COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Fundamentals of Chemistry	

Academic staff	Core academic unit(s)
Coordinating: Dovydas Karoblis **Other:**	Faculty of Chemistry and Geosciences, Institute of Chemistry, Naugarduko 24, Vilnius LT-03225, Lithuania

Study cycle	Type of the course unit
First	Compulsory

Mode of delivery	Semester or period when it is delivered	Language of instruction
Face to face		English

Requisites	
Prerequisites:	**Co-requisites (if relevant):**

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5	133	64	69

Purpose of the course unit		
Acquire fundamental knowledge of chemistry and apply it to solving tasks in practice and conducting laboratory experiments.		
Learning outcomes of the course unit	**Teaching and learning methods**	**Assessment methods**
A.1. Will be able to name different inorganic compounds, will be able to determine the organic materials by functional groups.	Textbook reading. Problem solving.	Midterm colloquium. Exam.
A.2. Will be able to determine the bond type in different compounds.	Textbook reading. Problem solving.	Midterm colloquium. Exam.
A.4. Will be able to apply the principles of thermodynamics to describe chemical processes.	Textbook reading. Problem solving. Conducting laboratory work. Preparation of laboratory work reports.	Midterm colloquium. Exam. Laboratory work defence
B.6. Will be able to work with chemicals safely during the laboratory work.	Textbook reading. Conducting laboratory work. Preparation of laboratory work reports.	Laboratory work defence.
B.8. Will be able to conduct standard laboratory procedures and use laboratory equipment.	Textbook reading. Conducting laboratory work. Preparation of laboratory work reports.	Laboratory work defence

C.1. Will be able to apply theoretical knowledge in solving quantitative and qualitative problems of both familiar and unfamiliar nature.	Textbook reading. Problem solving.	Midterm colloquium. Exam.
C.2. Will be able to plan problem-solving strategies.	Textbook reading. Problem solving.	Midterm colloquium. Exam.

Content	**Contact hours**							**Individual work: time and assignments**	
	Lectures	Tutorials	Seminars	Workshops	Laboratory work	Internship	**Contact hours, total**	**Individual work**	**Tasks for individual work**
1. **Introduction**: course objectives.	1						**1**		
2. **Matter and Measurements**: SI units. Unit conversions. Dimensionalanalysis method. Significant figures. Exact and approximate data. Calculations with approximate data. Absolute and relative errors. Percent and molar concentration. Preparation of solution. Introduction to laboratory equipment. Separation techniques. Titration. **Laboratory work:** Preparation and titration of sodium carbonate solution.	2			2	3		**7**	**6**	Textbook reading. Problem solving. Preparation of laboratory work reports.
3. **Atoms and bonds:** the basic unit of matter – the atom. Quantum numbers. N. Bohr model. Electronic configuration. Atomic and ionic radius. Chemical bonding. Lewis's structure. Molecules and ions. VESPR theory. Resonance. Geometrical structure of ions and molecules. Polarity of a bond and of a molecule.	4			2			**6**	**6**	Textbook reading. Problem solving
4. **Chemical formulas and Equations**: inorganic and organic compounds classes. Alkanes, alkenes, and alkynes. Aromatic hydrocarbons. Hydrocarbon derivatives. Polymers. Naming and writing compounds. The identification reactions.	2			1			**3**	**5**	Textbook reading. Problem solving
5. **Ion-exchange reactions:** Electrolytes and non-electrolytes. Weak and strong acids and bases. Metathesis reactions in aqueous solutions. Excess and limiting reactant. Determination of limiting reactant. Stoichiometric numerical calculations when one should determine the limiting reactant. **Laboratory work:** Electrolytic dissociation, ionic exchange reactions. Signs of reactions.	2			2	3		**7**	**9**	Textbook reading. Problem solving. Preparation of laboratory work reports.
6. **Oxidation-reduction reactions**: determination of oxidation number. Balancing the redox reaction by oxidation-number-change and half-	2			2	3		**7**	**9**	Textbook reading. Problem solving. Preparation of

reaction methods. Single replacement reactions, galvanic cells, corrosion, electrolysis. **Laboratory work:** Oxidation-reduction reactions.									laboratory work reports.
7. **State of matter**: solid, liquid or gas. Phase diagrams. Ideal gas. Gas pressure and units. Gas laws. Gaseous mixtures. Partial pressure. Dalton law of partial pressure. Effusion and diffusion. Real gas. The composition of atmosphere. Air pollution. Gas preparation and identification reactions. **Laboratory work:** Gas laws.	3			2	4		**9**	**8**	Textbook reading. Problem solving. Preparation of laboratory work reports.
8. **Thermochemistry and thermodynamics**: system, surroundings, universe. Open, closed, and isolated systems. Work, heat, internal energy, enthalpy. Calorimetry. State function. Enthalpy of formation. Hess' law. Combination of thermochemical equations. Entropy. Spontaneous and non-spontaneous processes. Gibbs energy. **Laboratory work:** Thermometric titration.	3			2	3		**8**	**7**	Textbook reading. Problem solving. Preparation of laboratory work reports.
9. **Chemical equilibrium**: equilibrium constants K_p and K_c. Activity and thermodynamic equilibrium constant. Le Chatelier principle. Homogeneous and heterogenous equilibria. Acid-base equilibrium in aqueous solutions. Introduction into acid-base theory. pH, pOH, K_a, K_h, pK_a, pK_b, K_w. Equilibrium calculations for one step processes.	4			3			**7**	**7**	Textbook reading. Problem solving
10. **Coordination compounds**: structure. Classification. Ligands. Coordination number. Nomenclature. Application. Isomers. Valence bond theory. Crystal field theory. Ligand field theory.	4			2			**6**	**7**	Textbook reading. Problem solving
11. **Introduction to inorganic synthesis**: devices for measuring the temperature. Furnaces for heating materials. Solid-state reactions. Combustion reactions. Thin film preparation techniques: physical vapor deposition, chemical vapor deposition. Techniques for preparation of monocrystals. Sol-gel method. Properties and preparation of nanoparticles.	3						**3**	**5**	Textbook reading.
Total	**30**			**18**	**16**		**64**	**69**	

Assessment strategy	Weight %	Deadline	Assessment criteria
Laboratory work	Pass/Fail	September-December	One-to-one conversation (understanding of theoretical background is tested). Ability to get reliable results. All laboratory works must be done, laboratory reports must be

			compiled, and defended in one-to-one conversation. In case of Fail, student must repeat laboratory work. If the laboratory work is not defended, the student cannot take the exam.
Midterm colloquium	40%	October/ November	Multiple choice questions, open answer questions and numerical calculation problems. The maximum number of points to collect is 30. In order to pass, your score must be equal or higher than 2. 4 – excellent knowledge and skills. Nearly all answers were correct. 27-30 points. 3 – good knowledge and skills, there may be minor errors. 20-26 points. 2 – average knowledge and skills, there are mistakes. 14-19 points. 0-1 – minimum requirements are not met. 0-13 points.
Final exam	60%	During session	Multiple choice questions, open answer questions and numerical calculation problems. The maximum number of points to collect is 45. In order to pass, your score must be equal or higher than 3. 6 – excellent knowledge and skills. Nearly all answers were correct. 40-45 points. 4-5 – good knowledge and skills, there may be minor errors. 31-39 points. 3 – average knowledge and skills, there are mistakes. 22-30 points. 0-2 – minimum requirements are not met. 0-21 points.

Author (-s)	Publishing year	Title	Issue of a periodical or volume of a publication	Publishing house or web link
Required reading				
R. Petrucci, W.Harwood,	2000	Bendroji chemija (General chemistry)		Tvermė, Kaunas
S. S. Zumdahl, S. A. Zumdahl	2007	Chemistry		Houghton Mifflin Company, UA
Shriver and Atkins‘	2010	Inorganic chemistry		W. H. Freeman and Company
Recommended reading				
K. Daukšas and co-authors	1997 2003	Chemijos terminų aiškinamasis žodynas (Dictionary of Chemical Therms)		Mokslo ir enciklopedijų leidybos institutas, Vilnius