1. COURSE DECRIPTION – GENERAL INFORMATION			
1.1. Course teacher	Assistant Professor Viktor Pilepić, PhD	1.6. Year of study	2nd
1.2. Name of the course	**Physical Chemistry 2**	1.7. Credit value (ECTS)	6
1.3. Associate teachers	Dr. sc. Cvijeta Jakobušić Brala Dr. sc. Ivana Fabijanić Ana Karković Marković, MPharm	1.8. Type of instruction (number of hours L+E+S+e-learning)	30+15+15
1.4. Study programme (undergraduate, graduate, integrated)	Pharmacy integrated study programme	1.9. Expected enrolment in the course	130
1.5. Status of the course	Compulsory	1.10. Level of use of e-learning (1, 2, 3 level), percentage of instruction in the course on line (20% maximum)	2nd
2. COURSE DESCRIPTION			
2.1. Course objectives	Identify the basic spectroscopic and kinetic methods and techniques, understand the basic principles of spectroscopy and chemical kinetics and to know how to apply them in exploring of the structure and properties of molecules and chemical processes. The course gives basic knowledge necessary for the Pharmaceuticals course.		
2.2. Enrolment requirements and required entry competences for the course	Requirement for enrollment: to take and pass Physics course and to attend Physical Chemistry 1 course.		
2.3. Learning outcomes at the level of the study programme to which the course contributes	• The application of fundamental knowledge in physical chemistry (physical chemistry principles in the field of spectroscopy and chemical kinetics) necessary for defining, analyzing and proposing methods (modern physical chemistry methods, techniques and instrumentation) related to research, development, production and analysis of drugs. • The implementation of solution for practical problems in the field of physical chemistry in the production and monitoring of the safe and proper use of medicinal products.		
2.4. Expected learning outcomes at the level of the course (4-10 learning outcomes)	After completing this course, students will be able to: 1. List and explain the basic spectroscopic methods and techniques. 2. Explain the interaction between electromagnetic radiation and matter. 3. Describe the principles of measurements and the interpretation of molecular spectra in order to study the structure and properties of molecules.		

	4. Identify the methods and techniques applied in exploring of kinetics and mechanism of chemical reactions and other processes in homogeneous and heterogeneous systems. 5. Describe simple spectroscopic and kinetic measurements, and to know to apply calculations in solving problems related to physical chemistry. 6. Experimentally determine certain physical variables.		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	LECTURES: • Introduction to spectroscopy, absorption and emission of the electromagnetic radiation, spectrum. • Dipole properties of molecules, Rotational and vibrational (IR) spectroscopy. • IR spectroscopy, instruments, IR spectra, Raman spectroscopy. • Electronic (UV-Vis) spectroscopy, spectrophotometers, UV-Vis spectra. • The fluorescence and phosphorescence, photochemical reactions, LASER. • Optical activity, CD and ORD spectra, NMR spectroscopy (introduction). • NMR spectrometers, NMR spectrum. • Pulse NMR technique measurements, EPR (ESR) spectroscopy. • Chemical kinetics-introduction, the reaction rate and rate constant. • The integrated rate law for chemical reactions. • Determination of the order of reaction, systems in equilibrium, the enzymatic reactions. • The theories of reaction rate of chemical reactions, Arrhenius relation. • Eyring theory of reaction rate of chemical reactions. • Thermodynamic aspects of the theory of reaction rate of chemical reactions, salt effects. • The kinetic isotope effects, Marcus theory. SEMINARS: • Beer-Lambert law, absorption, dipole moments. • IR, Raman and UV-Vis spectroscopy. • The fluorescence, photochemical reactions, optical activity. • NMR and EPR (ESR) spectroscopy, EPR spectra. • Integrated law of reaction rate of chemical reactions, the rate constant and half time of chemical reactions. • Enzyme kinetics, equilibrium and application of the Eyring relation. • Salt and kinetic isotope effects. EXERCISE: • Adsorption. • Determination of the rate constant of hydrogen peroxide decomposition. • Determination of the rate constant of sucrose hydrolysis. • Spectrophotometric titration.		
2.6. Type of instruction	**lectures**	independent study	2.7. Comments:

<table>
<tr><td>2.6. Type of instruction</td><td colspan="2"><u>seminars</u> and workshops
<u>exercises</u>
online in entirety
mixed e-learning
field work</td><td colspan="2">multimedia and the internet
<u>laboratory</u>
work with the mentor
(other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6"></td></tr>
<tr><td rowspan="6">2.9. Screening of student’s work (specify the proportion of ECTS credits for each activity so that the total number of CTS credits is equal to the credit value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td>0.5</td><td>Report</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other--describe)</td><td></td></tr>
<tr><td>Tests</td><td>0.5</td><td>Oral exam</td><td>2</td><td>(Other—describe)</td><td></td></tr>
<tr><td>Written exam</td><td>2</td><td>Project</td><td></td><td>(Other—describe)</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.1. Grading and evaluation of student work over the course of instruction and at a final exam</td><td colspan="6">During the course students are evaluated on seminars and in the Physical Chemistry Laboratory 2. Students will be evaluated during the class on preliminary exams during the semester and on written and oral exams.</td></tr>
<tr><td rowspan="4">2.2. Required literature (available at the library and via other media)</td><td colspan="6">Title</td></tr>
<tr><td colspan="6">P. W. Atkins i J. de Paula, Atkins’ Physical Chemistry, 9. izdanje, 2010, Oxford University Press.</td></tr>
<tr><td colspan="6">P. W. Atkins i J. de Paula, Physical Chemistry For The Life Sciences, 2. izdanje, 2011, Oxford University Press.</td></tr>
<tr><td colspan="6">C. A. Trapp, M. P. Cady i C. Giunta, Students’ Solutions Manual To Accompany Atkins’ Physical Chemistry, 9. izdanje, 2010, Oxford University Press.</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="6">T. Cvitaš: Physical chemistry, manuscript in preparation, chapters accessible in Central Chemical Library of Science.</td></tr>
<tr><td>2.13. Methods of monitoring quality that ensure acquisition of exit competences</td><td colspan="6">Outcomes 1-4 are validated by written and oral exams, the outcomes 5-6 are validated durring the Physical Chemistry Laboratory 2 and preliminary exams.</td></tr>
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