



Study program: Integrated Academic Studies in Pharmacy
Course title: Pharmaceutical Chemistry I
Teacher: Nataša B. Milić, Veljko S. Krstonošić, Maja Lj. Milanović
Course status: compulsory
ECTS Credits: 6
Condition: General chemistry; Inorganic chemistry; Organic Chemistry I
<p>Course aim</p> <p>The aim of this course is to offer students the basic, scientific and academic knowledge and skills in the field of pharmacological active substances of natural, polysynthetic and synthetic origin. Students will learn the structure, international generic names of drugs; branded names of drugs; nomenclature; physico-chemical properties of drugs. Introduction to the drug design and <i>in silico</i> techniques. Special emphasis is given to the association between the chemical structure and effects, as well as to drug biotransformation.</p>
<p>Expected outcome of the course:</p> <p>Knowledge and understanding of chemical structures and properties of the pharmacological active substances, metabolism and effects on the receptors or some other way. The application of the gained knowledge in research and practice. It is necessary for undergraduates to receive training and develop skills for laboratory work. They are trained to analyze and prepare pharmacological active substances, to bind theoretical and practical knowledge and to apply them in pharmacology, pharmaceutical technology and other medical courses.</p>
<p>Course description</p> <p><i>Theoretical education</i></p> <p>1. Introduction into pharmaceutical chemistry: chemical classification. The role of pharmaceutical chemistry in science. Nomenclature of drugs, therapeutic index, efficacy. Pharmacopeia. 2. Oxidation, hydrolysis and polymerization of drugs. Acid - base properties of the drug, pKa. 3. Interaction, chemical bond drug - receptor (ligand - receptor). Binding affinity of the drug for the receptor. Agonists, antagonists and partial agonists. The relationship between the structure and drug effects. Configuration isomerism and biological activity of drugs. Regioselectivity of the drug. 4. Development and design of new medicines - from the leading compound. A rational approach. Computer modeling. 5. Isosterism, bioisosterism. Lipophilicity, solubility of the pharmacologically active compounds. The basic principles of quantitative relationship between the structure and effects of pharmacologically active compounds: steric and electronic effects, functional group, modification of functional group. Leading ligands. 6. Molecular docking, HTS screening and QSAR analyses. 7. Polymorphism of drugs. 8. Therapeutic indications, effects, contraindications, side effects, drug-drug interactions. 9. Prodrug - the influence of metabolism on biotransformation of therapeutics and strategies for synthesis of the new drug. 10. Water as the vehicle in pharmacy. The purified water. Decarbonization of water. Aqua demineralisata. Aqua destilata (Aqua pro injection). Reverse osmosis. Ion exchange methods. Chemical and microbiological contaminants of water. Method of choice for water quality – TOC. 11. Mechanism of action. Pharmaceutical forms, incompatibility: a. Acid and antacid (products that contain Al, Mg, Ca, Na and Bi, combinations and complexes of Al, Mg, Ca, Na and Bi, adverse effects, contraindications and side effects of acid and antacids), b. Laxatives (medicinal substances which increase the volume of intestinal contents, hyperosmotic therapeutics, softeners of intestinal content (emollient laxatives), lubricants, saline laxatives, stimulant laxatives), c. Antianemics (types and treatment of anemia, oral forms based on Fe(II) and Fe(III), parenteral and intravenous dosage forms of Fe(II) and Fe(III) and their side effects and interactions, Fe in combination with folic acid, Fe in other combinations), d. Adsorbents (intestinal adsorbents: carbo medicinalis and others; kaolin, talc, bentonite). 12. Solution for oral hydration and infusion: crystalloid and colloid solutions, plasma volume expanders. 13. Local anti-infective and astringent: the chemical structure and antimicrobial activity, oxidizing agent, halogen derivatives, alcohols and atomizers, phenols and phenol derivatives, compounds of mercury and other metals, cationic surfactants, paints. 14. Inorganic gases as inhalation anesthetics: nitrous oxide and xenon - mechanism of action, usage, side effects, adverse effects, contraindications. 15. Active principles based on calcium or strontium in the osteoporosis therapy. 16. Diagnostic (contrast) agents. Definition, classification, chemical structures, side effects: agents based on Ba, I, Fe, Mn, Gd, Dy; agents based on Tc, F, Ga, In, Ta. 17. Radiopharmaceuticals: SPET and PET methods, cyclotron; drugs based on Tc, F, Ga, In, Ta</p> <p><i>Practical education</i></p> <p>1. Application of databases and modern computer methods in designing drug substances. 2. The computational methods in analyzing the structure and action of the drug: the calculation of molecular descriptors of pharmacologically active substances,</p>

introduction to the basic principles of molecular modeling of drugs. **3.** *In silico* determination of the logS of various biologically active compounds. The influence of the pH, the functional groups and their position on the solubility. **4.** *In silico* determination of logD of different biologically active compounds. The influence of the pH, the functional groups and their position on the lipophilicity. **5.** *In silico* determination of toxicity of different biologically active compound. **6.** Water analysis as a pharmaceutical raw material: a. Conductometric water analysis, b. Determination of total organic matter, c. Determination of acidity and alkalinity of water, d. Determination of calcium ions and total hardness, e. Determination of inorganic contaminants in water (chloride, nitrite, nitrate, ammonia, total phosphorus, total nitrogen, Cr(VI), phenols), **7.** Stoichiometric tasks. **8.** Plasma expanders: a. Biosynthesis and isolation of dextran, b. Determination of dextran **9.** Determination of chloride and glucose in the oral rehydration solution. **10.** Permanganometric determination of hydrogen-peroxide **11.** Determination of boric acid

Literature

Compulsory

1. Wilson E, Gisvold JB. Textbook of Organic Medicinal and Pharmaceutical Chemistry. 12th Edition. London, Philadelphia, New York: Lippincott Williams & Wilkins; 2011.
2. Sessler LJ, Doctrow SR, McMillury TJ, Lippard SJ. Medicinal Inorganic Chemistry. Washington, DC: American Chemical Society; 2005.
3. European Pharmacopoeia (Ph. Eur. III). Strasbourg: Council of Europe; 1997.

Number of active classes	Theory: 45	Practice: 45	
Teaching methods: interactive lectures with video presentations; laboratory practice – individual or group; consultations.			
Student activity assessment (maximally 100 points)			
Pre-exam activities	points	Final exam	points
Lectures		Written	
Practices	20	Oral	30
Colloquium	2x25	