

<b>2023/2024. ACADEMIC YEAR</b>	
<b>PROGRAM OF STUDY</b>	
<b>Full (Hungarian) name of the subject:</b> Analitikai kémia I.	
<b>Program:</b> Undivided program (pharmaceutical)	
<b>Schedule:</b> full time	
<b>Short name of the subject:</b> Anal. Chem.	
<b>English name of the subject:</b> Analytical Chemistry I.	
<b>German name of the subject:</b> Analytische Chemie I	
<b>Type of registration:</b> <u>obligatory</u> /obligatory elective/elective/criteria requirement	
<b>Neptun code of the subject:</b>	
<b>Responsible Department:</b> Department of Pharmaceutical Chemistry	
<b>Responsible tutor</b> <b>Prof. Dr. Balogh György Tibor</b> Contact information: Department of Pharmaceutical Chemistry, Semmelweis University address: H-1092 Budapest, Hőgyes Endre u. 9. phone: +36-1-217-0891 e-mail: balogh.gyorgy.tibor@semmelweis.hu  Csörgeiné Dr. Kurin Krisztina Contact information: Department of Analytical Chemistry, Eötvös University address: H- 1117 Budapest, Pázmány P. sét. 1/a phone: +36-1-372-2500/1241 e-mail: krisztina.kurin@ttk.elte.hu	<b>Title, academic degree:</b> director, professor, DSc           associate professor, Ph.D, Dr. Habil.
<b>Name of the persons responsible for the teaching of the subject:</b>  Krisztina Kurin-Csörgei Viktor Mihucz Edina Kiss István Molnár Norbert Szoboszlai Gergő Tóth Anikó Vasánits Ph.D. students	<b>Title, academic degree:</b>  associate professor, Ph.D, Dr. Habil head of department, associate professor, DsC assistant professor, PhD research assistant, PhD associate professor, Ph.D, assistant professor, PhD assistant professor, PhD
<b>Class per week:</b>  2 lecture(s) 4 practice(s)	<b>Credit point(s):</b>  6
<b>Professional content, intent of acquirement and it's function in order to implement the goals of the program:</b>  Analytical Chemistry is an essential field of science, that develops and implements various strategies, methodologies, and instrumentation to derive insightful information about the composition and structure of matter in space and time. This course emphasizes the integration of theoretical knowledge with practical applications in analytical chemistry, fostering an analytical mindset in both qualitative and quantitative substance analysis. Students will be engaged in cultivating their logical thinking abilities, enabling them to apply their theoretical knowledge and practical skills cohesively to the qualitative and quantitative examination of inorganic (and organic) materials. The course will not only strengthen their foundation in analytical chemistry methods but also expand their horizon by infusing analytical thinking and problem-solving skills into their scientific journey.	

**Short description of the subject:**

The principal objective of Analytical Chemistry is to glean both qualitative and quantitative insights into the chemical composition and structural framework of various materials.

The course explores the classification and characterization of chemical reactions employed in qualitative analysis, as well as methodologies based on acid-base reactions in both aqueous and non-aqueous media, employed in quantitative chemical analysis.

**Course data**

Recommended term	Contact hours (lecture)	Contact hours (practice)	Contact hours (seminar)	Individual lectures	Total number of contact hours/semester	Normal course offer	Consultations
2 semester	28	56			84	Autumn semester* <u>Spring semester</u> Both semesters (* Please underline)	--

**Program of semester\*\*****Topics of theoretical classes (pro week):**

- 1. week:** Introduction. Analytical chemistry: definition, aim, methods and brief history. Review of literature of analytical chemistry.
- 2. week:** Theoretical basis of qualitative analytical ionic reactions. Qualitative analytical chemistry: definition, classification of the reactions (analytical parameters, group reagents, group reactions, Fresenius-system)
- 3. week:** Group reagents for qualitative analysis of cations. Identifications reactions of cations.
- 4. week:** Group reagents for qualitative analysis of anions. Identifications reactions of anions.
- 5. week:** Qualitative analysis of complex solution and solid sample. Instrumental analytical methods in inorganic qualitative analysis.
- 6. week:** Test I. Types of interactions in analytical chemistry. Quantitative analysis and its important methods. Steps of chemical analysis.
- 7. week:** Preparation of sample for analysis (sampling, storage and dissolving of the sample, distillation, extraction, fusion). Retake Test I.
- 8. week:** Types of chemical reactions and their application in practice of quantitative analytical chemistry. Chemical equilibria, equilibrium constants. Introduction to the titrimetry, general rules of volumetric determinations. Standard solutions (titrants) and their effective value (factor), measurement for analysis, calculation of analytical results.
- 9. week:** Introduction to acid-base titrations. Acid-base equilibria in aqueous solution. Calculation of pH (strong and weak acids/bases, salts, buffer solutions). Neutralization analysis: aim, standard solutions, standardization, factor calculation.
- 10. week:** Possibilities for end point detection (chemical and instrumental). Acid-base indicators.
- 11. week:** Change of pH during the acid-base titration (calculation of titration curves for the reaction of strong acid/base with strong base/acid, weak acid/base with strong base/acid, polyprotic acid with strong base). Indicator error.
- 12. week:** The main possibilities of determination in acidimetry and alkalimetry. (measurement of strong/weak acids, strong/weak bases, salts, „specific“ determinations, with examples).
- 13. week:** Test II. Reactions in nonaqueous solutions. Classification of solvents. Advantages and disadvantages of using non-aqueous solvents.
- 14. week:** Nonaqueous titrations: standard solutions, end point detection, applications. Retake Test II. Re-retake test I., II.

**II. Practice topics/week:**

- 1. week:** Laboratory bench and equipments inventories ; Safety and order in the laboratory; Schedule of the semester; Practical and theoretical requirements in the semester. Reactions of Group I of cations. Reactions of As(III). Analysis of simple unknown.
- 2. week:** Reactions of cations in group III. Analysis of complex unknown (I. – III.).
- 3. week:** Reactions of cations in group IV and V. Analysis of simple unknown (I. – V.)
- 4. week:** Reactions of the most important anions. Analysis of complex unknown.
- 5. week:** Analysis of a solid sample (salt mixture).
- 6. week:** Equipments and methods of quantitative analysis (introduction) Practicing the use of laboratory tools. (Supplementary lab).
- 7. week:** Neutralization analysis: Determination of sulfuric acid.
- 8. week:** Neutralization analysis: Standardization of  $\approx 0.1M$  hydrochloric acid.
- 9. week:** Neutralization analysis: Continuation of previous week's measurements; Determination of lactic acid (Acidum lacticum Ph.Hg. VIII.).
- 10. week:** Acidity-Alkalimetry: Determination of sodium tetraborate and boric acid in the presence of each other.
- 11. week:** Neutralization analysis: Determination of NaOH and  $Na_2CO_3$  in the presence of each other. Measurement of HgO.
- 12. week:** Acidity-Alkalimetry: Indirect determination of sodium thiosulfate; Determination of 4-aminosalicylic acid in nonaqueous solution.
- 13. week:** Titration Lidocaine in non-aqueous medium. Nonaqueous determination of Papaverine HCl. (Supplementary lab).
- 14. week:** Supplementary lab; Closing

**Schedule of consultations:** at the request of students (in the period prior to the tests; etc.)

**Course requirements****Prerequisites:**

General and Inorganic Chemistry I.  
Introduction to Pharm. Studies  
Mathematics for Pharmacists

**Conditions of attending the classes, amount of acceptable absences, way of presentation of leave, opportunity for makeup:**

Students must be present at minimum of 75% of the total number of laboratory practices scheduled during the semester (i.e. a maximum of 3 absences is allowed). Timeliness is mandatory. Arriving more than 15 minutes late will be considered equivalent to absence from the laboratory practice.

All exercises and measurements listed in the schedule must be completed before the end of semester. A make up ("supplementary lab") to complete the measurements labs missed will be provided during the semester; and at the end of the semester for justified cases.

**Number, topics and dates of tests during the semester, opportunities of makeup and improvement of results\*\*\*:**

In order to assess the mastery of the course material, two (2) major test-papers are administered during the semester scheduled for weeks 6. and 13. Each test will include a different set of topics on the theoretical background of measurements covered at the lectures or performed at laboratory practices, as well as numerical problems. Opportunities to correct the marks of each major test will be provided (retake), as well as an additional retake at the end of semester (re-retake). If written, the marks of the retakes will be used to determine the final grade. Shorter oral or written quizzes at the time of the laboratory practices can occur throughout the entire semester. All written tests and oral answers will be evaluated according to a five-scale grading system. Minimum of 50% of the total score is required for earning a passing mark (2) on the tests. A non-programmable calculator is required to complete the numerical problems in tests, calculators cannot be shared between students. Mobile phones, smart watches, tablets, etc. may not be utilized during tests under any circumstances. Students caught using any kind of forbidden aid during oral or written tests will automatically earn an "unsatisfactory" (1) practical mark.

**Requirements of signature:**

A satisfactory knowledge of the theoretical aspects of the analytical chemistry (including knowledge of the subject-matter of analytical chemistry covered at lectures and laboratory practices, writing/balancing equations, proven knowledge of stoichiometric and equilibrium calculations, familiarity with the principles of the measurements, etc).

The final grade (practical mark) of the laboratory training on analytical chemistry will be established by considering both the theoretical and practical requirements as set forth next.

The theoretical requirement for passing the semester is that both marks obtained on the major tests (or that of the retakes) must be at least passing (2).

Practical requirements: all exercises or measurements must be performed as scheduled, and the final measurement mark must be passing. The average of all marks of the individual measurements is used to establish the final mark for the measurements as follows:

1.00 – 2.50	1 (unsatisfactory);
2.51 – 2.99	2;
3.00 – 3.49	3;
3.50 – 3.99	4;
4.00 – 5.00	5.

The practical requirements are fulfilled only if the number of absences did not exceed the permitted limit (see above) and the final mark for the measurements is at minimum 2.

The final practical grade is determined based on the average of the two major tests (or retakes) and the final mark of the measurements using the table below:

2.00 – 2.50	2;
2.51 – 3.50	3;
3.51 – 4.50	4;
4.51 – 5.00	5.

**Number and type of projects students have to perform independently during the semester and their deadlines:**

Each measurement is completed and at least 80% of the measurements must be accepted at a satisfactory accuracy (at most  $\pm 4\%$  error for quantitative determinations in most cases). Unsuccessful measurements can be repeated *once* during the "supplementary lab" time.

A written report must be prepared upon the completion of each laboratory exercise. The calculated results of the measurements must be presented for evaluation to the supervising teacher within a week after completion of the exercises. Failure to hand in lab reports on time will result in "unsatisfactory" mark for the corresponding measurement and therefore it must be repeated during the "supplementary lab" time.

**Type of the semester-end examination:** signature\*/practical grade\*/semi-final\*/final\* (\* Please underline)

**Examination requirements:** as published by the education-research department on the MOODLE interface at the start of the academic term.

**Form of the semester-end examination:** written\*/oral\*/combined examination\* (*Please underline*)

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**Scientific, course related research, publications, essays:**

Materials of the lectures and laboratory practices and additional notes (solved calculation problems, videos, etc.) can be downloaded from Moodle E-learning interface.

According to the program of semester, the slides of the lectures, and materials required to complete the laboratory exercises, other documents, sample reports, etc. will be uploaded to the Moodle system no later than the week before a topic covered herein is discussed at the laboratory practices.

Additional material for the theoretical lectures and laboratory exercises (list of textbooks, hand-outs, scripts, etc.):

Buvári-Barcza: Quantitative Analytical Chemistry. Bp. (SE)

Skoog, West, Holler: Fundamentals of Analytical Chemistry. Saunders College Publishing.

**In the case of a subject lasting more than one semester, the position of the teaching/research department on the possibility of parallel enrolment and the conditions for admission\*\*\*\*:**

yes\*/no\*/on and individual assesment basis\* (*Please underline*)

**The course description was prepared by:**

György Tibor Balogh, Krisztina Kurin-Csörgei