and Box-Behenken design with the application examples.

Literature

Motulsky H. Inventive biostatistics. New York: Oxford University Press, 2010.

Good P. Common errors in statistic and how to avoid them. New York: John Wiley & Sons, 2009.

Bustin, Stephen. A-Z of quantitative PCR. California: International university line. 2004.

Yuryev, Anton. PCR primer design. New Yersey: Humana Press. 2007.

Watson DG. Pharmaceutical analysis: a textbook for pharmacy students and pharmaceutical chemists. Elsevier Health Sciences; 2015.

Ahuja S. and Scypinski S. Handbook of modern pharmaceutical analysis (Vol. 10). Academic press; 2010.

Ansel H, Stockton J. Pharmaceutical Calculations. LWW Lippincott Williams and Wilkins. 2016.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, laboratory practice

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**

8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: MEDICAL BIOCHEMISTRY

Teachers: Ivana Nikolić, Sanja Stanković

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in second year of Pharmacy – Integrated academic studies

Course unit objective:

The main goal of the course is to acquaint students with the clinical interpretation of the most commonly determined biochemical analyzes, as well as the basic principles of analytical methods and their use in clinical biochemical laboratories. Students should acquire the knowledge and skills to clinically interpret the results of biochemical analyzes in the detection, monitoring and treatment of diseases that they will be able to use usefully in their professional practice and be able to efficiently and rationally adopt new knowledge.

Learning outcomes of course unit:

Analytical procedures. Collection, processing and application of laboratory data, Examination of disorders in carbohydrate metabolism, Examination of disorders in lipid metabolism; Examination of disorders in amino acid and protein metabolism; Examination of the catalytic activity of enzymes; Clinical and biochemical analyzes in the diagnosis of diseases of the liver, kidneys, cardiovascular system; Clinical and biochemical analyzes in the diagnosis of hematological and rheumatic diseases and diseases of the locomotor system; Clinical biochemical diagnosis of hormonal disorders. At the end of the course in Medical Biochemistry, students are expected to master the following skills: Preparation for experimental work in the laboratory; Principles of analytical procedures; Collection and processing of samples; sources of biological variation; Collection, processing and application of laboratory data; Determination of blood sugar concentration, clinical and biochemical diagnosis of diabetes; Determination of blood lipid concentration; Performing diagnostic tests for amino acid and protein disorders; Determination of catalytic activity of clinically relevant enzymes; Performing diagnostic tests to examine liver function; Performing diagnostic tests to examine kidney function; Performing diagnostic tests to examine the function of the cardiovascular system; Performing diagnostic tests in the examination of hematological diseases; Performing diagnostic tests in the examination of rheumatic and diseases of the locomotor system; Performing diagnostic tests in the examination of hormonal disorders; Performing diagnostic tests in the examination of urine and urine sediment.

Course unit contents

Theoretical and practical classes:

Analytical procedures, testing of metabolic disorders of carbohydrates, lipids, amino acids and proteins. Testing act. enzymes, liver, kidney and CVC functions. Examination of hematological, rheumatic and hormonal disorders.

Literature

Alberts, Bruce. Molecular biology of the cell. N.York: Garland Science. 2015.

Peter J. Russell. Genetics. A Molecular approach. San Francisco: Benjamin Cumm i tigs. 2006.

Boron, Walter F. Medical physiology: a cellular & molecular approach. Phyladelphia:Elsevier. 2005.

Yuryev, Anton. PCR primer design. New Yersey: Humana Press. 2007.

Bustin, Stephen. A-Z of quantitative PCR. California: International university line. 2004.

Baynes J, Dominiczak M. Medical Biochemistry, 5th Edition. Elsevier Science. 2018.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lecture; Discussion; Problem solving; Cooperative learning; Experimental work.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**

7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACOLOGY 2

Teachers: Nataša Đordjević, Radiša Pavlović, Tamara Nikolić-Turnić

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Understanding pharmacological properties and application modalities of drugs that are used to treat disorders affecting gastrointestinal tract, endocrine system, and electrolyte balance, as well as antimicrobials, cytostatics and immunosuppressants.

Learning outcomes of course unit:

Upon completion of the course in Pharmacology 2, the student is expected to acquire knowledge of:
antiulcer drugs, antiemetics, emetics, laxatives, antidiarrheals; drugs used for the treatment of inflammatory bowel diseases; water and electrolyte replacement solutions, solutions for enteral and parenteral nutrition; hypothalamic, pituitary and thyroid hormones, antithyroid drugs; insulin and oral antidiabetics, hyperglycemic agents; adrenal cortex hormones, osteoporosis drugs; antibacterials, antivirals, antifungals, antihelmintics; antiprotozoals and drugs used for the treatment of ectoparasites; cytostatics and immunosuppressants.
At the end of the Pharmacology 2 course, the student is expected to master the skills of:
identifying and assessing indications, contraindications, interactions, and adverse reactions to drugs used to treat disorders affecting gastrointestinal tract, endocrine system, and electrolyte balance; identifying and assessing indications, contraindications, interactions, and adverse reactions to antimicrobials, cytostatics and immunosuppressants; determining optimal drug dosage regimens; rational approach to drugs; assessing strengths and weaknesses of pharmacotherapy; continuous advancement of pharmacological knowledge for optimization of therapeutic approach.

Course unit contents:

Theoretical classes

Pharmacotherapy of peptic ulcer; pharmacotherapy of gastrointestinal tract motility disorders; pharmacotherapy of blood and tissue disorders; hormones and hormone antagonists; cytostatics and immunosuppressants; antimicrobials..

Practical classes

Problem-based practical application of pharmacological knowledge in treating disorders affecting gastrointestinal tract, endocrine system, and electrolyte balance, and prescribing antimicrobial drugs, cytostatics and immunosuppressants.

Literature:

Katzung BG. Basic & Clinical Pharmacology. San Francisco:California; 2003.
Katzung B. Basic and Clinical Pharmacology. Pharmacotherapy: a pathophysiologic approach. New York:McGraw-Hill,Inc. 2004
DiPiro JT, Talbert RL, Yee GC, Matzke GR, Wells BG, Posey ML, editors. Pharmacotherapy: a pathophysiologic approach. 7th ed. New York: McGraw-Hill; 2008.
Hilal-Dandan R, Brunton L. Goodman And Gilman Manual Of Pharmacology And Therapeutics, Second Edition, (Int'l Ed). McGraw Hill. 2014.
Trevor A, Katzung B. Basic and Clinical Pharmacology, 15th Edition, International Edition. McGraw Hill. 2020.
Chisholm-Burns M, Schwinghammer T, Wells B, Malone P, Dipiro J, Kolesar J. Pharmacotherapy Principles and Practice, 4rd Edition. McGraw Hill. 2016.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**

9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: IMMUNOLOGY

Teachers: Ilija Jeftić, Dejan Baskić

Course status: Mandatory

ECTS: 4

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge in basic immunology and immunomodulation.

Learning outcomes of course unit:

Upon completion of the course in Immunology, the student is expected to acquire the following knowledge:

Learn the basic principles of active and passive immunization; learn the structure and function of central and peripheral lymphatic organs; understand the role of immune system in body defense against pathogenic microorganisms; learn the mechanisms responsible for development of autoimmune diseases; learn immunopathogenesis of allergic diseases and chronic inflammatory diseases of the respiratory, gastrointestinal, musculoskeletal, central and peripheral nervous systems, as well as therapeutic approaches in the treatment of these diseases; be able to explain the basic mechanisms of immunomodulatory substances action; be able to explain the mechanisms of anti-inflammatory drugs action; understand vaccine technology.

Course unit contents:

Theoretical and Practical classes

Immunology introduction. Cells and tissues of the immune system. Innate immunity. Molecular mechanisms of inflammation. Antigen presentation. Recognition of antigens in acquired immunity. Cellular immune response. Effector mechanisms of cellular immunity. Humoral immune response. Effector mechanisms of humoral immunity; Immune basis of allergic diseases. Anaphylaxis and urticaria. Immune basis of skin and respiratory allergies. Sepsis and septic shock. Inflammatory bowel disease. Immune tolerance and autoimmunity. Immune mediated diseases of joints and muscles. Immune mediated diseases of the thyroid gland. Immune basis of type 1 diabetes mellitus; Immune basis of neurological diseases. Therapeutic effects of intravenous immunoglobulins, corticosteroids and nonsteroidal anti-inflammatory drugs. Immunomodulatory drugs. Therapeutic use of cytokines. Vaccines. Antibodies in therapy. Monoclonal antibodies. Immunoconjugates and immunotoxins.

Literature:

Chapel H, Haeney M, Misbah S, Snowden S. Essentials of Clinical Immunology. Blackwell Publishing Ltd, Massachusetts, USA, 2006.

Abbas A, Lichtman A, Pillai S. Basic Immunology: Functions and Disorders of the Immune System, 6th Edition. Elsevier Science. 2019.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**40**
practical classes/tests		written examination	**30**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL CHEMISTRY 2

Teachers: Nevena Jeremić, Sanja Stanković

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

The aim of the course is for students to master the knowledge and skills of pharmaceutical and medical chemistry that will enable them to clearly see and understand the relationship between structure and biological activity, as well as to facilitate the acquisition of knowledge in pharmacology and other fields of pharmacy.

Learning outcomes of course unit:

Upon completion of the course in Pharmaceutical Chemistry 2, student are expected to acquire basic knowledge:
On physicochemical properties of biologically active molecules, stability, mechanism of action of drugs and their pharmacokinetic parameters.
At the end of the course in Pharmaceutical Chemistry 2, students are expected to master the following skills:
Predicting the reactivity of functional groups of pharmacologically active compounds; understanding and analyzing the relationship between the structure of drugs and the manifestation of biological activity; analyzing the electronic effects and mechanisms of chemical reactions in which biologically active molecules participate in in vivo and in vitro conditions; rational approach to the design, production, storage and distribution of medicinal preparations.

Course unit contents:

Theoretical and Practical classes

Introduction to pharmaceutical chemistry and its significance. Steroid hormones and other compounds of steroidal structure in therapy. Peptide hormones, antihyperglycemics and thyrostatics. β-lactam antibiotics. Aminoglycoside and macrolide antibiotics. Tetracyclines. Antibiotics of peptide and other structures. Sulfonamides. Quinolones and oxazolidinones. Antiseptics and disinfectants. Antituberculotics and antifungals. Antiparasitics.

Literature:

Nogrady T. Medicinal Chemistry. A Biochemical Approach. Oxford: Oxford University Press. 1988.
Shalom S. Trends in Medicinal Chemistry '90. Oxford: Blackwell Scientific Publications. 1992.
Lemke T. Foye's Principles of Medical Chemistry. Philadelphia: Wolters Kluwer. 2013.

Number of active teaching hours:	Lectures: 45	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: BROMATOLOGY

Teachers: Jovana Joksimović Jović, Ivan Srejović, Dragica Selaković

Course status: Mandatory

ECTS: 4

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Introducing to the methodology of food, dietary products and objects of general use testing with the use of modern accredited methods, as well as work on modern appliances.

Learning outcomes of course unit:

Knowledge about:

Food quality and safety; Non-nutritive food ingredients; Understanding of biologically active molecules of natural origin; Conditions necessary for placing food on the market; Food health safety; Quality systems - HASSP, HALAL, ISO 9001 2015, ISO 17025; Understanding the basic principles of organically produced food and food biotechnology; Understanding the basic characteristics of dietary products; Adverse reactions to food; Understanding the interaction of food ingredients, drugs and dietary supplements.

Skills about:

Physical and chemical analysis of food and dietary products and items of general use; Application of accredited food analysis methods; Determining the energy value of food, the total value of meals and dietary products; Analysis of vitamins, minerals, heavy metals, additives, pesticides and mycotoxins; Proper use of applicable legislation, appropriate regulations for each type of food.

Course unit contents:

Theoretical classes

Food composition (energy value, nutrient content and protective substances), methods for determining the health safety of drinking water and determining the content of non-nutritive food ingredients. Food safety (professional risk analysis and management of possible risks for food contamination by natural toxic ingredients, pollutants originating from the environment, additives, residues of substances used in agriculture and veterinary medicine), Safety of objects of general use. Specially formulated food products, Adverse reactions to food, Interactions of food ingredients, drugs and dietary supplements, Food labeling, Legislation - food and diet products.

Practical classes

Determining the food composition. Procedures and methods. Methods of pesticide residues analysis in food. Types and groups of packaging. Additives. Artificial colors and sweeteners. Declaration. Food labeling.

Literature:

Belitz H. Food Chemistry. Berlin: Springer. 2009.

Hall J. Guyton & Hall Textbook of Medical Physiology, 14th Edition, International Edition. Elsevier Science. 2020.

Webster-Gandy J, Madden A, Holdsworth M.Oxford Handbook of Nutrition and Dietetics, 3rd Edition. Oxford University Press. 2020.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**

8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: MEDICINAL CHEMISTRY 2

Teachers: Slobodan Novokmet, Isidora Milosavljević, Jovana Jeremić

Course status: Mandatory

ECTS: 5

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Introduction to the general chemical properties of selected drug molecules that are important for their rational design; Examine the influence of different functional groups in the structure of drug molecules on activity, selectivity, specificity, toxicity and other pharmacokinetic properties.

Learning outcomes of course unit:

Knowledge about:

The influence of physico-chemical properties of drug molecules (hydrophobic properties, electronic effect of different substituents, lipophilicity, polarity and steric properties) on activity, selectivity, specificity, toxicity and other pharmacokinetic properties.

Skills about:

Based on the structure (functional groups) of drug molecules, assess the physico-chemical properties by calculating the degree of ionization, solubility and lipophilicity; Introduction to basic approaches in drug design through examples of selected groups of drug molecules.

Course unit contents:

Theoretical classes

Medical chemistry of antihistamines, antiulcer drugs and adrenergic agonists. Medical chemistry of the drugs for cardiovascular system treatment. Medical chemistry of drugs that act on the nervous system.

Practical classes

Physico-chemical properties of drug molecules through examples. Histamine N1-and N2-receptor antagonists. Proton pump inhibitors. Agonists and antagonists of adrenergic and muscarinic receptors. Calcium antagonists. Diuretics. ACE and HMG-inhibitors. Antipsychotics, Hallucinogens, Antiparkinsonians.

Literature:

Nogrady T. Medicinal Chemistry. A Biochemical Approach. Oxford: Oxford University Press. 1988.
Shalom S. Trends in Medicinal Chemistry '90. Oxford: Blackwell Scientific Publications. 1992.
Lemke T. Foye's Principles of Medical Chemistry. Philadelphia: Wolters Kluwer. 2013.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACOGNOSY

Teachers: Isidora Milosavljević, Jovana Jeremić, Jovana Bradić

Course status: Mandatory

ECTS: 5

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Providing knowledge of pharmacologically active metabolites of plants and animals (chemical and physical characteristics, distribution and biological activity, qualitative and quantitative analysis, isolation and chemical characterization of bioactive compounds) and natural medicinal raw materials - drugs (morphological and anatomical characteristics, chemical ingredients, method of production, identification, quality testing, action, application).

Learning outcomes of course unit:

The student should be able to perform a qualitative and quantitative analysis of the natural medicinal ingredients, conceptualize and perform the procedure of their extraction and separation into laboratory conditions, knows the natural raw materials for isolating medicinal ingredients for the needs of the pharmaceutical industry, be able to identify, examine the general and specific quality of drugs, knows the possibilities of their use, participates in conception, organizing and managing of the drug production process and ensuring its quality.

Course unit contents:

Theoretical classes

Pharmacognosy as a scientific discipline; history and application of natural medicinal products; classification, nomenclature and taxonomy of medicinal plants; morphological and microscopic analysis of medicinal plants; metabolic pathways of biosynthesis of plant metabolites; methods for isolating, separating and characterizing plant metabolites; carbohydrates, amino acids and peptides in pharmacy; heterosides (glycosides); simple phenolic compounds in plants; polyphenolic compounds in plants; coumarins, lignans, lignins and flavonoids; quinone, cyanogenic and sulfur heterosides; monoterpenic and cardiotonic heterosides; saponosides and tannins; properties, extraction, proving and determination of alkaloids; ornithine, lysine and nicotinic acid alkaloid derivatives; alkaloid derivatives of phenylalanine, tyrosine, tryptophan and histidine; terpene, steroid and purine alkaloids; terpenoids and essential oils; oleoresins, balms and resins; lipids and fatty substances in pharmaceutical practice.

Practical classes

Identification, testing of the quality of herbal drugs; morphological and microscopic analysis of medicinal plants; methods of isolating (extracting) secondary metabolites, obtaining extracts; chromatographic analysis of plant extracts; methods for testing the chemical composition of plant extracts; testing of sugars in herbal drugs; testing of mucus drugs; qualitative demonstration (reaction) of particular classes of heterosides; chromatographic and quantitative analysis of individual classes of heterosides; isolation and testing of tannins and saponosides; isolation, qualitative and quantitative analysis of alkaloids; isolation of essential oils; testing of the correct, qualitative and quantitative composition of essential oils.

Literature:

Barnes J. Herbal medicine. London: Phamaceutical Press. 2007.

Barnes J. Herbal medicines a guide for healthcare proffesionals. London: Pharmaceutical Press. 2002.

Heinrich M, Barnes, Prieto-Garcia J, Gibbons S, Williamson E. Fundamentals of Pharmacognosy and Phytotherapy, 3rd Edition (International Edition). Elsevier Science. 2018.

Williamson E, Driver S, Baxter K. Stockley's Herbal Medicines Interactions: A Guide to the Interactions of Herbal Medicines, 2nd Edition. Macmillan Distribution. 2013.

Boullata J, Armenti V. Handbook of Drug-Nutrient Interactions. Humana Press. 2010.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lecture, Discussion, Problem solving, Cooperative learning, Experimental work

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**

Seminars/homework			
Project			
Other			

Grading system		
Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: TOXICOLOGY

Teachers: Nataša Đorđević, Radiša Pavlović, Dušan Đurić

Course status: Mandatory

ECTS: 5

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Introducing students to the types of toxins, their effects on the human body and experimental animals, the metabolism of toxins, and the movement of toxins through the ecosystem, as well as to develop a rational approach to intoxication problems in practice, based on the scientific evidence.

Learning outcomes of course unit:

Upon completion of the course in Toxicology, the student is expected to acquire knowledge about:
the type, origin and mechanism of action of toxic substances; the most important toxidromes; the needs and perspectives of intoxicated patients; the principles of evidence-based toxicology; the methods for detecting toxins in the human body; toxicokinetics; the basic principles of toxins movement through ecosystems.
At the end of the Toxicology course, the student is expected to master the skills of:
recognizing toxidromes; communication with the intoxicated person and his companions; interpreting results of the toxicological analyzes; using toxicological databases available on the Internet; controlling prescribed therapy for a intoxicated patient; rationally solving practical cases of intoxication; making a summary report on a case of intoxication, and a critical evaluation of the therapy taken; properly informing the public about the dangers of toxic substances from the environment.

Course unit contents:

Theoretical classes

The basic principles of toxicology, diagnostic methods in toxicology; the basic principles of the management of intoxicated patient; the effects of toxins in pregnancy and lactation, ecotoxicology; intoxication with drugs acting on central nercous system, cardiovascular system, and blood clotting; intoxication with opioids, antiseptics and disinfectants, household poisoning; intoxication with carbon-containing compounds and heavy metals; intoxication with blood agents and caustics; toxic animals and plants.

Practical classes

Problem-based practical application of toxicological knowledge in recognizing, diagnosing and treating intoxications.

Literature:

Katzung BG. Basic & Clinical Pharmacology. San Francisko:California; 2003.
Katzung B. Basic and Clinical Pharmacology. Pharmacotherapy: a pathophysiologic approach. New York:McGraw-Hill,Inc. 2004
DiPiro JT, Talbert RL, Yee GC, Matzke GR, Wells BG, Posey ML, editors. Pharmacotherapy: a pathophysiologic approach. 7th ed. New York: McGraw-Hill; 2008.
Miller K. Principles and Practice of Immunotoxicology. Oxford: Blackwell Scientific Publications. 1992.
Gad Cox S. In Vitro Toxicology. New York: Raven Press. 1994.
Klaassen C, Watkins III J.Casarett & Doull's Essentials of Toxicology, Third Edition. McGraw Hil. 2015.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 0

Teaching methods: Lecture, Discussion, Problem solving, Cooperative learning, Experimental work

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**

8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: DISPENSING DRUGS IN PRACTICE

Teachers: Milena Jurišević, Olivera Milovanović, Aleksandra Stojanović

Course status: Mandatory

ECTS: 5

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills of drug dispensing and the highest professional standards in drug dispensing practice. Students should be able to consult patients for the practical application of drugs that are most often used in practice and master the systems of dispensing drugs in health care institutions.

Learning outcomes of course unit:

Knowledge of recipe control, drugs dispensing phases, labeling prescription medications, pharmacist responsibilities for dispensing controlled substances, medical dosage calculations and formulas, principal routes and sites of drug administration, drug distribution systems in hospital, Unit dose drug distribution, automatic dispensing systems, dispensing errors and safe medication storage systems.

Knowledge of improving dispensing and counseling practices for therapies of the most prevalent diseases (diabetes, asthma, hypertension, heart failure, coronary heart disease, schizophrenia, depression), contagious diseases (bacterial and fungal infections).

Skills necessary for pharmacist-patient communications, promoting health in public pharmacy, rational drug usage, assessing the patient's understanding of prescriptions and OTC therapies, assessment of patient understanding of self-monitoring therapy

Course unit contents:

Theoretical classes

Phases in drug dispensing; recipe control; checking the availability of the medicine in the pharmacy, dosage regimen, interactions, contraindications and indications of the drug being dispensed. Verbal and nonverbal communication skills with patient - principles; establishing contact, active listening, reaching an agreement with the patient on how to use the drug. Drug distribution systems in hospital; Traditional system dispensing of medicines; Unit dose drug distribution; Automatic dispensing systems; Dispensing errors and safe medication storage systems. Improving dispensing and counseling practices for Diabetes therapy. Improving dispensing and counseling practices for corticosteroid therapy. Improving dispensing and counseling practices for asthma treatment. Improving dispensing and counseling practices for angina pectoris treatment. Improving dispensing and counseling practices for anticoagulant therapy. Improving dispensing and counseling practices for treatments of bacterial infections. Improving dispensing and counseling practices for schizophrenia and depression therapies.

Practical classes

Verification of identification data on prescription; detection of irregularities in the prescription; training communicating with patients; practical dispensing of drugs to patients; ménage medical dosage calculations and formula; practical strategies for safe and effective delivery of aerosolized medications; practical application of subcutaneous injections; discovering potential drug interactions; practically solving given clinical problem.

Literature:

Walker R. Clinical Pharmacy and Therapeutics. Aberdeen:Churchill Livingstone. 1999.

Katzung BG. Basic & Clinical Pharmacology. San Francisko:California. 2003.

Katzung B. Basic and Clinical Pharmacology. Pharmacotherapy: a pathophysiologic approach. New York:McGraw-Hill,Inc. 2004.

Malone P, Malone M, Park S. Drug Information: A Guide for Pharmacists, 6th Edition. McGraw Hill. 2017.

Chisholm-Burns M, Schwinghammer T, Wells B, Malone P, Dipiro J, Kolesar J. Pharmacotherapy Principles and Practice, 4rd Edition. McGraw Hill. 2016.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 0

Teaching methods: Lecture, Discussion, Problem solving, Cooperative learning, Experimental work

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			

Other			
Grading system			
Grade	**No. of points**	**Description**	
10	**91-100**	**Excellent**	
9	**81-90**	**Exceptionally good**	
8	**71-80**	**Very good**	
7	**61-70**	**Good**	
6	**51-60**	**Passing**	
5	**< 51**	**Failing**	

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL TECHNOLOGY 2

Teachers: Snežana Cupara, Marina Tomović, Ana Barjaktarević

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Introducing to pharmaco-technological, physico-chemical and biological factors affecting the release and absorption of drugs, as well as routes of drug administration. Understanding of modern aspects of drug administration, with special emphasis on new materials used in the design of drug administration systems. Synthesis and quality control of parenteral preparations, cytostatics and radiopharmaceuticals. Introduction to physiological factors affecting certain technological procedures of manufacturing and administration of drugs, introduction to controlled release drug delivery systems developed for oral and parenteral routes of administration.

Learning outcomes of course unit:

Upon completion of the course in Pharmaceutical Technology 2, students are expected to acquire basic knowledge about: Effect of pharmaco-technological, physico-chemical and biological factors on drug release/absorption; Manifacturing technology of sterile, parenteral, cytotoxic preparations and radiopharmaceuticals, as well as quality control of obtained products. Review of new polymers for advanced drug delivery mechanisms, controlled drug release; Microemulsions as drug carriers; Application of nanoparticles, pulsatile and stimulus-responsive drug delivery systems; Inhalation and intravaginal application of modern pharmaceutical formulations. At the end of the course in Pharmaceutical Technology 2, students are expected to master the following skills: Preparation of various medicinal pharmaco-technological forms; Skills in searching and using professional literature (pharmacopoeias, manuals, laws, internet); Ability to rationally solve practical problems in the field of making medicinal forms; Acquiring knowledge in the field of new drugs; Ability to observe the benefits of new methods for drug administration; • Ability to rationally solve practical problems in the pharmaceutical industry within the new methods of drug administration; Interpretation of new therapeutic systems rational application.

Course unit contents

Theoretical and practical classes:

Introduction of biopharmacy. Sterile preparations.Pparenteral preparations. Radiopharmacy. Cytostatics. Application of polymers in controlled release drug delivery systems. Hydrogels, Microparticles and Nanoparticles of medicinal substances - synthesis, properties and application. Microemulsions as carriers of drugs. Therapeutic systems with modified drug release. Pharmaceutical forms for intravaginal and inhalation use.

Literature

Avdeef A. Absorption and Drug Development. Wiley-Interscience,USA. 2003.

Troy D. Remington: The Science and Practice of Pharmacy. Philadelphia:Lippincot Williams&Wilkins. 2006.

Swabrick J. Encyclopedia of Pharmaceutical Technology – volume 1. New York: Marcel Dekker, Inc., 2002.

Swabrick J. Encyclopedia of Pharmaceutical Technology – volume 2. New York: Marcel Dekker, Inc., 2002.

Ansel H. Pharmaceutical Dosage Forms and Drug Delivery Systems Baltimore: Williams & Wilkins. 1995.

Ansel H, Stockton J. Pharmaceutical Calculations. LWW Lippincott Williams and Wilkins. 2016.

Number of active teaching hours:	Lectures: 45	Practice: 30	Other active classes: 0

Teaching methods: Lectures, practice in a clinic, clinical problems solving.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**

7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

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Study program: Pharmacy – Integrated academic studies

Course unit: CLINICAL PROPAEDEUTIC FOR PHARAMACISTS

Teachers: Goran Davidović, Vojislav Ćupurdija

Course status: Mandatory

ECTS: 4

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills in internal medicine propaedeutic.

Learning outcomes of course unit:

Knowledge about medical treatment of the most prevalent internal medicine disorders (e.g. acute coronary syndrome, arterial hypertension, acute and chronic heart failure, asthma, chronic obstructive pulmonary disease, acute pulmonary embolism, anemia, diabetes mellitus, thyroid gland disorders, gastric ulcer, urinary infection, rheumatoid arthritis, anaphylaxis, etc.). Knowledge about medical prophylaxis of the most prevalent internal medicine disorders in population. Knowledge about clinically important adverse drug reactions and drug-drug interactions in internal medicine. Knowledge about interpretation of laboratory findings. Skills of patients examination and clinical interview in internal medicine. Skills of making appropriate drug choices and tailoring dosage regimens according to the needs of patients.

Course unit contents

Theoretical classes:

Diagnosis and treatment of pneumonia, asthma, chronic obstructive pulmonary disease and acute pulmonary embolism. Diagnosis and treatment of arterial hypertension, acute and chronic heart failure and acute coronary syndroma. Diagnosis and treatment anemia. Diagnosis and treatment of thyroid gland disorders and diabetes mellitus. Differential diagnosis of abdominal pain and treatment of gastric and duodenal ulcers. Diagnosis and treatment of rheumatoid arthritis and osteoporosis. Diagnosis and treatment of anaphylaxis. Diagnosis and treatment of urinary infection. Clinically important adverse drug reactions and drug-drug interactions in internal medicine.

Practical classes:

Principles of clinical interview in internal medicine. Principles of patient examination. Interpreting of laboratory and radiology findings. Principles tailoring dosage regimens according to a patient's needs. Discovering potential drug-drug and drug-food interactions. Causal interpretation of adverse events.

Literature

Fauci A. Harrison's Principles of Internal Medicine. New York: Mc Graw-Hill. 2008.
Malone P, Malone M, Park S. Drug Information: A Guide for Pharmacists, 6th Edition. McGraw Hill. 2017.
Chisholm-Burns M, Schwinghammer T, Wells B, Malone P, Dipiro J, Kolesar J. Pharmacotherapy Principles and Practice, 4rd Edition. McGraw Hill. 2016.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 0

Teaching methods: Lectures, practice in a clinic, clinical problems solving.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures		oral examination	
practical classes/tests	**30**	written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL ETHICS WITH INTERNATIONAL REGULATIVE

Teachers: Dragana Ignjatović-Ristić, Milica Borovčanin, Branimir Radmanović

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Getting the students familiar with the ethical concepts of clinical practice and research in pharmacy. Increase of knowledge about ethical principles, processes, and law regulations in the field of scientific research in multicentric, international research. The goal is also to strengthen research ethics capacity through increasing with in-depth knowledge of the ethical principles, processes, and policies related to international clinical and public health research as well as the critical skills to develop research ethics education and expert consultation to researchers and their institutions. Introduction to the most significant historical events in the development of medicine and pharmacy, the development of pharmaceutical activity from prehistory to modern times and the role of pharmacists throughout history.

Learning outcomes of course unit:

Knowledge of ethical principles in clinical practice and research in stomatology, managing clinical practice and research in stomatology while maintaining ethical normes and acceptance of an attitude that ethics are the norm in stomatology. Use of ethical principles in design, conduct, monitoring and disseminating results of multicentric and international studies.

Course unit contents

Theoretical classes:

The notion of ethics. Philosophical concepts important for the development of ethics. Prerequisites for moral conduct. Basic ethical principles. Developmental stages of medicine and pharmacy over time. History of modern medicine. The Hippocratic Oath. Deontology. Ethical committees of health institutions. members of ethics committees. Ethics committee selection procedure. Ethics committee work procedure. An experiment in medicine. Legal responsibility of a medical worker. Informed consent form for the respondent. Ethical challenges of animal research. The obligations of researchers in their work towards experimental animals. Unethical conduct of research in pharmacy. Falsification of results. Fabrication of results. Plagiarism. Ethical aspects of preclinical drug research. Ethical aspects of clinical drug research. Legislation of preclinical drug research. Legislation of clinical drug research. History of pharmacy - definition. Areas of study of the history of pharmacy. Scientific and auxiliary disciplines of importance for the history of pharmacy. Periods during the development of pharmacy. Pharmacy as a health activity through the centuries. History of drug development. Different approaches in drug design. Ethics of advertising in pharmacy. Modern pharmacy. Glossary of terms used in pharmacy. Pharmacist and society. Moral characteristics of pharmaceutical health care. Working with vulnerable groups. Ethical aspects of the end of life. Euthanasia.

Seminars:

Groups of students make a presentation on a given topic, followed by a discussion within the whole group.

Literature

Beauchamp Tom. Principles of biomedical ethics. New Jork: Oxford universaty presss. 2009.

Appelbe G. Dale and Appelbe s Pharmacy Lav and ethics. London:Pharmaceutical Press. 2001.

Phalen R. Core ethics for health Proffesionals. Irvin: Springer. 2017.

Number of active teaching hours:	Lectures: 15	Practice: 15	Other active classes: 15

Teaching methods: Lecture, Discussion, Cooperative learning.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**60**
Seminars/homework	**10**		
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**

9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: NUTRITIONAL SUPPLEMENTS

Teachers: Dragica Selaković, Jovana Joksimović-Jović, Ivan Srejović

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

To enable students to understand the application of nutritional supplements for the purpose of diet prophylaxis and diet therapy, as well as the physiological and pharmacological basis of dietary supplementation.

Learning outcomes of course unit:

Knowledge about: General principles of dietary supplementation, physiological and pharmacological bases of nutritional supplements, health and nutritional statements, current legislation and recommendations for the use of nutritional supplements for dietary prophylaxis and diet therapy.

Skills about: Solving of practical problems in the field of nutritional supplements application; Recommending nutritional supplements to different categories of healthy, adult people; Interpreting recommendations for the use of nutritional supplements; Interpretation skills analysis of dietary products; Proper application of nutritional supplements as part of preserving and improving human health.

Course unit contents

Theoretical classes:

Physiological bases of dietary supplements application. Dietetics. Mechanisms of water and minerals secretion and absorption. Mechanisms of digestion and absorption of proteins, amino acids, fats and fatty acids. Importance of dietary supplementation. Development of dietary supplementation and application. Basic definitions and divisions of dietary products. Sampling, storage and transport of dietary products.

Practical classes:

Preparation of samples for analysis. Methods of dietary products analysis. Energy value of dietary product. Declaration. Health and nutritional statements. Packaging of dietary products. Examples of dietary products.

Literature

Belitz H. Food Chemistry. Berlin: Springer. 2009.

Hall J. Guyton & Hall Textbook of Medical Physiology, 14th Edition, International Edition. Elsevier Science. 2020.

Webster-Gandy J, Madden A, Holdsworth M.Oxford Handbook of Nutrition and Dietetics, 3rd Edition. Oxford University Press. 2020.

Number of active teaching hours:	Lectures: 15	Practice: 15	Other active classes: 15

Teaching methods: Lectures, laboratory practice.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: RESEARCH IN BASIC PHARMACEUTICAL SCIENCE

Teachers: Vladimir Jakovljević, Vladimir Živković, Ivan Srejović

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies

Course unit objective:

Enabling students to independently conducting research in the field of pharmacy, through all necessary phases: selection of research objectives, selection of appropriate methodology, development of research plans, implementation of research and communication of results in the form of scientific or professional manuscript; development of a rational approach to problems in practice, based on research and evidence derived from them.

Learning outcomes of course unit:

Upon completion of the course in Research in Basic Pharmaceutical Science, the student is expected to acquire the following:
Knowledge of basic research principles, as well as the methodology used in research, knowledge of how to make a scientific manuscript, knowledge of the basic principles of research planning. At the end of the course in Research in Basic Pharmaceutical Science, the student is expected to master the following skills: Ability to search for valid literature, ability to choose focused and relevant research topics, skills in conducting research in pharmacology, the skill of making a scientific or professional manuscript for a journal.

Course unit contents

Theoretical classes:
All aspects of conducting research and preparing and writing a scientific article will be discussed with students.

Practical classes:
Students will independently apply the knowledge acquired during lectures and discussions, all with the aim of conducting independent research and writing a scientific article.

Literature

Hulley, Stephen B. Designing Clinical Research. Philadelphia: Lippincot Williams & Wilkins, 2007.
Ray S, Fitzpatrick S, Golubic R, Fisher S, Gibbings S. Oxford Handbook of Clinical and Healthcare Research (Flexicover) (Oxford Medical Handbooks). Oxford University Press. 2016.
Gamulin S. Clinical research - clinical epidemiology. Medicinska naklada. 2017.

Number of active teaching hours:	Lectures: 15	Practice: 15	Other active classes: 15

Teaching methods: Lecture, Discussion, Cooperative learning

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	
Seminars/homework		Final Paper	**70**
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: RADIOPHARMACY

Teachers: Slobodan Novokmet, Nedeljko Manojlović, Vladimir Vukomanović

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in third year of Pharmacy – Integrated academic studies.

Course unit objective:

Acquiring knowledge and skills of preparation and quality control of radiopharmaceuticals.

Learning outcomes of course unit:

Understands the issues regarding patient, personnel and environment safety when working with radioactive materials and is able to apply that knowledge in practice when preparing a radiopharmaceutical. Basic knowledge of radiopharmacy, which includes production, preparation of radiopharmaceuticals, preparation of individual doses for patients, quality control of pharmaceutical forms labeled with different radioactive isotopes with the application of the principle of protection against ionizing radiation. Knowledge about clinically important adverse drug reactions and drug-drug interactions. Basics of pharmacokinetics and pharmacodynamics of radiopharmaceuticals, pathophysiological basis of diseases and conditions in the diagnosis and therapy of which radiopharmaceuticals are used, the importance of recognizing side effects and effects of drugs. Making appropriate radiopharmaceutical choices and dosage regimens according to the needs of patients.

Course unit contents

Theoretical classes:

Introduction to radiopharmacy. Properties and method of radioisotope production for use in nuclear medicine. Basic characteristics of ^{99}Mo / ^{99m}Tc generator; Aseptic procedure of preparation of radiopharmaceuticals for diagnosis. Labeling of biological material with radioactive isotopes. Quality control of radiopharmaceuticals. Properties and production of PET radiopharmaceuticals. Radionuclide therapy. Pharmacology and pharmacokinetics of radiopharmaceuticals. Adverse reactions and interactions of radiopharmaceuticals.

Practical classes:

Calculation of generator radioactivity eluate. Calculating a single dose for a patient. Applying the principles of radiation protection. Introduction to the work in the HOT laboratory and to the methods of quality control of radiopharmaceuticals. Handling of PET radiopharmaceuticals. Preparation of the patient for examinations and therapy with radionuclides with monitoring of the pharmaceutical-therapeutic plan.

Literature

Ell PJ, Khan O, Jarritt PH, Cullum ID. Radionucleide, section scanning. Edinburgh:Churchill livingstone. 1982.
Robinson P.J.A. Nuclear Gastroenterology. Edinburgh: Churchill Livingstone. 1986.
Chandra R, Rahmim A. Nuclear Medicine Physics: The Basics, 8th Edition. LWW Lippincott Williams and Wilkins. 2017.

Number of active teaching hours:	Lectures: 15	Practice: 15	Other active classes: 15

Teaching methods: Lectures, practice in a clinic, clinical problems solving.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: CLINICAL PHARMACY 1

Teachers: Olivera Milovanović, Aleksandra Stojanović, Milena Jurišević

Course status: Mandatory

ECTS: 7

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills of clinical pharmacy.

Learning outcomes of course unit:

Knowledge about clinical pharmacy and their skills necessary for practical clinical work; Knowledge about medical treatment orientated for individual patient according to their physical and pathophysiological status; Knowledge about clinically important adverse drug reactions and drug-drug interactions; Skills of literature research and use of evidence-based medicine approach; Skills of making appropriate drug choices and tailoring dosage regimens according to the specific needs of patients; Skills of interpretation different medical and biochemical/laboratory test.

Course unit contents:

Theoretical classes

Introduction to the practice of clinical pharmacy - patient in focus; communication with patient and healthcare professionals; pharmacotherapy of specific population groups; basic principles of FZD; basic biochemical parameters, diagnostic methods and tests, basic principles of pharmacokinetics; therapeutic monitoring of drugs in body fluids; drug concentration curve in relation to the time of application; drug clearance; drug interactions; detection, assessment and prevention of adverse drug reactions; reporting adverse drug reactions; pharmacotherapy according to the individual needs of the patient; basic principles of pharmacogenetics; parenteral and enteral nutrition; pharmacoeconomic aspects of rational pharmacotherapy; advising clinicians on prescribing medications; help with making a class form; therapeutic drug monitoring; pharmacoeconomic evaluations of new drugs; the role of the clinical pharmacist in the clinical trial of drugs, critical assessment of the validity of a clinical study; rational application of pharmacotherapy in: disorders of the gastrointestinal tract, CVD, respiratory disorders, neurological and psychiatric disorders, infectious, endocrine, hematological, rheumatic, renal, malignant diseases.

Practical classes

Exercises of communication with the patient and colleagues; solving clinical problems of patients belonging to specific population groups; solving tasks with clinical problems where the student should assess whether there are drugs that interact in the therapy of a certain patient; visit to the Drug Agency: national center for pharmacovigilance, determination of therapy according to the needs of a particular patient; making forms for the department; therapeutic drug monitoring - calculating the required dose of the drug; development of a monitoring plan for the therapy "Pharmacist, s care plan".

Literature:

DiPiro J, et al. Pharmacotherapy: a Pathophysiologic Approach. 8th edition. McGraw-Hills Companies; 2011.
Atkinson JA, Huang SM, Lertora JJL, Markey SP. Principles of Clinical Pharmacology, 3rd ed., Academic Press, 2012.
Katzung B, Trevor A. Basic & Clinical Pharmacology, 13th edition, McGraw-Hill Medical, 2014.
Malone P, Malone M, Park S. Drug Information: A Guide for Pharmacists, 6th Edition. McGraw Hill. 2017.
Hilal-Dandan R, Brunton L. Goodman And Gilman Manual Of Pharmacology And Therapeutics, Second Edition, (Int'l Ed). McGraw Hill. 2014.
Trevor A, Katzung B. Basic and Clinical Pharmacology, 15th Edition, International Edition. McGraw Hill. 2020.
Chisholm-Burns M, Schwinghammer T, Wells B, Malone P, Dipiro J, Kolesar J. Pharmacotherapy Principles and Practice, 4rd Edition. McGraw Hill. 2016.

Number of active teaching hours:	Lectures: 45	Practice: 15	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problems solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			

Other			
Grading system			
Grade	**No. of points**	**Description**	
10	**91-100**	**Excellent**	
9	**81-90**	**Exceptionally good**	
8	**71-80**	**Very good**	
7	**61-70**	**Good**	
6	**51-60**	**Passing**	
5	**< 51**	**Failing**	

Study program: Pharmacy – Integrated academic studies

Course unit: PHYTOTHERAPY

Teachers: Jovana Jeremić, Isidora Milosavljević, Jovana Bradić

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Providing knowledge of the place and role of phytotherapy in the primary care system and self-medication, herbal remedies (as active components contain herbal drugs or preparations herbal drugs), justification for their use for the recovery, preservation, and promotion of health.

Learning outcomes of course unit:

The student should be familiar with the principles of rational phytotherapy, the active components of herbal remedies and mechanisms of action of active ingredients, perform procedures for quality assurance and control of active components and herbal remedies, suggests active component(s) of herbal remedy, build a critical attitude to a particular herbal remedy, evaluate the benefit/harm ratio of individual herbal medicines, knows the indications, contraindications, side effects and interactions of herbal medicines, provide patients with valid information and advice on their use.

Course unit contents:

Theoretical classes

The student should be familiar with the principles of rational phytotherapy, the active components of herbal remedies and mechanisms of action of active ingredients, perform procedures for quality assurance and control of active components and herbal remedies, suggests active component(s) of herbal remedy, build a critical attitude to a particular herbal remedy, evaluate the benefit/harm ratio of individual herbal medicines, knows the indications, contraindications, side effects and interactions of herbal medicines, provide patients with valid information and advice on their use.

Practical classes

Analysis of the composition of herbal medicinal products from the market; advising on the rational and safe use of phytopreparations in relation to the health condition of the patient. A. Discussion on quality control of herbal drugs and herbal drug preparations as active ingredients of herbal medicinal products.

Literature:

Barnes Joanne, Herbal medicine, London: Pharmaceutical Press; 2007

Barnes Joanne, Linda Anderson, and John David Phillipson. Herbal medicines: a guide for healthcare professionals. No. Ed. 2. London: Pharmaceutical Press 2003.

Heinrich M, Barnes, Prieto-Garcia J, Gibbons S, Williamson E. Fundamentals of Pharmacognosy and Phytotherapy, 3rd Edition (International Edition). Elsevier Science. 2018.

Williamson E, Driver S, Baxter K. Stockley's Herbal Medicines Interactions: A Guide to the Interactions of Herbal Medicines, 2nd Edition. Macmillan Distribution. 2013.

Boullata J, Armenti V. Handbook of Drug-Nutrient Interactions. Humana Press. 2010.

Number of active teaching hours:	Lectures: 45	Practice: 15	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups, Problem solving, Cooperative learning, Experimental work

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**

8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: INDUSTRIAL PHARMACY WITH COSMETOLOGY

Teachers: Snežana Cupara, Marina Tomović, Ana Barjaktarević

Course status: Mandatory

ECTS: 7

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Introducing students to the basic principles of industrial production (development of drug formulation, stability, legal acts related to development, production and storage). Characteristics and types of devices used in the production of drugs. Introduction to raw materials for the production of dermo-cosmetic preparations, types, forms and manufacturing procedures as well as the effects of these products.

Learning outcomes of course unit:

Upon completion of the course in Industrial Pharmacy with Cosmetology, students are expected to acquire basic knowledge about:
Introduction to the principles of operation and types of devices used in the manufacture of drugs; Introducing students to the basic aspects of development, production and quality assurance of medicines; Knowledge about types and procedures for making dermo-cosmetic products; Knowledge about potential side effects of various cosmetic products.
At the end of the course in Industrial Pharmacy with Cosmetology, students are expected to master the following skills:
Quality assessment and production methods of pharmaceutical forms; To properly and efficiently use the acquired knowledge of pharmaceutical technology when making decisions about the preparation; Ability to properly use professional literature; Acquiring knowledge in the field of new drugs; Acquiring knowledge in the field of new aspects of the production of old drug formulations, as well as the formulation of new ones; Rational solution of practical problems in the pharmaceutical industry; Proper choice of active and auxiliary substances in the production of cosmetic products.

Course unit contents:

Theoretical and Practical classes

Regulations governing the development, production, storage of medicines and cosmetic products. Influence of formulation factors and production process on the stability of drugs and cosmetic products. Methods for testing drug stability; Pharmaceutical-technological operations used in the pharmaceutical industry. Characteristics of devices used in the production of various pharmaceutical forms; Selection of ingredients for the production of dermo-cosmetic products, formulation, selection of active and auxiliary substances for the production of various cosmetic products.

Literature:

Swabrick J, Boylan J. Encyclopedia of Pharmaceutical Technology, sec.ed.,vol. 1-3, Marcel Dekker, New York, Basel, 2002.
Flegeer Carolyna, Handbook of Pharmaceutical manufacturing formulations, Washington: CRC Press, 2004
Ansel Howard, Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, Lippincot Williams & Wilkins, Phyladelphia, 1995.
Nogrady Thomas, Liposomes: Methods and Protocol, New York: Humana Press, 2010.
Marriot John, Pharmaceutical compounding and dispensing, London: Pharmaceutical Press, 2006.
Loyd A. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 11th Edition. LWW Lippincott Williams and Wilkins. 2017.
Lester Elder D. A Practical Guide to Contemporary Pharmacy Practice and Compounding, 4th Edition. LWW Lippincott Williams and Wilkins. 2017.
Wolverton S, Wu J. Comprehensive Dermatologic Drug Therapy, 4th Edition. Elsevier. 2020.
Shargel Andrew L. Applied Biopharmaceutics & Pharmacokinetics, Seventh Edition. McGraw Hill. 2015.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups, Cooperative learning, Experimental work

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**

10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: BIOPHARMACY

Teachers: Jovana Bradić, Snežana Cupara, Marina Tomović

Course status: Mandatory

ECTS: 5

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

The aim of the course is to consider the influence of physico-chemical properties of the drug, pharmaceutical form and route of administration on absorption and bioavailability. Understanding the principles of drug absorption from different dosage forms, as well as getting acquainted with all the factors that affect the therapeutic effect of the drug. Acquiring knowledge about pharmaceutical-technological modifications that are carried out in order to optimize the pharmacological action of drugs.

Learning outcomes of course unit:

Knowledge about:

Biopharmaceutical approach in the development of new drugs and modern formulations of existing active substances; Methods for improving the rate of release and absorption of medicinal substances from different dosage forms; Pharmaceutical-technological aspects in the design of the dosage form in order to modify the therapeutic response of the drug; Possible strategies in the process of changing the pharmaceutical form, excipients, technological average in the goal to optimize drug release and absorption; Methods for testing the stability of preparations and factors that affect the quality of preparations during storage.

Skills about:

Analysis of the biological factors influence affecting the drug absorption; Knowledge of drug transport (passive, active, convective diffusion, ion vapor transfer, active transfer, pinocytosis); Absorption, distribution, metabolism, elimination. LADMER system; The importance of metabolism for the new drug formulations development and new methods of drug administration; Differentiation of physico-chemical factors that affect the rate of dissolution and absorption of the drug (degree of ionization, dissociation constant, partition coefficient, solubility, dissolution rate, polymorphism and pseudopolymorphism); Analysis of pharmaceutical-technological factors that affect the rate of drug release from pharmaceutical forms (acid-resistant tablets, coated tablets, preparations with modified drug release); New approaches in enteral and parenteral routes of drug application; Examination of the dissolution rate of a medicinal substance from different pharmaceutical forms; Examples of bioavailability determination and analysis of factors influencing the absorption of a drug from different pharmaceutical forms.

Course unit contents:

Theoretical classes

Biopharmaceutical approach in drug development process. Principles of absorption from different dosage forms of drugs, as well as the influence of physico-chemical, pharmaceutical-technological and physiological factors on the availability of the drug at the site of action. Physical and oxidative stability of preparations and strategies that contribute to preserving the quality of the dosage form during the period of storage and use.

Practical classes

Production of pharmaceutical forms available on the market for internal and external use. Biopharmaceutical characterization and stability testing of manufactured preparations. Considering the advantages of modern drug formulations and methods of pharmaceutical form, excipients, technological procedure changing in order to optimize the release of the drug from the dosage form and absorption.

Literature:

Klefenz, Heinrich, Industrial Pharmaceutical Biotechnology, Weinheim,Wiley Vch., 2005.

Nogrady Thomas, Liposomes: Methods and Protocol, New York: Humana Press, 2010.

Loyd A. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 11th Edition. LWW Lippincott Williams and Wilkins. 2017.

Lester Elder D. A Practical Guide to Contemporary Pharmacy Practice and Compounding, 4th Edition. LWW Lippincott Williams and Wilkins. 2017.

Wolverton S, Wu J. Comprehensive Dermatologic Drug Therapy, 4th Edition. Elsevier. 2020.

Shargel Andrew L. Applied Biopharmaceutics & Pharmacokinetics, Seventh Edition. McGraw Hill. 2015.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups, Cooperative learning, Experimental work

Examination methods (maximum 100 points)			
Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**

Student’s activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system		
Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: TREATMENT OF INFECTIVE DISEASES

Teachers: Goran Davidović, Vojislav Ćupurdija

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills in infectious diseases.

Learning outcomes of course unit:

Knowledge about diagnosing and medical treatment of the infectious diseases (streptococcal and staphylococcal infections, rash fever, respiratory infections, neuroinfections, intestinal infections, viral hepatitis, anaerobic infections and zoonozes, herepes viral infections, sepsis, FUO and AIDS, intrauterine and intrahospital infections.); Knowledge about prophylaxis and medical treatment of infectious disease (bacterial, viral, fungal, protozoal infections and prion diseases) in population; Skills of patients examination and clinical interview in infectious diseases.

Course unit contents:

Theoretical classes

Infectious diseases as a discipline. Basics of clinical careful history, epidemiologic feature, physical examination, laboratory, microbiological, serological analysis and appropriate radiographic procedure. Diagnosis and treatment of streptococcal and staphylococcal infections. Diagnosis and treatment of rush fever. Diagnosis and treatment of respiratory infections and enterovirosis. Diagnosis and treatment of bacterial and viral neuroinfections. Diagnosis and treatment of intestinal infections. Diagnosis and treatment of acute and chronic viral hepatitis. Diagnosis and treatment of anaerobic infections and zoonozes. Diagnosis and treatment of herepes viral infections. Diagnosis and treatment of FUO and AIDS. Diagnosis and treatment of sepsis and viral hemorrhagic fevers. Diagnosis and treatment of parasitic and ricketssial diseases. Diagnosis and treatment of intrauterine and intrahospital infections. Clinically important adverse drug reactions and drug-drug interactions in infectious diseases

Practical classes

Principles of patient examination with rush fever, respiratory and intestinal infections, neuroinfections, viral hepatitis, anaerobic infections and zoonozes, herepes viral infections, FUO and AIDS, sepsis and viral hemorrhagic fevers, parasitic and ricketssial diseases, intrauterine and intrahospital infections. Principles of diagnosis and medical treatment of these patients. Dosing in children and elderly. Discovering potential drug-drug interactions. Causal interpretation of adverse events.

Literature:

Prescott L, Harley J, Klein D. Microbiology, New York:McGraw-Hill,Inc. 2000.
Cooke F, Török E, Moran E. Oxford Handbook of Infectious Diseases and Microbiology 2nd Edition. Oxford University Press. 2016.
Abbas A, Lichtman A, Pillai S. Basic Immunology: Functions and Disorders of the Immune System, 6th Edition. Elsevier Science. 2019.
Levinson W. Review of Medical Microbiology and Immunology, 16th Edition, International Edition. McGraw Hill. 2020.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problem solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**40**
practical classes/tests	**30**	written examination	
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**

6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACEUTICAL BIOTECHNOLOGY

Teachers: Slobodan Novokmet, Isidora Milosavljević, Jovana Jeremić

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:
Acquiring knowledge and skills in the production of biopharmaceuticals.

Learning outcomes of course unit:
Providing knowledge of basics of pharmaceutical biotechnology and biopharmaceuticals; Students will be trained for the basic genome manipulation by PCR and will be informed about recombinant DNA technology; Studding of different groups of therapeutic proteins obtained by recombinant DNA technology; Mastering the hybridoma technique for the production of monoclonal antibody and vaccine production technology.

Course unit contents:

Theoretical classes

Introduction to Pharmaceutical Biotechnology. Structure of protein molecules. Recombinant DNA technology. Sources for the production of biopharmaceuticals. Biosynthesis of biopharmaceuticals (upstream processes). Isolation of therapeutic proteins from cell cultures (downstream processes). Formulation of final protein products. Process rooms. Final product analysis. Detection of pyrogens and other potential impurities. Therapeutic cytokines: The interferon family. Therapeutic cytokines: Interleukins and tumor necrosis factor. Therapeutic growth factors. Therapeutic hormones. Therapeutic enzymes. Recombinant blood products. Monoclonal antibodies. Vaccine production technology. Gene therapy. Antisense therapy.

Practical classes

Principles of the basic genome manipulation by PCR technique (real-time PCR). Principles and detection of specific protein molecules by Western blot. Analysis and interpretation of obtained results.

Literature:

Klefenz Heinrich, Industrial Pharmaceutical Biotechnology,Wiley Vch., 2002.
Grokes Michael, Pharmaceutical Biotechnology, Taylor & Francis, USA, 2003.
Walsh Garay, Biopharmaceutical Biochemestry and biotechnology, Weinheim,Wiley Vch., 2006
Kayser Oliver, and Heribert Warzecha, eds. Pharmaceutical biotechnology: drug discovery and clinical applications. John Wiley & Sons, 2012.
Loyd A. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 11th Edition. LWW Lippincott Williams and Wilkins. 2017.
Abbas A, Lichtman A, Pillai S. Basic Immunology: Functions and Disorders of the Immune System, 6th Edition. Elsevier Science. 2019.
Lester Elder D. A Practical Guide to Contemporary Pharmacy Practice and Compounding, 4th Edition. LWW Lippincott Williams and Wilkins. 2017.

Number of active teaching hours:	Lectures: 45	Practice: 30	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problem solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**10**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project	**20**		
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**

6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: SOCIAL PHARMACY

Teachers: Olivera Milovanović, Milena Jurišević, Aleksandra Stojanović

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge and skills of social pharmacy.

Learning outcomes of course unit:

Knowledge about social pharmacy; Implementation of social pharmacy postulate to the health care organization; Knowledge about significance and role of pharmacists in providing pharmaceutical health care; Knowledge about ethical principles in the provision of pharmaceutical health care; Knowledge of basic national and international regulations, laws, which clearly define the pharmaceutical activity within the health care system.

Course unit contents:

Theoretical classes

Pharmaceutical health activity, origin and development. Basic principles of pharmaceutical health care, holders and participants in the provision of pharmaceutical health care and standards for its performance. Pharmaceutical health institutions (types of institutions, their structure and bodies of pharmaceutical health institutions). European and international regulations on medicines - basic guidelines of regulations. Implementation of pharmaceutical health care according to national regulations - Law on Medicines and Medical Devices, Law on Health Care, Law on Health Insurance, Law on Chambers of Health Workers. The role and tasks of the Agency for Medicines and Medical Devices. Registration of drugs and medical devices - procedures and conditions. Pharmaceutical Chamber of Serbia, license to work as a pharmacist. Courts are part of the health care system. Ethical aspects of conducting biomedical research. Ethics Committee. Advertising of pharmaceutical products. Drug pricing policy; list of refundable drugs.

Practical classes

Problem-oriented learning, application of the law on current issues.

Literature:

Phalen, Robert F. Core ethics for health professionals: principles, issues, and compliance. Springer, 2017.
EU directive, European Parliament and European Council. Academic network: http://ec.europa.eu/health/documents/eudralex/index_en.htm
ICH Quality, Efficacy, Safety, and Multidisciplinary Guidelines. International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use. Academic network: http://www.ich.org/products/guidelines.html

Number of active teaching hours:	Lectures: 45	Practice: 15	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problem solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**

5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: CLINICAL PHARMACY 2

Teachers: Olivera Milovanović, Milena Jurišević, Aleksandra Stojanović

Course status: Mandatory

ECTS: 7

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Clinical pharmacy as a health science discipline enabling to pharmacists to provide patient care that optimizes medication therapy and promotes health, and disease prevention. The practice of clinical pharmacy embraces the philosophy of pharmaceutical care, blending a caring orientation with specialized therapeutic knowledge, experience, and judgment to ensure optimal patient outcomes.

Learning outcomes of course unit:

Clinical pharmacy II offers a mix of clinical, applied practice, public health and research units, giving you the knowledge and skills to be an excellent clinical pharmacist. Also, this course cover applied practice topics, including public health, pharmacy practice research, training others and organisational influences on healthcare.

This course aims to help students to develop:

Knowledge that students will acquire after mastering the program: Advanced knowledge and understanding of the management of a range of acute and chronic conditions of gastrointestinal, cardiovascular, respiratory, urogenital, hematological system in adults and vulnerable population (children, pregnancy and breastfeeding); Skills that students will acquire after mastering the program: skills in medicines optimization and the ability to communicate with a range of healthcare professionals to promote the appropriate use of medicines; skills in the critical evaluation of a range of health services literature; Attitudes that students will acquire after mastering the program: Rational approach to the use of drugs; maximum caution when using drugs; responsibly behavior towards the social community; awareness of the limitations of one's own knowledge of drugs; thoughts about the future.

Course unit contents:

Theoretical classes

Clinical pharmacy in the health care system; Management of conditions of cardiovascular, respiratory, gastrointestinal, urogenital and hematological system; Management of acute and chronic infectious conditions; Management of various conditions in children and pregnant woman and during breastfeeding.

Practical classes

Rational approach of using drugs that act on the receptors of the of cardiovascular, respiratory, gastrointestinal, urogenital and hematological system; Rational use of anti-inflammatory drugs; Rational use of drugs in pediatrics; Rational use of anti-inflammatory and neoplastic drugs.

Literature:

Katzung Bertran, Basic and Clinical Pharmacology, Mc Grawhill, New York, 2004

Clinical Pharmacy and Therapeutics. Cate Whittlesea & Karen Hodson, 6th edition, 2018; Elsevier Science.

Hilal-Dandan R, Brunton L. Goodman And Gilman Manual Of Pharmacology And Therapeutics, Second Edition, (Int'l Ed). McGraw Hill. 2014.

Trevor A, Katzung B. Basic and Clinical Pharmacology, 15th Edition, International Edition. McGraw Hill. 2020.

Chisholm-Burns M, Schwinghammer T, Wells B, Malone P, Dipiro J, Kolesar J. Pharmacotherapy Principles and Practice, 4rd Edition. McGraw Hill. 2016.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 0

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problem solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**70**
practical classes/tests		written examination	
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**

10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: SPORTS PHARMACY

Teachers: Vladimir Jakovljević, Vladimir Živković, Ivan Srejović

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Introducing students with the role of pharmacists in sports and testing and detecting drug abuse in sports. Advisory and educational role of pharmacists in the sports team in the prevention and detection of doping. Introduction with the work of specialized laboratories for the detection of collected substances in sports. Proper dosing of nutritional supplements in sports. Use of drugs in sports. Monitoring and analysis of the effects of applied drugs on biochemical and hematological parameters and functional performance of the organism.

Learning outcomes of course unit:

Knowledge about legislative rules that regulate the use of drugs and medicinal substances in sport; Knowledge about abuse of drugs and medical substances in sports; Knowledge about the use of nutritional supplements in sports and monitoring the effects of their application; Knowledge about the methods for detecting the use of doping agents; Skills about HPLC methods in qualitative and quantitative analysis of illicit substances in dietary supplements; Skills about screening of biological material for the presence of certain groups of drugs used in doping.

Course unit contents:

Theoretical classes

Biomedical sciences in sport. Sports medical-pharmaceutical doctrine in Serbia. The impact of modern sport on the human body. The role and place of pharmacists in modern sport. Legal frameworks for the use of drugs and medicinal substances in sport. The most common injuries in sport. Pharmacological therapy of the most common sports injuries. Changes in water-salt balance during physical activity. Effects of dehydration on the body. Nutritional needs of athletes. Basic principles of proper and timely nutrition of athletes. Dietary supplements in sport. Vitamins and minerals as supplements in sport. Amino acids and proteins as supplements in sport. Ergogenic agents as supplements in sport. Illicit drugs and medicinal substances in sport. Doping in sport. Exemption for therapeutic use (TUE). Supplementation and doping. Doping sanctions.

Practical classes

Sports medical organizations in the world and their importance. Physical ability. The role and place of pharmacists in the sports team. Practical application of legislative rules that regulate the use of drugs and medicinal substances in sports. Prevention of the most common injuries in sports. Specifics of hydration in relation to gender, age of the athlete and type of sport. Principles of composing a nutritious meal for athletes. The use of dietary supplements in athletes. Doping control. TUE analysis in Serbia. The most common practical issues related to the use of supplements.

Literature:

Hall J. Guyton & Hall Textbook of Medical Physiology, 14th Edition, International Edition. Elsevier Science. 2020.

Webster-Gandy J, Madden A, Holdsworth M.Oxford Handbook of Nutrition and Dietetics, 3rd Edition. Oxford University Press. 2020.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problem solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**15**	oral examination	
practical classes/tests	**15**	written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**

8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: IMMUNISATION AND VACCINES

Teachers: Dejan Baskić, Ilija Jeftić, Isidora Milosavljević

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Introduction to the immune mechanisms of active immunisation, types of vaccines, manufacturing and quality control of vaccines.

Learning outcomes of course unit:

Upon completion of the course Immunisation and vaccines, students are expected to acquire basic knowledge on:
Active immunisation mechanisms; Vaccine categories; Manufacturing and quality control of vaccines; regulatory and clinical aspects of vaccines; Immunisation of specific populations; Prophylactic and therapeutic vaccines; Pitfalls of improving immunisation rate and how to cope with them.
At the end of the course Immunisation and vaccines, students are expected to master the following skills on:
Independently perform analyzes and synthesis of relevant data, identify and solve problems, make decisions and apply the acquired knowledge in practice in team work.

Course unit contents:

Theoretical and Practical classes

History of infectious diseases and vaccines. Immune response – summary. Passive and active immunisation. Vaccine categories. Routes of vaccine administration. Manufacturing, formulation, caracterisation and storage of vaccines. Regulatory and clinical aspects; Efficacy and safety - preclinical and clinical studies. Vaccination schedule; vaccines recommendations for special populations; herd immunity. Bacterial vaccines. Virus vaccines. Tumor vaccines. Non-infectious and non-tumor vaccines. Adverse effect of vaccines – myths and reality. Barriers to improve immunisation rate and ways to overcome them..

Literature:

Abbas AK, Lichtman AH, Pillai S. Cellular and molecular immunology. Elsevier Saunders, Philadelphia, PA, USA, 9th ed., 2017.
Cooke F, Török E, Moran E. Oxford Handbook of Infectious Diseases and Microbiology 2nd Edition. Oxford University Press. 2016.
Abbas A, Lichtman A, Pillai S. Basic Immunology: Functions and Disorders of the Immune System, 6th Edition. Elsevier Science. 2019.
Levinson W. Review of Medical Microbiology and Immunology, 16th Edition, International Edition. McGraw Hill. 2020.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problem solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**40**
practical classes/tests		written examination	**30**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: DRUG ADDICTION AND DRUG ABUSE

Teachers: Dragana Ignjatović Ristić, Branimir Radmanović, Milica Borovčanin

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

To acquaint students with the concepts of harmful use and abuse of substances, basic concepts of the neurobiology of addiction, basic clinical characteristics of addiction as well as current methods of treatment. Develop an ethical approach to the problem of addiction, without stigmatization and discrimination of the patient, based on the scientific claim that addiction is a chronic recurrent disease.

Learning outcomes of course unit:

Upon completion of the course Drug addiction and drug abuse, the student is expected to acquire basic knowledge in the following:
Neurobiological mechanisms underlying addiction, Understanding the concepts of harmful use, abuse and dependence on psychoactive substances and drugs, Diagnosing substance abuse, Characteristics of opiates and their addictive abilities, Characteristics of alcohol and its consequences, Characteristics of marijuana and consequences of action; knowledge of the mechanism of action of stimuli and ecstasy, Addictive potential of benzodiazepines, other hypnotics and barbituratesBasic principles of drug addiction treatment
At the end of the course Drug addiction and drug abuse students are expected to master the following skills:
Recognition of psychiatric syndromes associated with drug and substance abuse, Conducting interviews with a patient addicted to drugs or substances, Advising patients addicted to drugs or substances regarding treatment methods, Consideration of health problems of addicts in a broader context (health risk due to associated infections - HIV and HCV), Consideration of other problems of addicts that are important for the community - traffic problems, Problems related to productivity, crime, violence, family issues.

Course unit contents:

Theoretical and Practical classes

History, Distinction between terms: acute intoxication and abuse, Neurobiology of benzodiazepine dependence, Clinical picture of benzodiazepine dependence, Abuse of anabolic-androgenic steroids, Neurobiology of opiate dependence, Principles of opiate addiction treatment, Neurobiology of alcohol, Acute psychosis of alcoholics, Principles of psychostimulants - MDMA, Neurobiology of marijuana, Drug abuse, Substance abuse, Pharmacoeconomic aspect of addiction

Literature:

Stahl Stephen, Essential Psychopharmacology – The Prescriber's Guide, Cambridge: University Press, 2006.
Fuller Matthew, Drug Information Handbook for Psychiatry, Hudson: Lexicomp Inc, 2000.
Galanter Marc, Textbook of Substance Abuse Treatment, Washington: American Psychiatric Publishing Inc, 2004.
Herron A, Koehler Brennan T. The ASAM Essentials of Addiction Medicine, 3rd Edition. LWW Lippincott Williams and Wilkins. 2019.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problem solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**

6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: RESEARCH IN CLINICAL PHARMACOLOGY

Teachers: Tamara Nikolić Turnić, Nataša Đorđević, Radiša Pavlović

Course status: Elective

ECTS: 5

Prerequisites: Enrolled in fourth year of Pharmacy – Integrated academic studies

Course unit objective:

Enabling students to independently conduct research in the field of pharmacology, through all necessary phases: selection of research topics, selection of appropriate methodology, development of research plans, conducting research, data collecting and analyzing, data presentation in the form of scientific manuscript; development of a rational approach to problems in practice.

Learning outcomes of course unit:

Knowledge about:

Basic principles of research planning; Mastering general principles in the field of research; Ethical principles; Different methodology used in research; Making a scientific manuscript.

Skills about:

Searching for valid literature; Choosing focused and relevant research topics; Conducting research in pharmacology; Making a scientific manuscript for a journal; Critical analysis of clinical studies, meta-analyzes and systematic reviews.

Course unit contents:

Theoretical and Practical classes

Introduction to research in Clinical Pharmacology. Basic principles of research in pharmacology. Types of studies. Assessment of the scientific article quality. Determining research design. Literature search. Literature citation.

Practical classes

Analyzing of practical examples. Making a research plan. Obtaining a decision from the Ethics Committee. Data collection for research. Results analyzing. Data presentation. Writing a manuscript.

Literature:

Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB (eds). Designing Clinical Research, 3th edition. Philadelphia: Lippincot Williams & Wilkins, 2007.

Medical Databases: PubMed, Kobson.

Ray S, Fitzpatrick S, Golubic R, Fisher S, Gibbings S. Oxford Handbook of Clinical and Healthcare Research (Flexicover) (Oxford Medical Handbooks). Oxford University Press. 2016.

Gamulin S. Clinical research - clinical epidemiology. Medicinska naklada. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, Discussion, Work in small groups, Clinical problem solving

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**

8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: CLINICAL PHARMACY 3

Teachers: Aleksandra Stojanović, Olivera Milovanović, Milena Jurišević

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fifth year of Pharmacy – Integrated academic studies

Course unit objective:

Enabling students to work independently in a health team that deals with disease prevention and treatment of patients. Development of pharmaceutical services and skills within the healthcare system. Introduction to ethical aspects of pharmaceutical healthcare.

Learning outcomes of course unit:

Knowledge about: mastering general principles in the field of clinical pharmacology; Introduction to the basic characteristics of most often used drugs in various therapeutic areas of medicine (mechanism of action, indications, route of administration, basic characteristics of pharmacokinetics, contraindications and side effects); Clinically significant pharmacokinetic variability of drugs; New laboratory markers in risk assessment for disease. Skills about: Prescription control; Critical analysis of clinical studies, meta-analyzes and systematic reviews; Use of independent information on medicines, health promotion in public pharmacy - communication skills, rational use of medicines; Pharmaceutical healthcare.

Course unit contents

Theoretical classes:

Introduction to clinical pharmacy and its significance about drug use in certain vulnerable populations and populations that require special care and therapy, possible dose adjustment. The use of drugs in pregnancy and lactation. Specific diseases manifestations and presentations in geriatric. Drug use in the geriatric population. Specific diseases manifestations and presentations in pediatrics. Drug use in the pediatric population.

Practical classes:

Solving of clinical problems and making clinical decisions in order to improve patient health. Recognition and treating of comorbidities according to priority. Therapy planning. Dose adjustment. Disease outcomes monitoring.

Literature

Hilal-Dandan R, Brunton L. Goodman And Gilman Manual Of Pharmacology And Therapeutics, Second Edition, (Int'l Ed). McGraw Hill. 2014.
Trevor A, Katzung B. Basic and Clinical Pharmacology, 15th Edition, International Edition. McGraw Hill. 2020.
Chisholm-Burns M, Schwinghammer T, Wells B, Malone P, Dipiro J, Kolesar J. Pharmacotherapy Principles and Practice, 4rd Edition. McGraw Hill. 2016.

Number of active teaching hours:	Lectures: 30	Practice: 30	Other active classes: 0

Teaching methods: Lectures, *Problem-based learning.*

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**

5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACOVIGILANCE

Teachers: Dušan Đurić, Tamara Nikolić Turnić, Radiša Pavlović

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fifth year of Pharmacy – Integrated academic studies

Course unit objective:

Introducing students to the methods of recognition and spontaneous reporting of adverse drug reactions. Enabling students to independently design and conduct research in the field of pharmacovigilance.

Learning outcomes of course unit:

Upon completion of the course in Pharmacovigilance, the student is expected to acquire knowledge about: adverse drug reactions (frequency in outpatient and inpatient settings, predisposing factors, methods of prevention, methods of detecting adverse drug reactions, causality assessment and reporting adverse drug reactions); drug interactions, as potential factors for the development of drug side effects (mechanisms of interactions: chemical, physiological, pharmacological, pharmacokinetic, steps for preventing drug interactions); common treatment mistakes (reasons for errors in treatment, strategies to minimize the risk of error). At the end of the Pharmacovigilance course, the student is expected to master the skills of: verification of the development of adverse drug reaction; spontaneous reporting of adverse drug reactions; implementation of measures that could prevent the occurrence of adverse drug reactions; adequate familiarization of patients with the side effects of the drugs they use; designing and conducting drug side effect study; statistical processing of research results and their interpretation.

Course unit contents

Theoretical classes:

Contemporary aspects of pharmacovigilance; Methods of collecting and reporting adverse drug reactions; Causal interpretation of drug adverse events; *Design*ing a drug side effect study.

Practical classes:

Practical aspects of detecting and reporting adverse drug reaction; Conducting a research in the field of pharmacovigilance.

Literature

Lindquist AM. Seeing and Observing in International Pharmacovigilance. Sweedan: Proefschrift, 2003.

Stockley IH. Drug Interactions. Oxford: Blackwell Science, 1994.

Salway JG. Drug-Test Interactions Handbook. Edinburgh: Churchill-Livingstone, 1990.

Stockley IH. Stockley's Drug Interactions. London: Pharmaceutical Press, 2002.

Waller P, Harrison-Woolrych M. An Introduction to Pharmacovigilance, 2nd Edition. John Wiley & Sons. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, Problem-based learning.

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	**70**
practical classes/tests		written examination	
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**

5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACOEPIDEMIOLOGY

Teachers: Olivera Milovanović, Milena Jurišević, Aleksandra Stojanović

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fifth year of Pharmacy – Integrated academic studies

Course unit objective:

Enabling students to independently design and perform pharmacoepidemiological research, processing the results and their interpretation, as well as to apply the principles of pharmacoepidemiology in clinical practice and research.

Learning outcomes of course unit:

Knowledge about: Definitions, history and development of pharmacoepidemiology; Types of pharmacoepidemiological studies; Design of pharmacoepidemiological studies; Drug use studies; Indicators of rational drug use; Drug classifications and the concept of defined daily doses; The concept of 90% consumption; Sampling and classification of subjects into groups, in experimental and other types of pharmacoepidemiological research; Data collection in pharmacoepidemiology and use of secondary sources. Skills about: Design and implementation of pharmacoepidemiological studies; Estimation of drug consumption in a health institution; Collection of the data about drugs use in a health institution; Developing of drug use studies and ABC analysis; Working with structured and semi-structured questionnaires; Interview: in direct contact, by phone; Patients informing and written consent obtaining to participate in a pharmacoepidemiological study; Statistical processing of the results of own research and their interpretation.

Course unit contents

Theoretical classes:

Introduction to pharmacoepidemiology. Fundamentals of pharmacoepidemiology. Types of pharmacoepidemiological studies. Cohort and cross-sectional studies. Case-control studies and crossover studies. Descriptive and case-series studies. Drug use studies.

Practical classes:

Analyzing of practical examples. Solving of practical problem and the individual research approach in the development of systematic review in the field of pharmacoepidemiology.

Literature

Haynes B. Clinical epidemiology: how to do clinical practice research. Philadelphia: Lippincot Williams & Wilkins, 2005.

Storm B. Pharmacoepidemiology. New York:John Wiley & Sons, 1995.
Storm BL. Textbook of Pharmacoepidemiology. London: John Willy & Sons, 2008.

Malone P, Malone M, Park S. Drug Information: A Guide for Pharmacists, 6th Edition. McGraw Hill. 2017.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: *Lectures, Problem-based learning.*

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PHARMACOKINETICS

Teachers: Radiša Pavlović, Tamara Nikolić Turnić, Dušan Đurić

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fifth year of Pharmacy – Integrated academic studies

Course unit objective:

Introducing students to the processes that define the fate of the drug in the human body, analysis and interpretation of the pharmacokinetic parameters, and methods of implementation of pharmacokinetic data in optimizing pharmacotherapy.

Learning outcomes of course unit:

Upon completion of the course in Pharmacokinetics, the student is expected to acquire knowledge about: principles of pharmacokinetic processes in the human body and the factors that affect their variability; methods of assessing pharmacokinetic parameters; pharmacokinetic data analysis; principles of pharmacogenetics; clinical application of pharmacokinetics and pharmacogenetics; basic principles and indications for therapeutic drug monitoring; mechanisms, outcomes, and methods of prevention of clinically important pharmacokinetic drug interactions; principles of toxicokinetics. At the end of the Pharmacokinetic course, the student is expected to master the skills of: clinical application of pharmacokinetics principles; analysis of pharmacokinetic parameters; selecting and adjusting drugs and dosing regimens based on pharmacokinetic parameters; optimizing therapeutic approach in specific populations, including children, elderly, overweight patients, pregnant and brest-feeding women, and patients with impaired liver or renal function.

Course unit contents

Theoretical classes:

Introduction to pharmacokinetics: absorption, distribution, metabolism and excretion; Repeated dosing and steady-state pharmacokinetics; Pharmacokinetic modelling and compartmental approach to pharmacokinetic analysis; Principles of first- and zero-order pharmacokinetics; saturable pharmacokinetics; Principles, indications and clinical application of therapeutic drug monitoring; Principles and application of population pharmacokinetics; Principles and clinical application of pharmacogenetics; Pharmacokinetics drug interactions; Drugs and dosing regimens choice and adjustment in children, elderly, overweight patients, pregnant and brest-feeding women, and patients with impaired liver or renal function; Toxicokinetics.

Practical classes:

Problem-based practical application of pharmacokinetic data in individualizing pharmacotherapy, using basic pharmacokinetic equations in estimating and optimizing drugs and dosing regimens.

Literature

Murphy J. Clinical Pharmacokinetics. Marylend:American Society of Health System, 2005.

Brikket D. Pharmacokinetics. Sidney:Mc Graw, 2005.

Brikket DJ. Pharmacokinetics Made Easy: revised. Sydney: The McGraw Hill Co, 2008.

Loyd A. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 11th Edition. LWW Lippincott Williams and Wilkins. 2017.

Lester Elder D. A Practical Guide to Contemporary Pharmacy Practice and Compounding, 4th Edition. LWW Lippincott Williams and Wilkins. 2017.

Shargel Andrew L. Applied Biopharmaceutics & Pharmacokinetics, Seventh Edition. McGraw Hill. 2015.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, practical clases, and p*roblem-based learning.*

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**30**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project			
Other			

Grading system

Grade	No. of points	Description
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: APPLIED PHARMACEUTICAL BIOTECHNOLOGY

Teachers: Isidora Milosavljević, Jovana Jeremić, Jovana Bradić

Course status: Mandatory

ECTS: 6

Prerequisites: Enrolled in fifth year of Pharmacy – Integrated academic studies

Course unit objective:

Acquiring knowledge about the possibilities of applying modern techniques of pharmaceutical biotechnology in the design and formulation of various pharmaceutical forms.

Learning outcomes of course unit:

Pharmaceutical biotechnology is a relatively new and growing field in which the principles of biotechnology are applied to the development of drugs. A majority of therapeutic drugs in the current market are bioformulations, such as antibodies, nucleic acid products and vaccines. Applied pharmaceutical biotechnology uses scientific knowledge from molecular biology, immunology and biomedical engineering in research and creation of useful products related to the functions of the human body. The field of applied pharmaceutical biotechnology is a subset of the pharmaceutical industry that produces drugs, medicines and cosmetics using biological methods. The findings of biotechnological research help in the development of these pharmaceutical products. Molecular biology refers to the study of molecules within a cell, including their composition, structure and interactions.

Course unit contents:

Theoretical classes

The principles and techniques of biotechnology in the context of the global biotechnology industry is gained. The purpose of Applied pharmaceutical biotechnology is to use biological concepts to create technologies and products. It is the practical arm of biology. However, many other scientific fields work in partnership with the biotechnology industry to generate useful products. Biotechnology helps the pharmaceutical industry to develop new products, new processes, methods and services and to improve existing ones.

Practical classes

Principles of the basic genome manipulation by different techniques.

Literature:

Klefenz Heinrich, Industrial Pharmaceutical Biotechnology,Wiley Vch., 2002.

Grokes Michael, Pharmaceutical Biotechnology, Taylor & Francis, USA, 2003.

Walsh Garay, Biophaharmaceutical Biochemestry and biotechnology, Weinheim,Wiley Vch., 2006

Kayser Oliver, and Heribert Warzecha, eds. Pharmaceutical biotechnology: drug discovery and clinical applications. John Wiley & Sons, 2012.

Number of active teaching hours:	Lectures: 30	Practice: 15	Other active classes: 15

Teaching methods: Lectures, Discussion, Work in small groups

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures	**10**	oral examination	
practical classes/tests		written examination	**70**
Seminars/homework			
Project	**20**		
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**

7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: PROFESSIONAL STUDENT PRACTICE

Teachers:

Course status: Mandatory

ECTS: 15

Prerequisites: Enrolled in fifth year of Pharmacy – Integrated academic studies

Course unit objective:

Application of knowledge acquired during studies in pharmacy conditions. Acquiring communication skills with patients, colleagues and the healthcare public. Application of acquired knowledge in the field of pharmaceutical technology, pharmacology, pharmaceutical health care, regulations and professional regulations. Formation of personal attitude and responsibility towards work and professional public as well as towards users of health services.

Learning outcomes of course unit:

Upon completion of classes in the subject Professional Student Practise, students are expected to acquire basic knowledge: Under the supervision of a pharmacist, receive, record and store active and auxiliary substances in the galenic laboratory; Conduct procurement and storage of medicines and medical resources; Properly and timely develop a magistral drug; Determine the correctness of the prescribed medication, dispense the appropriate medication, monitor and report side effects; Conduct proper administrative data processing in the pharmacy. At the end of the course in the subject Professional Student Practise, the student is expected to master the following skills: Build the ability to communicate with patients, colleagues in the pharmacy and doctors who prescribe therapy; To properly and effectively use previously acquired knowledge when making decisions about individual therapy; Ability to properly use professional literature; Acquiring knowledge in the field of new drugs.

Ability to properly make a magistral drug; Rational solution of practical problems in the pharmaceutical industry; Interpretation of the rationality of the application of new therapeutic systems.

Course unit contents

Theoretical and practical classes:

Performing practice in the laboratory. Production of magistral products. Performing an internship in a pharmacy. Introduction to the literature of the pharmacy, working methods and keeping professional records of the pharmacy. Performing practise in a pharmacy. Working with pharmacy users. Determining the accuracy of the prescribed therapy and issuing the same.

Literature

Avdeef A. Absorption and Drug Development. Wiley-Interscience, USA, 2003.

Krogsgaard-Larsen P, Bundgaard H. A Textbook of Drug Design and Development. Australia: Harwood Academic Publishers, 1991.

Katzung B. Basic and Clinical Pharmacology. New York: McGraw-Hill, Inc., 2004.

Troy DB. Remington: The Science and Practice of Pharmacy. Philadelphia :Lippincot Williams&Wilkins, 2006.

Swarbrick J. Encyclopedia of Pharmaceutical Technology-volume 1. New York: Marcel Dekker, 2002.

Swarbrick J. Encyclopedia of Pharmaceutical Technology-volume 2. New York: Marcel Dekker, 2002.

Ansel H. Pharmaceutical Dosage Forms and Drug Delivery Systems. Baltimore: Williams & Wilkins, 1995.

Malone P, Malone M, Park S. Drug Information: A Guide for Pharmacists, 6th Edition. McGraw Hill. 2017.

Chisholm-Burns M, Schwinghammer T, Wells B, Malone P, Dipiro J, Kolesar J. Pharmacotherapy Principles and Practice, 4rd Edition. McGraw Hill. 2016.

Number of active teaching hours:	Lectures: 0	Practice: 0	Other active classes: 0	Other: 450

Teaching methods: Teaching is carried out in the form of work in small groups (PBL).

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures		oral examination	
practical classes/tests		written examination	
Seminars/homework			
Project			
Other			

Study program: Pharmacy – Integrated academic studies

Course unit: FINAL WORK-RESEARCH

Teachers: Teachers from the study program

Course status: Mandatory

ECTS: 5

Prerequisites: Enrolled in fifth year of Pharmacy – Integrated academic studies

Course unit objective:

The student, in cooperation with the mentor, defines the research that will be realized within the final research work. When choosing topics it is necessary to meet the following criteria: topicality, suitability for processing and precision in content specificity (clear and a precisely defined topic).

Learning outcomes of course unit:

By completing the course, a student needs to prove that he/she has competencies and has achieved learning outcomes in solving problems from professional and scientific fields that were content of studies and that he was trained in the use of theoretical and practical knowledge gained during the course of study.

Course unit contents

The mentor, in cooperation with the student, determines the tasks for SIR, monitors the work student and provides the necessary support and professional assistance in planning and solving tasks. Tasks for SIR include: Project development / goal and character of the research, purpose of the research, methodology and plan of research; Realization of research; application of planned research techniques and; Processing and interpretation of the obtained data, drawing conclusions; Preparation of the report on SIR- Research report with a proposal for solving the problem which is subject of research.

The SIR- Research report contains: Title, data on the student, data on the mentor and associate practitioner and data on the institution in which research was conducted. The structure of the SIR- Research report consists of: summary, key words, introduction, research methodology, results with discussion, conclusion (with a proposal for solving the problem), literature and contributions. Volume the report is at least 10,000 characters. After the realization of SIR, the student submits the SIR- Research report. Rating the Final work-research consists of a grade for the development of SIR and a grade for the defense of SIR. The final grade is expressed by the sum of points obtained for the preparation and defense of the SIR and appropriate grade, according to the established rating scale.

Literature

The literature depends on the topic of the final work as well as on the chosen mentor.

Number of active teaching hours:	Lectures: 0	Practice: 0	Other active classes: 300	Other:

Teaching methods: Work with mentor

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student's activity during Lectures		oral examination	
practical classes/tests		written examination	**30**
Seminars/homework			
Project	**70**		
Other			

Grading system

Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**

Study program: Pharmacy – Integrated academic studies

Course unit: FINAL WORK-DESIGN AND DEFENSE

Teachers: /

Course status: Mandatory

ECTS: 10

Prerequisites: Completed all exams in course Pharmacy – Integrated academic studies

Course unit objective:

The aim of this course is to enable the student to independently find relevant literature related to a particular topic, to classify the literature according to quality, as well as to critically analyze the available data to draw a conclusion on a given question. The goal is also to stimulate the student to consolidate all the knowledge acquired during schooling.

Learning outcomes of course unit:

Upon completion of the final work, the student is expected to acquire the following knowledge: literature search techniques, assessment of the validity and clinical significance of published studies, designing a research plan, statistical processing of results, writing original scientific research work. Upon completion of the final work, the student is expected to acquire the following skills: formulating a research question, collecting data from practice, processing of results in statistical programs, making a presentation of the results, mastering certain laboratory techniques.

Course unit contents

Theoretical classes:

The final work is a research work of the student in which he gets acquainted with the research methodology in the field of medicine. The student independently decides on the professional field as well as the choice of mentor. In agreement with the mentor, the topic of the final work is set. After the research, the student prepares the final work in the form that contains the following chapters. The title of the paper should be as short and clear as possible. The introductory part discusses the theoretical assumptions of the paper, especially the current level of scientific knowledge on the topic. Objectives of the study: List exhaustively (by ordinal numbers) the main objectives (under A) and working hypotheses of the test (B). Material and methods: This part of the study is the most important because it determines the accuracy, precision and validity of the results. The methodology is precisely described so that other authors can verify the presented results, using the same procedures and under the same conditions. Describe the patient/respondent population in as much detail as possible, ie. experimental animals, tissue sources, cells, data, etc.. Detailed description of used clinical (diagnostic, therapeutic) procedures and laboratory-experimental procedures, reagents, methods and course of experiments, data processing and more. Methods of scientific evaluation (scales, surveys, equipment, etc.). Statistical data processing: Describe basic statistical methods, way of presenting data, etc. Results: Show the obtained results through tables and graphs. Use statistical tests to prove the significance of the examined characteristics that are predicted by the methodology of work.Discussion: The obtained results should be commented within the previous research, and according to the available literature. Literature: The literature is listed according to the chronology of citations in the paper itself.

Practical classes:

The final work is an independent work of the student made in writing, with instructions and consultation with the mentor. The student submits at least four bound copies of the final work to the Faculty, one of which is submitted to the Faculty Library. Along with each copy of the printed version of the paper, the student submits a CD with an electronic version of the paper in. pdf format which is exactly the same as the printed one. The commission for the defense of work is formed depending on the topic of the final work. The commission for evaluation and defense of the final work consists of three members from among the teachers of the Faculty. The date and time of the public defense of the paper are published on the notice board of the Faculty at least three working days before the scheduled date of the defense. The final work is defended before the commission. The defense consists of an oral presentation of the results of the final work and a test of knowledge in the scientific field of work. The grade on the success of the candidate in this exam is announced within three days from the completion of the defense before the members of the commission, with an appropriate explanation.

Literature

The literature depends on the topic of the final work as well as on the chosen mentor.

Number of active teaching hours:	Lectures: 0	Practice: 0	Other active classes: 0	Other: 150

Teaching methods: Work with mentor

Examination methods (maximum 100 points)			
Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**

Student's activity during Lectures		oral examination	**70**
practical classes/tests		written examination	
Seminars/homework			
Project			
Other	**30**		

Grading system		
Grade	**No. of points**	**Description**
10	**91-100**	**Excellent**
9	**81-90**	**Exceptionally good**
8	**71-80**	**Very good**
7	**61-70**	**Good**
6	**51-60**	**Passing**
5	**< 51**	**Failing**