SYLLABUS

1. Information about the program

1.1 Higher education institution	Politehnica University Timisoara
1.2 Faculty[1]/ Department [2]	Chemical Engineering, Biotechnologies and Environmental Protection / CAICAM
1.3 Field of study (name/code[3])	Chemical Engineering / 10.30.50
1.4 Study cycle	License
1.5 Study program (name/code/qualification)	Chemical Engineering / 10.30.50.60 /engineer

2. Information about the discipline

2.1 Name of discipline/ formative category[4]			Analytical chemistry and instrumental analysis II / DD				
2.2 Coordinator (holder) of course activities			Conf.dr.ing. Cornelia MUNTEAN				
2.3 Coordinator (holder) of applied activities[5]			Conf.dr.ing. Cornelia Muntean, Ș.l.dr.ing. Laura Cocheci				
2.4 Year of study[6]	II	**2.5** Semester	3	**2.6** Type of evaluation	E	**2.7** Regime of discipline[7]	DI

3. Total estimated time – hours / semester: direct teaching activities (fully assisted or partly assisted) and individual training activities (unassisted) [8]

3.1 Number of fully assisted hours / week	4 of which:	**3.2** course	2	**3.3** seminar / laboratory / project	0/2/0
3.1* Total number of fully assisted hours / semester	56 of which:	**3.2*** course	28	**3.3*** seminar / laboratory / project	0/28/0
3.4 Number of hours partially assisted / week	of which:	**3.5** training		**3.6** hours for diploma project elaboration	
3.4* Total number of hours partially assisted / semester	of which:	**3.5*** training		**3.6*** hours for diploma project elaboration	
3.7 Number of hours of unassisted activities / week	4.93 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			0.93
		hours of individual study after manual, course support, bibliography and notes			2
		training seminars / laboratories, homework and papers, portfolios and essays			2
3.7* Number of hours of unassisted activities / semester	69 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			13
		hours of individual study after manual, course support, bibliography and notes			28
		training seminars / laboratories, homework and papers, portfolios and essays			28
3.8 Total hours / week [9]	8.93				
3.8* Total hours /semester	125				
3.9 Number of credits	5				

4. **Prerequisites** (where applicable)

4.1 Curriculum	• Fundamentals of General chemistry, Inorganic chemistry

[1] The name of the faculty which manages the educational curriculum to which the discipline belongs
[2] The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.
[3] The code provided in HG - on the approval of the Nomenclature of fields and specializations / study programs, annually updated.
[4] Discipline falls under the educational curriculum in one of the following formative disciplines: Basic Discipline (DF), Domain Discipline (DD), Specialist Discipline (DS) or Complementary Discipline (DC).
[5] Application activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).
[6] Year of studies in which the discipline is provided in the curriculum.
[7] Discipline may have one of the following regimes: imposed discipline (DI) or compulsory discipline (DOb)-for the other fundamental fields of studies offered by UPT, optional discipline (DO) or optional discipline (Df).
[8] The number of hours in the headings 3.1 *, 3.2 *, ..., 3.8 * is obtained by multiplying by 14 (weeks) the number of hours in headings 3.1, 3.2, ..., 3.8. The information in sections 3.1, 3.4 and 3.7 is the verification keys used by ARACIS as: (3.1) + (3.4) ≥ 28 hours / wk. and (3.8) ≤ 40 hours / wk.
[9] The total number of hours / week is obtained by summing up the number of hours in points 3.1, 3.4 and 3.7.

4.2 Competencies	• Making simple measurements; Simple calculations and operations with logarithms; Graphic representations on graph paper and with the help of software

5. Conditions (where applicable)

5.1 of the course	• Room of appropriate size, supporting materials: laptop, projector, blackboard
5.2 to conduct practical activities	• Laboratory with specific equipment, computer, blackboard

6. Specific competencies acquired through this discipline

Specific competencies	• Description and application of the principles of the studied analysis techniques (gravimetry, titrimetry, potentiometry, conductometry) • Selection of the analysis method • Performing the measurement operations necessary for analyzes (weighing, volume measurements, pH measurement, preparation of solutions) • Performing titrations based on different types of equilibria, with chemical indicator and with instrumental indication of equivalence (potentiometric and conductometric titrations) • Processing of experimental data obtained and the correct expression of the result of an analysis; interpretation of the result; correlation of the value of the determined parameter with the composition of the analyzed system
Professional competencies ascribed to the specific competencies	• - Analyse production processes for improvement; • - Manage chemical testing procedures; • - Test materials; • - Write technical reports • -Performs chemical experiments • -Approve engineering design • -Assess environmental impact
Transversal competencies ascribed to the specific competencies	• - Conduct quality control; • - Apply scientific, technological and engineering knowledge; • - Uses equipment, instruments or technological equipment accurately.

7. Objectives of the discipline (based on the grid of specific competencies acquired - pct.6)

7.1 The general objective of the discipline	• Explanation and assimilation of the theoretical bases of analytical chemistry and the principles of analysis techniques and their use within the classical methods of identification and/or quantitative determination of some chemical species (components of the environment, raw materials, intermediate products, finished products and waste) with applications in the control of technological processes, product quality control and environmental protection.
7.2 Specific objectives	• Acquiring the theoretical notions of analytical chemistry and the principles of gravimetry, titrimetry, potentiometry, conductometry • Acquiring the criteria underlying the selection of the analysis method • Assimilation of theoretical notions and formation of practical skills for performing titrations based on different types of equilibria, with chemical indicator and with instrumental indication of end point (potentiometric and conductometric titrations) • Training the necessary skills for processing the obtained experimental data and correctly expressing the result of an analysis; interpretation of the result; correlation of the value of the determined parameter with the composition of the analyzed system

8. Content [10]

8.1 Course	Number of hours	Teaching methods [11]

[10] It details all the didactic activities foreseen in the curriculum (lectures and seminar themes, the list of laboratory works, the content of the stages of project preparation, the theme of each practice stage). The titles of the laboratory work carried out on the stands shall be accompanied by the notation "(*)".

1. Introductory concepts: analytical chemistry and chemical analysis, stages of chemical analysis, classification of analytical techniques, selection of the analysis method, ways of expressing the concentration of solutions, calculation of the number of millimoles and milliequivalents of substance	2	Lecture, PPT presentations, conversations, examples, use of specific software, explanations, materials available in pdf format in the Virtual Campus
2. Titrimetric method of analysis: principles of analytical calculation, direct and indirect titration procedures	2	
3. Chemical titrimetry based on acid-base equilibria: choice of reagents, titration of strong and weak protolytes, titration of protolyte mixtures, titration curves, choice of indicator, titration errors	8	
4. Chemical titrimetry based on solubility equilibria: titration curves, determination of end point, titration errors	3	
5. Chemical titrimetry based on oxidation-reduction equilibria: titration curves, determination of end point, titration errors	3	
6. Chemical titrimetry based on complexation equilibria: complexonometry, titration curves, determination of end point, titration errors	2	
7. Potentiometric method of analysis: electrodes, potentiometric pH measurement, potentiometric titrations	2	
8. Conductometric method of analysis: conductance, conductivity, conductometric titrations	2	
9. Gravimetry and electrogravimetry	2	
10. Statistical processing of experimental data in chemical analysis: characterization of measurements and results, characterization of experimental errors, accuracy, precision, errors and uncertainties, propagation of uncertainties, partial and global uncertainties, correction of the result, statistical calculation applied to populations, statistical calculation applied to selections of population, verification of input data	2	

Bibliography [12] 1. D. Harvey, Modern Analytical Chemistry, McGraw-Hill, 2000.
2. C. Liteanu, E. Hopîrtean, Quantitative chemical analysis. Volumetry (Chimie analitică cantitativă. Volumetria), Ed. Didactica şi Pedagogică, Bucureşti, 1972.
3. D. Oprescu, M. Stoia, Basic notions of analytical chemistry and chemical titrimetry (Noţiuni fundamentale de chimie analitică şi titrimetrie chimică), Ed. Politehnica, Timişoara, 2003.
4. D. Oprescu, M. Ştefănescu, M. Stoia, C. Muntean, Quantitative chemical analysis. Principles and applications (Analiză chimică cantitativă. Principii şi aplicaţii), Ed. Politehnica, Timişoara, 2002.
5. D. Oprescu, V. Chiriac, M. Stoia, C. Muntean, Titrimetric chemical analysis (Analiză chimică titrimetrică), Ed. Politehnica, Timişoara, 2001.
6. C. Muntean, A. Negrea, L. Lupa, M. Ciopec, Chemical and physico-chemical analysis with applications in environmental protection (Analiză chimică şi fizico-chimică cu aplicaţii în protecţia mediului), Ed. Politehnica, Timişoara, 2009
7. I. Julean, Şt. Holban, Uncertainties in the processing of experimental data and in the expression of results (Incertitudini la prelucrarea datelor experimentale şi în exprimarea rezultatelor), Editura Politehnica, Timişoara, 2009.
8. Peter C. Meier, Richard E. Zund, Statistical Methods in Analytical Chemistry, second edition, John Wiley & Sons Inc., 2000
9. G.D. Christian, P.K. Dasgupta, K.A. Schug, Analitical Chemistry, 7th edition, Wiley, 2014

8.2 Applied activities [13]	Number of hours	Teaching methods
1. Utensils and instruments used in quantitative chemical analysis; Processing of experimental results in quantitative chemical analysis, measurement uncertainties, sources of errors, elimination of outliers, confidence interval	4	Discussion of the theoretical aspects of the experiments, conversations, examples, use of specific software, explanations, experiments, materials available in pdf format
2. Titrimetric determinations based on acid-base equilibria: preparation and standardization of the sodium hydroxide titrant solution	4	
3. Titrimetric determinations based on acid-base equilibria: Direct alkalimetric determination of hydrochloric acid	4	

[11] Presentation of the teaching methods will include the use of new technologies (e-mail, personalized web page, electronic resources etc.).
[12] At least one title must belong to the discipline team and at least one title should refer to a reference work for discipline, national and international circulation, existing in the UPT library.
[13] Types of application activities are those specified in footnote 5. If the discipline contains several types of applicative activities then they are sequentially in the lines of the table below. The type of activity will be in a distinct line as: "Seminar:", "Laboratory:", "Project:" and / or "Practice/training".

4. Titrimetric determinations based on complexation equilibria: preparation and standardization of the necessary solutions; their use for the determination of some chemical species: Indirect complexonometric determination of Ni(II); Complexonometric determination of water hardness	4	and web page in the Virtual Campus
5. Titrimetric determinations based on redox equilibria: preparation and standardization of the titrant solution; its use for the determination of some chemical species: Direct permanganometric determination of Fe(II)	4	
6. Titrimetric determinations based on solubility equilibria: preparation and standardization of the titrant solution; its use for the determination of some chemical species: Direct argentometric determination of bromide by the Mohr procedure and of iodide by the Fajans procedure	4	
7. Titrations with instrumental determination of the end point (conductometric and potentiometric): Titration of hydrochloric acid with sodium hydroxide solution	4	

Bibliography [14] 1. D. Oprescu, M. Ştefănescu, M. Stoia, C. Muntean, Quantitative chemical analysis. Principles and applications (Analiză chimică cantitativă. Principii şi aplicaţii), Ed. Politehnica, Timişoara, 2002.
2. D. Oprescu, V. Chiriac, M. Stoia, C. Muntean, Titrimetric chemical analysis (Analiză chimică titrimetrică), Ed. Politehnica, Timişoara, 2001.
3. C. Muntean, A. Negrea, L. Lupa, M. Ciopec, Chemical and physico-chemical analysis with applications in environmental protection (Analiză chimică şi fizico-chimică cu aplicaţii în protecţia mediului), Ed. Politehnica, Timişoara, 2009.
4. I. Julean, S. Holban, Uncertainties in the processing of experimental data and in the expression of results (Incertitudini la prelucrarea datelor experimentale şi în exprimarea rezultatelor), Ed. Politehnica, Timişoara, 2009
5. G.D. Christian, P.K. Dasgupta, K.A. Schug, Analytical Chemistry, 7th edition, Wiley, 2014.

9. Corroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program

- Knowledge of analysis methods and their use within the chemical analysis of some systems (environmental factors, raw materials, intermediate products, finished products, waste), performing chemical analysis, processing experimental data and interpreting analysis results, represent some of the main expectations of employers.

10. Evaluation

Type of activity	**10.1** Evaluation criteria [15]	**10.2** Evaluation methods	**10.3** Share of the final grade
10.4 Course	Answering questions from the course topic	Written exam - theoretical subjects and numerical applications accumulating 9 points, plus a starting point	66%
10.5 Applied activities	**S:**		
	L: Solving problems corresponding to experiments	Written tests from the theoretical aspects of the experiments, the appreciation of the way to participate in the laboratory activities, to train the skills of handling the equipment, processing the experimental data, and interpreting the obtained result.	20%
	Homework	Presentation of solutions, answers to questions	7%
	Attendance	Registration of attendance	7%
	P[16]**:**		
	Pr:		
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified [17])			

[14] At least one title must belong to the discipline team.
[15] Syllabus must contain the procedure for assessing the discipline, specifying the criteria, methods and forms of assessment, as well as specifying the weightings assigned to them in the final grade. The evaluation criteria shall be formulated separately for each activity foreseen in the curriculum (course, seminar, laboratory, project). They will also refer to the forms of verification (homework, papers, etc.)
[16] In the case where the project is not a distinct discipline, this section also specifies how the outcome of the project evaluation makes the admission of the student conditional on the final assessment within the discipline.
[17] It will not explain how the promotion mark is awarded.

- Exam - The answers to the questions must accumulate a minimum score of 4 points out of a total of 9 possible.
- Laboratory – The student must do all the experiments, hand in all the reports and homework

Date of completion	**Course coordinator (signature)**	**Coordinator of applied activities (signature)**
	Conf.dr.ing. Cornelia Muntean	Conf.dr.ing. Cornelia Muntean
		Ș.l.dr.ing. Laura Cocheci

Head of Department (signature)	**Date of approval in the Faculty Council** [18]	**Dean (signature)**
Conf.dr.ing. Andrea KELLENBERGER		Ș.L.dr.ing. Mircea Laurențiu DAN

[18] The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.