1. COURSE DECRIPTION – GENERAL INFORMATION			
1.1. Course teacher	Professor Svjetlana Luterotti, PhD	1.6. Year of study	1.
1.2. Name of the course	**Analytical chemistry 1**	1.7. Credit value (ECTS)	7.5
1.3. Associate teachers	Assistant Professor Suzana Inić, PhD Jasna Jablan, PhD	1.8. Type of instruction (number of hours L+E+S+e-learning)	30+30+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)	2.

2. COURSE DESCRIPTION	
2.1. Course objectives	Students will acquire the knowledge on application of basic chemical terms and phenomena in analytical chemistry, will learn basic principles of chemical–analytical process, will be able to analyze salts and organic analytes by the use of classical analytical separation and detection methods, will understand the conditions of performing chemical-analytical procedures under real conditions, will be able to define the conditions and how to apply classical and modern instrumental procedures of analytical separations. The knowledge and skills acquired throughout the course of Analytical chemistry 1 make the basis for the courses that follow, namely Analytical chemistry 2, Pharmacognosy 1 Analytics of drugs, in part Biological chemistry, etc.
2.2. Enrolment requirements and required entry competences for the course	Knowledge in General and inorganic chemistry satisfied. Competences needed: knowledge of basic chemical phenomena, terms and principles, and chemical calculations.
2.3. Learning outcomes at the level of the study programme to which the course contributes	• Application of basic knowledge in analytical chemistry in defining, analyzing and suggesting the procedures to be used in research, manufacture and quality assurance, and implementation of novel laboratory procedures in diagnostics, the illness follow-up, and effica of therapy. • Application of analytical skills in the development and implementation of problem-solving in laboratory diagnostics (informing and advising the analysis user about the choice of analytical/separation procedures).
2.4. Expected learning outcomes at the level of the course (4-10 learning outcomes)	After the student has passed the exam he/she will be able to: 1. Apply the general chemical knowledge, terms and phenomena acquired during the prevous studies into analytical-chemical practice 2. Apply basic chemical-analytical principles in qualitative and quantitative chemical analysis of diverse samples. 3. Apply acquired knowledge in analysis of inorganic salts, alone or in mixtures, inorganic-organic salts and organic analytes, by

	classical chemical analysis procedures, with no separation or after separation. 4. Explain the principles of analytical separations, to compare them and make the proper choice. 5. Analyze chemical samples after separation based on distribution between two solvents, or ion-exchange, on a micro- or macrosca or by chromatography on thin layer, or by ion-exchange chromatography in the column. 6. Define the conditions of separation of ionic species by classical precipitations, based on calculations. 7. Define the conditions and feasibility of chemical-analytical procedures under real, complex conditions, based on calculations (comp chemical equilibria). 8. Explain the choice of separation procedure and its analytical applicability. 9. Explain and elaborate the principles of modern chromatographic separations.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	LECTURES: • Introduction and general terms in chemical analysis, analytical process, sample/sampling, analytical signal, information • Equilibria in chemical analysis I – protolytic: dissociation of a weak electrolyte, common ion effect (example with acetylsalicylic ac indicators, amphoterism, hydrolysis • Equilibria in chemical analysis II – complexes in chemical analysis: introduction • Analytically important complexes I: complexes with monodentate and bidentate inorganic ligands • Analytically important complexes II: complexes with organic bidentate and polydentate ligands • Analytical applicability of complex species • Redox reactions in chemical analysis • Reactions of luminescence in chemical analysis • Heterogeneous equilibria in chemical analysis I - introduction • Heterogeneous equilibria in chemical analyisis II – solid-liquid: selective precipitation and dissolution; ion-exchange • Heterogeneous equilibria in chemical analyisis III – liquid-liquid: solvent extraction • Analytical separations – introduction • Chromatography I – introduction, general • Chromatography II – column chromatography: gas chromatography, liquid chromatography (LC, HPLC), supercritical fluid chromatograp ion chromatography, gel chromatography • Chromatography III – planar chromatography and related techniques: thin layer chromatography, paper chromatography, electrophoresis • Chromatography IV – new trends in chromatography and related techniques: capillary electrophoresis (CE) and capill electrochromatography (CEC), micellar chromatography, lab-on-a-chip (LOC), hyphenated system liquid chromatography-ma spectrometry (LC-MS, LC-MS^n), monolithic columns, ultra performance liquid chromatography (UPLC), ultra performance converger chromatography (UPC^2), two-dimensional techniques, field-flow fractionation (FFF), and others. SEMINARS: • Equilibria in analytical systems I – protolytic equilibria - amphoterism, hydrolysis: mathematical deduction, calculations, examples; buffers mathematical deduction, calculations, examples

<table>
<tr><td></td><td colspan="6">• Equilibria in analytical systems II – equilibria of complexation: introduction
• Performing of the analytical reactions and detection of ions; sample, matrix, analytical examples; dissolution and decomposition of solid samples, solubility: calculations, examples
• Selective precipitation/dissolution I – chlorides and sulphides, calculation of the conditions, examples
• Selective precipitation/dissolution II – hydroxides and carbonates, calculation of the conditions, examples
• Performances of analytical reactions, evaluation
• Analysis on the capillary support; ion-exchange in chemical analysis; classification of analytical procedures
EXPERIMENTALS:
• Equilibria in chemical analysis – reactions of: complexation, precipitation/dissolution/evaporation, light emission, redox reactions, acid-ba equilibria, masking, demasking
• Weak organic electrolytes and inorganic-organic salts as samples: detection of functional groups and radicals of organic acids
• Solid inorganic salts as samples: salts soluble in water, salts soluble in acids, dissolution, detection of ions, neutralization, sodium carbonate-added mixture
• Selective precipitation/dissolution: separation and detection of cations in the mixture (I+IV, IIa+b, or III+V+VI anal. groups), or anions in t mixture (I-V anal. groups); detection of co-ions
• Improving performances of analytical reactions (selectivity, sensitivity) by the use of separations I – application of organic solvents (diver scales): separation and detection of ions
• Improving performances of analytical reactions (selectivity, sensitivity) by the use of separations II – application of ion exchangers (divers scales): separation and detection of ions
• Chromatography – TLC: separation and detection of organic compounds, ion chromatography on the column: separation and detection c metal ions</td></tr>
<tr><td>2.6. Type of instruction</td><td colspan="3"><u>lectures</u>
<u>seminars</u> and workshops
<u>exercises</u>
online in entirety
mixed e-learning
field work</td><td colspan="2">independent study
<u>multimedia and the internet</u>
<u>laboratory</u>
work with the mentor
(other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Lectures, seminars, experimental work in laboratory, consultations, investigation of the literature, solving problems.
Attendance of experimentals and seminars is obligatory.</td></tr>
<tr><td rowspan="6">2.9. Screening of student’s work (specify the proportion of ECTS credits for each activity)</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td>1</td><td>Report</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>0.5</td><td>(Other--describe)</td><td></td></tr>
<tr><td>Tests</td><td>1</td><td>Oral exam</td><td>2.5</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>2.10. Grading and evaluation of student work over the course of instruction and</td><td colspan="6">Two tests (written) during semester; final written and oral exam.
Entrance test (oral) and final test (written) at the end of experimentals.</td></tr>
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at a final exam	
2.11. Required literature (available at the library and via other media)	**Title** 1. S. Luterotti: *Introduction into chemical analysis*, 6. ed., Faculty of Pharmacy and Biochemistry, University of Zagreb, Zagreb 2013 2. D. Kodrnja, D. Pavišić-Strache and S. Luterotti: *Practicals in Analytical Chemistry I*, 2. ed., Faculty of Pharmacy and Biochemistry, University of Zagreb, Zagreb 2006.
2.12. Optional literature	1. F. W. Fifield and D. Kealey: *Principles and Practice of Analytical Chemistry*, 5. ed., Blackwell Science, Oxford 2000. 2. D. Kealey and P. J. Haines: *Analytical Chemistry*, in: *Instant Notes* (Ed. B. D. Hames), BIOS Scientific Publishers Ltd., Oxford 2002. 3. R. Kellner, J.-M. Mermet, M. Otto and H. M. Widmer (Eds.): *Analytical Chemistry*, Wiley-VCH, Weinheim 1998. 4. D. A. Skoog, D. M. West and F. J. Holler: *Fundamentals in Analytical Chemistry* (Croatian translation: *Osnove analitičke kemije)*, 6. ed. Školska knjiga, Zagreb 1999. 5. M. Valcárcel: *Principles of Analytical Chemistry*, A textbook, Springer-Verlag, Berlin-Heidelberg 2000.
2.13. Methods of monitoring quality that ensure acquisition of exit competences	Learning outcomes 1, 4, 6-9 are checked through the written and oral exams; learning outcomes 2, 3 and 5 also during the experimental work in the laboratory and by the final test.