SYLLABUS

1. Data about the program of study

1.1	Institution	Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Electrical Engineering
1.3	Department	Electrotechnics and Measurements
1.4	Field of study	Electrical Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/ Qualification	Electrical System/ Engineering
1.7	Form of education	Full time
1.8	Subject code	11.00

2. Data about the subject

2.1	Subject name				Chemistry	
2.2	Course responsible/ lecturer				Associate professor Liviu Călin Bolunduţ liviu.bolundut@chem.utcluj.ro	
2.3	Teachers in charge of Seminars/ Laboratory/ Project				Associate professor Liviu Călin Bolunduţ liviu.bolundut@chem.utcluj.ro	
2.4 Year of study	I	2.5 Semester	2	2.6 Type of assessment *(E – exam, C – colloquium, V – verification)*		E
2.7 Subject category	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*					DF
	DI – compulsory, DO – elective, Dfac – optional					DI

3. Estimated total time

3.1 Number of hours per week:	3	of which	3.2 Course	2	3.3 Seminar		3.3 Laboratory	1	3.3 Project	
3.2 Total hours per semester	42	of which	3.5 Course	28	3.6 Seminar		3.6 Laboratory	14	3.6 Project	

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	30
(b) Supplementary study in the library, online and in the field	25
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	25
(d) Tutoring	
(e) Exams and tests	3
(f) Other activities	

3.8 Total hours of individual study *[sum (3.7(a) to 3.7(f))]*	83
3.9 Total hours per semester *[sum of 3.4 and 3.8]*	125
3.10 Number of credit points	5

4. Prerequisites (where applicable)

4.1	Curriculum	General concepts of chemistry.
4.2	Competences	-

5. Requirements (where appropriate)

5.1	For the course	N/A
5.2	For the applications	Laboratory attendance is mandatory.

6. Specific competences

Professional competences	C1. Appropriate application of fundamental knowledge of mathematics, physics, chemistry specific to the field of electrical engineering C1.1. Description of the concepts, theories and basic methods of chemistry, appropriate for the field of electrical engineering C1.2. Explanation and interpretation of phenomena presented in the disciplines of the field and specialty, using fundamental knowledge of mathematics, physics, chemistry. C1.3. Application of general scientific rules and methods for solving chemistry problems specific to electrical engineering. C1.4. Appreciation of the quality, advantages and disadvantages of some physical-chemical methods and procedures in the field of electrical engineering, as well as the level of scientific documentation of projects and the consistency of programs using scientific methods and techniques. C1.5. Development of professional projects, using adequately the fundamental knowledge of chemistry.
Cross competences	Responsible execution of professional tasks, under conditions of limited autonomy and qualified assistance. Familiarization with the roles and activities specific to teamwork and distribution of tasks for subordinate levels. Awareness of the need for continuous training; efficient use of learning resources and techniques, for personal and professional development.

7. Expected learning outcomes

Knowledge	The student/graduate identifies and describes basic concepts, principles, and methods in mathematics, physics, chemistry, technical drawing, economics, and computer science.
Abilities	The student/graduate operates with basic concepts, principles, and methods from fundamental disciplines. The student/graduate solves problems of mathematics, physics and chemistry with applicability in engineering and validates the solution obtained. The student/graduate describes physico-chemical and economic phenomena and processes.
Responsibility and autonomy	The student/graduate practices logical reasoning, evaluation and self-evaluation in decision-making.

8. Discipline objectives (based on specific competencies acquired)

8.1	General objective	Development of engineering skills in the field of electrical engineering, in support of professional training (e.g. knowledge of metal properties necessary in the planning and design of electrical systems)
8.2	Specific objectives	Assimilation of general chemistry knowledge for application in engineering. Application developers.

9. Contents

9.1. Course (Lectures)		No of hours	Teaching methods	Additional remarks
1	Fundamental notions of chemistry (general presentation; classification of chemistry; distribution of elements in nature, chemical combinations). Units of measurement specific to chemistry (International System). Applications: mole, amount of substance, mass and volume percentage concentration, molar concentration, normal concentration, crude and molecular formulas, Avogadro's number).	2	Interactive teaching methods (ppt.), presentation at the blackboard, discussions with students.	In case of force majeure, classes will be held online on the MS TEAMS UTCN platform.
2	The periodic table of elements (atomic structure; electronic configurations; radioactivity; classification of chemical elements; periodicity of physical and chemical properties).	2		
3	Chemical bonds (ionic, covalent, coordinative, metallic, Van der Waals, dipole-dipole, ion-dipole, hydrogen bond)	2		
4	Gaseous state Ideal gases (ideal gas equation of state, ideal gas laws) Real gases (compressibility diagram, virial coefficients, Van der Waals equation of state).	2		
5	Liquid state (general concepts, classification, properties, kinetic model of liquids, viscosity coefficient; surface tension and vapor pressure of liquids). Solid state (crystalline, amorphous substances; crystalline systems; state transformations).	2		
6	Materials used in electrical engineering (metallic conductive materials; non-metallic; semiconductors - quantum mechanics and orbital functions; Schrödinger's equation; band formation; semiconductor elements and combinations; impurities; Schottky and Frenkel lattice defects; integrated circuits; insulating materials)	2		
7	General notions of chemical thermodynamics (state of the thermodynamic system; state quantities; thermodynamic equilibrium; principles 0, I, II and III of thermodynamics and their consequences). Reaction enthalpy - definition, enthalpy in systems with chemical reactions, Robert-Mayer equation, calculation of reaction enthalpy at different temperatures.	2		
8	Thermochemistry (calorimetry; Lavoisier-Laplace law, Hess's law; applications). Meaning of spontaneous chemical processes, reaction entropy, variation of reaction entropy with temperature. Chemical potential, free energy of reaction (Helmholtz energy), free enthalpy of reaction (Gibbs energy).	2		
9	Chemical equilibrium (law of mass action; chemical equilibrium in homogeneous systems; relationship between Kp, Kc, Kn and Kx). Equilibria in heterogeneous systems; shift of chemical equilibrium, quantities characteristic of chemical equilibrium; applications; acid-base equilibria; pH; buffer solutions.	2		
10	Kinetics of chemical reactions	2		

	Classification of chemical reactions from a kinetic point of view, reaction rate; molecularity, reaction order; reaction mechanism, rate law, factors influencing reaction rate, Arrhenius equation. Kinetics of simple and complex reactions - kinetic laws for 0th, 1st, 2nd, 3rd and fractional order reactions. - Kinetics of successive, parallel, opposite, pre-equilibrium reactions. - Chain reactions, rate laws, explosions. Homogeneous, enzymatic catalysis, heterogeneous catalysis, inhibition of reactions.			
11	The subject of electrochemistry; history of electrochemistry. Electrolytes, the study of electrolyte solutions; dissolution processes; theory of electrolytic dissociation; degree of dissociation. Electrolysis (mechanism of electrolysis; Faraday's laws; uses of electrolysis; electromotive force; Nernst equation).	2		
12	Type I, II, III electrodes, redox, amalgam, reference electrodes. Chemical sources of electricity (history of galvanic cells; primary cells; secondary cells; fuel cells; solar batteries).	2		
13	Applications of electromotive force measurements. Electrochemical sensors. Biosensors. Material balances in electrochemical processes. Electrochemical methods for investigating electrode processes (polarography, rotating disk, cyclic voltammetry, electrochemical impedance). Extractive electrochemistry.	2		
14	Corrosion and corrosion protection (definition of corrosion, phenomenology, theories, Pourbaix diagrams, mixed potential, corrosion on homogeneous and inhomogeneous surfaces); Corrosion protection methods; Electrochemical waste treatment processes.	2		

Bibliography

1. **Lawrence S. Brown, Thomas A. *Holme, Chemistry for Engineering Students*, Brooks/Cole 20 Davis Drive, Belmont USA 2011.**

From UTCN library:

1. D. M. Gligor, M.-L. Ungureşan, *Noţiuni de Electrochimie*, Ed. Galaxia Gutenberg, 2009, pg. 186.
2. **M.-L. Ungureşan, D. M. Gligor, *General Chemistry*, Ed. UTPRESS, Cluj-Napoca, 2012, pg. 490**.
3. M.-L. Ungureşan, L. Jantschi, *Termodinamică şi cinetică chimică*, Ed. Mediamira, Cluj-Napoca, 2005.
4. P. W. Atkins, *Tratat de chimie-fizică*, Bucureşti, Ed. Tehnică, 1996.

Materiale didactice virtuale (on-line):

Prezentarea cursului e accesibila la adresa: http://mihaela.academicdirect.ro/free

From other libraries:

1. L. Oniciu, L, Mureşan, „*Electrochimie aplicată*”, Ed. Presa Universitară Clujeană, 1998.
2. L. Oniciu, E. Constantinescu, „*Electrochimie şi coroziune*”, EDP, Bucureşti, 1982.
3. L. Oniciu, P. Ilea, I. C. Popescu,”*Electrochimie tehnologică*”, Ed. Casa Cărţii de Ştiinţă, Cluj-Napoca, 1995.
4. I. Bâldea, „*Cinetica Chimică*”, curs litografiat, Cluj, 1992.
5. I. G. Murgulescu, T. Oncescu, E. Segal, „*Introducere în Chimia Fizică*”, Vol. II, 2, „*Cinetică şi Cataliză*”, şi
6. IV, „*Electrochimie*”, Ed. Ştiinţifică, Bucureşti, 1981.

9.2. Applications - Seminar /Laboratory/Project		Number of hours	Teaching methods	Additional remarks
1	Presentation of the laboratory themes. Occupational safety standards in the chemistry laboratory. Analytical balance and its use. Utensils, glassware and laboratory equipment.	2	Using specific techniques in the laboratory, performing experimental work, observing, measuring and recording the experimental data obtained, interpreting and evaluating experimental results	Experimental equipment, computer, software. In case of force majeure, classes will be held online with students having registered all the work with everything is necessary.
2	Determination of acetic acid concentration in food vinegar by acid-base titration.	2		
3	Hydration heat of copper sulphate.	2		
4	Thermal analysis.	2		
5	Determination of acidity of fruit juices. Determination of conductivity of solutions. Acid-base pH indicators.	2		
6	Protection of metals against corrosion by copper plating.	2		
7	Activity series of metals.	2		

Bibliography

From UTCN library:

[1] A. Mesaroş, L. Bolunduţ, M.-L. Ungureşan, *Experimente de Chimie Generală*, Ed. Galaxia Gutenberg, Colecţia Tehne 5, ISBN: 978-973-141-228-3, 2010, pg. 197.

[2] M.-L. Ungureşan, *Chimie fizică. Experimente de Cinetică şi Dinamică Moleculară*, Ed. Amici, Cluj, 2003, pg. 146.

[3] L. Bolunduţ, A. Mesaroş, M.-L. Ungureşan, *Electrochimia prin experimente*, Ed. Galaxia Gutenberg, 2009, pg. 110.

Materiale didactice virtuale (on-line): Prezentarea indrumatorului e accesibil de pe adresa: http://mihaela.academicdirect.ro/free/Indrumator_laborator.pdf

10. Alignment of course content with expectations of the epistemic community, professional associations, and representative employers in the field

Applying fundamental knowledge of chemistry in general and specialized engineering to solve technical problems specific to the field of electrical engineering.

11. Assessment

Activity type	11.1 Assessment criteria	11.2 Assessment methods	11.3 Weight in the final grade (%)
11.4 Course	20 question multiple choice test.	Written test – duration of assessment 60 minutes multiple choice test 20 questions 5 answer options one correct answer	80%
11.5 Laboratory	Laboratory work verification	Each paper is graded by the teacher, and at the end, the final grade in the chemistry laboratory is calculated by arithmetic average.	20%
11.6 Minimum standard of performance: • Correctly solving 10 problems from the course quiz and 3 problems from the laboratory.			

Date of completion	Lecturers	Title/ Surname/ Name:	Signature
20.09.2025	Course	Associate professor Liviu Călin Bolunduţ	
	Applications Seminar/ Laboratory/ Project	Associate professor Liviu Călin Bolunduţ	

Date of approval in the ETHM Department Council **January 2026**	**Head of Department:** Prof. Eng. MICU Dan Doru, PhD
Date of approval in the Faculty of Electrical Engineering Council **February 2026**	**Dean:** Assoc. Prof. Eng. CZIKER Andrei, PhD