

Study program: Integrated Academic Studies of Pharmacy			
Type and level of studies: Master of Pharmacy (300 ECTS)			
Course unit: Instrumental Methods (Methods of instrumental analysis)			
Lecturer: Nedeljko Manojlović			
Language of instruction: English			
ECTS credits: 5			
Prerequisites: General background in organic chemistry, physics, physical chemistry, analytical chemistry.			
Semester: Summer			
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 pharmaceutical 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 to complete the required task in accordance with the specificity of the pharmaceutical profession. Student is able to solve the problems with basic instruments and apparatus using the supplied manuals.			
Course unit contents: <i>Theoretical classes:</i> 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. <i>Practical classes:</i> Planck's law; displaying energy level diagrams; estimate λ_{\max} 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 ¹ H NMR spectra; chemical shift, multiplicity of the signal and the ratio of the number of protons; Analysis ¹ H NMR spectra of some pharmaceutical substances; analysis of ¹³ C 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: 1. <i>Watson DG. Pharmaceutical analysis: a textbook for pharmacy students and pharmaceutical chemists. Elsevier Health Sciences; 2015.</i> 2. <i>Scheinmann F. (Ed.). An introduction to spectroscopic methods for the identification of organic compounds: Mass spectrometry, ultraviolet spectroscopy, electron spin resonance spectroscopy, nuclear magnetic resonance spectroscopy (recent developments), use of various spectral methods together, and documentation of molecular spectra. Elsevier; 2013.</i> 3. <i>Ahuja S. and Scypinski S. Handbook of modern pharmaceutical analysis (Vol. 10). Academic press; 2010.</i>			
Number of active teaching hours:			Other classes:
Lectures: 30	Practice: 30	Other forms of 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	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	0-50	Failing