COURSE UNIT DESCRIPTION - GENERAL AND PHYSICAL CHEMISTRY

Course unit title	Code
GENERAL AND PHYSICAL CHEMISTRY	

Lecturer(s)	Department(s)
Coordinator: Assoc. Prof. Deivis PLAUŠINAITIS **Other(s):** Lect. Jonas Kiuberis	Faculty of Chemistry, Department of Physical chemistry and Department of Analytical and Environmental Chemistry, Naugarduko g. 24, LT-03225 Vilnius

Cycle	Level of the course unit	Type of the course unit
Full-time studies (1st stage)	1 out of 1	Compulsory

Mode of delivery	Period of delivered	Language(s) of instruction
Face to face	1st semester, autumn	Lithuanian

Prerequisites and corequisities	
Prerequisites: None	**Corequisities (if any):** None

Number of credits allocated to the course unit	Student's total workload	Contact hours	Self-study and research hours
7	**187**	**112**	**75**

Purpose of the course unit: programme competences to be developed

The course unit aims to develop:

Specific competences:

- knowledge of the laws of chemistry, the quantitative characteristics of the solutions, ionic product and pH indicator, salt hydrolysis, ion exchange in aqueous solution and oxidation - reduction reactions, thermochemical reactions, acquaintance of the laboratory grounds;
- knowledge of the gas laws, laws of thermodynamics, the spontaneity of reaction, chemical equilibrium in gas phase, chemical equilibrium in solutions, atomic structure, reaction rate theory, reaction mechanisms and catalysis concept, concept of enzymatic catalysis, phase transformation of substances, concept of the electrode potential, solutions colligative properties, disperse heterogeneous systems;
- ability to apply knowledge in solving of problems, in laboratory studies;
- ability to work safely in chemical laboratory;
- ability to perform experiments and interpret data obtained;
- ability to perform reliable measurements (to make solutions, dilution, titration, temperature measurement, to collect the gas generated during the reaction, measure the reaction rate), document and analyse the results of the measurements;

General competences:

- analytical and critical thinking
- skills for self-development, learning skills in order to study general science resources;
- ability to organize and plan their work and time.

Learning outcomes of the course unit (module)	Teaching and learning methods	Assessment methods
Upon Successful completion of this course the student will be able to: • Make reduced ionic equation and determine if an exchange reaction takes place; to calculate the concentration of the prepared solutions and quantities of required regents for laboratory works; to calculate the pH values of knowing solutions; • Align redox reaction equations; • Perform stoichiometric calculations; • Describe an ideal gas, to perform calculations using the ideal gas equation;	Lectures, seminars, laboratory work, individual work	Midterm exam, control works, and final exam.

• Calculate the reaction enthalpy, entropy and Gibbs free energy changes, to assess the spontaneity of reactions; • Describe the chemical equilibrium, perform the calculations in witch requiring the equilibrium constant; • Determine the reaction rate from the experimental data and evaluate the degree of reaction.		

Content: breakdown of the topics	Contact hours							Self-study work: time and assignments	
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work placement	**Contact hours**	**Self-study hours**	**Assignments**
1. Mol concept. Percentage and molarity of solutions. Solutions production. Dilution. Titration. Make three labs: I-II, III-IV cations analytical group setting: individual reactions and mixture of unknown composition analysis.	4	2		10	10		**26**	**12**	Writing the chemical equation. Analyzing the results of the laboratory work. Solving the problems
2. Hardness of the natural water and its softening. Systemic and nonsystemic cation analysis. Indicators. Buffer solutions.	4						**4**	**3**	Chemical equations for comparison. Solving the problems.
3. pH, ionic product of water. Electrolytes and nonelectrolytes. Ion-exchange reactions in aqueous solutions.	4						**4**	**3**	Theory analysis. Solving the problems.
4. Covalent chemical bonds, covalent compounds. Ionic chemical bonds, ionic compounds. Salt composition, properties, hydrolysis of salts. Complex and mixed salt.	4						**4**	**3**	Theory analysis. Solving the problems.
5. Oxidation-reduction. Oxidation number, oxidation state determination. Equalization of Oxidation-reduction reactions by electronic-ionic method.	4	2					**6**	**3**	Theory analysis. Solving the problems.
6. The gas laws. Basic concepts of thermodynamics: the system, the environment and the universe. Energy and its modes of transmission: work and heat. Thermal capacity. The first law of thermodynamics. Chemical reaction heat. Enthalpy change ΔH. Hess Law. The standard formation enthalpy of reaction. Melting enthalpy. Calorimetry.	4			3	6		**13**	**10**	Using the gas laws solving the problems. Analyzing the results of the laboratory work.
7. Spontaneous processes. Spontaneity and disorderliness. Entropy. Entropy temperature dependence. 3rd law of thermodynamics, entropy and its absolute concept.	2			1			**3**	**2**	Solving the Thermochemistry problems
8. 2nd Law of Thermodynamics. Gibbs energy and its change ΔG. Spontaneous process directions and limits. Free energy dependence from temperature.	2			2			**4**	**2**	Solving the Thermodynamics problems
9. Chemical equilibrium. Equilibrium constant expressions. Equilibrium in Heterogeneous systems. Le Chatelier principle. ΔG and equilibrium relationship. Equilibrium constants dependent from temperature.	3			2			**5**	**3**	Solving the Equilibrium problems

10. The statistical thermodynamics concepts. Bolcman'o distribution.	1						**1**	**2**	Theory analysis.
11. Electrode potential and its measurement. Galvanic cell (electrochemical cell). The standard electrode potential. Electrochemical cell potential E_c and spontaneous processes. Nernst equation. E_c relationship with the equilibrium constant. E_c dependence on the electrolyte concentration. Measurement of pH of the solution. Reference electrodes examples. Membrane potential.	4						**4**	**3**	Theory analysis. Solving the problems.
12. Reaction rate concept and its measurement. The reaction rate law. The reaction rate equations. Reaction order. Zero, 1st and 2nd order reactions. Half-time. Determination of the reaction order and rate constant.	4			1	4		**9**	**8**	Analyzing the results of the laboratory work. Solving the problems about determination of the reaction order and rate constant.
13. Temperature influence on the reaction rate. Arenijus equations. Activation energy and its determination.	2			1			**3**	**2**	Theory analysis. Solving the problems.
14. The theoretical models of chemical kinetics: Collision theory, the theory of the intermediate state. Reaction mechanism concept. Limiting stage. Examples of reaction mechanisms. Steady state approximation.	5			1			**6**	**3**	Theory analysis. Solving the problems.
15. Homogeneous and heterogeneous catalysis. The enzyme catalytic reaction mechanisms. Michaelis -Menten equation. Enzyme catalytic efficiency and inhibition.	4			1	4		**9**	**7**	Analyzing the results of the laboratory work. Theory analysis. Solving the problems.
16. Diffusion influence to reaction rate. Thermodynamic and kinetic stability.	1						**1**	**1**	Theory analysis. Solving the problems.
17. Liquid water structure and polarity. Intermolecular forces in liquids and solids. Hydrogen bonding influence to the properties of liquid. Fluid viscosity. The surface tension. Fluid boiling and freezing. Hydrophobicity and hydrophilicity.	2						**2**	**2**	Theory analysis. Solving the problems.
18. Aqueous solutions. Methods for expressing concentration. Intermolecular forces and dissolution process. Melting process. Electrolytic dissociation theory. Solvating ions. Ion activity and activity coefficient. Equilibrium in solutions. Gas solubility. Vapor pressure of the solution. Raul's Law. Ideal solutions. Osmotic pressure. Boiling and freezing points of solutions.	2				2		**4**	**4**	Analyzing the results of the laboratory work. Theory analysis. Solving the problems.
19. Disperse systems and concept of dispersivity. Macromolecular compounds and dispersion system. Kinetic and Aggregate stability of dispersed systems. Centrifugation. Surface phenomena in phase contact boundary. Adsorption, surface active substances. Chromatography. Electrical properties of disperse systems. Electrophoretic phenomena.	4						**4**	**2**	Theory analysis. Solving the problems.

Total	**60**	**4**		**22**	**26**		**112**	**75**	

Assessment strategy	Weight,%	Assessment period	Assessment criteria
laboratory works	5%	during the semester	Theoretical preparation for laboratory work, experiment execution and data logging, completeness of theoretical part and experimental results, reasoning of the results in writing and orally.
Test works.	5%	during the semester	Are written three control works. In the works presents control tasks of the relevant topics.
Midterm exams	50%	during the semester	Resolved tests and open-ended tasks and decision tasks of the relevant topics.
Exam	50%	during the session	Resolved tests and open-ended tasks and decision tasks of the whole course
Total	100		

Author	Year of publica-tion	Title	Issue of a periodical or volume of a publication	Publishing place and house or web link
Compulsory reading				
S. S. Zumdahl, S. A. Zumdahl	2010	Chemistry	7th edition	Houghton Mifflin Company, USA
P. Atkins, J. dePaula.	2006	Physical Chemistry for the Life Sciences	Second edition.	Oxford University Press, Oxford
P. Atkins, L. Jones.	2010	Chemical Principles: The Quest for Insight	5th edition	H.W.Freeman and co, New York
J. McMurry, R. C. Fay.	2012	Chemistry	6th edition	Pearson Prentice Hall, Upper Saddle River
R. Petrucci, W. Harwood	2000	General Chemistry (in Lithuanian)		Vilnius,Tvermė,
J.Martišius	1998	General Chemistry (in Lithuanian)		Kaunas, Šviesa
Optional reading				
J. Škadauskas. I.Blažys	2000	Exercises in Calculating Solutions Concentrions (in Lithuanian)		VU leidykla
K. Daukšas ir kt.,	2003	Chemistry Explanatory Dictionary (in Lithuanian)		Mokslo ir enciklopedijų leidybos institutas, Vilnius.
J. Janickis.	1987	Physical Chemistry (in Lithuanian)		Mintis, Vilnius.