COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Analytical Chemistry I	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: A. Padarauskas	Faculty of Chemistry and Geosciences, Institute of Chemistry Naugarduko 24, LT-03225 Vilnius

Study cycle	Type of the course unit (module)
First	Compulsory

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Face to face	2nd semester	Lithuanian

Requirements for students	
Prerequisites: general chemistry	**Additional requirements (if any):**

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	135	112	23

Purpose of the course unit (module): programme competences to be developed		
The purposes of the course are: - to provide knowledge and understanding in theoretical background of analytical chemistry and classical analytical techniques - to develop practical skills in using laboratory equipment and carrying out analytical procedures - to develop critical and analytical thinking		
Learning outcomes of the course unit (module)	**Teaching and learning methods**	**Assessment methods**
After successful completion of this course student will be able to: • understand the theoretical background of analytical chemistry and the principles of classical analytical techniques • choose appropriate methods of qualitative and classical quantitative analysis and perform the analyses • work in chemical laboratory safely • evaluate the reliability of analytical data • perform the main procedures of qualitative and classical quantitative analysis and use laboratory equipment • apply theoretical knowledge in solving numerical problems of analytical chemistry	Lectures; Individual problem solving; Problem solving classes (tutorials); Laboratory work; Writing of laboratory work reports; Textbook reading.	Two colloquiums (includes open answer questions and numerical calculation problems). All laboratory works must be done, laboratory reports must be compiled. Final exam (includes open answer questions and numerical calculation problems).

Content: breakdown of the topics	Contact hours	nt ac	ud y	Self-study work: time and assignments

	Lectures	Seminars	Exercises	Laboratory work	Internship/work placement			**Assignments**
1. Introduction. Course objectives.	1					**1**		
2. Analytical chemistry and chemical analysis. Qualitative and quantitative analysis. Analytical techniques, classification. Main analytical procedures.	1					**1**	**1**	Text book reading.
3. Qualitative analysis. Classification of the ions. Common reagents and procedures. Heating, precipitation, centrifugation, microcristaloscopic reactions, flame tests. Lab. works Identification of cations and anions.	1			24		**25**	**5**	Text book reading. Preparation of laboratory work reports.
4. Errors in chemical analysis. Absolute and relative errors. Systematic, random and gross errors, their sources and evaluation.	2	2				**4**	**1**	Text book reading. Problem solving.
5. Molar concentration, mass fraction, mass concentration, ppm, pX. Electrolyte ionic strength, activity, activity coefficient. Chemical equilibrium in aqueous solution.	2	2				**4**	**1**	Text book reading. Problem solving.
6. Precipitation equilibrium. Solubility-product constant and molar solubility. Effect of main factors on solubility: ionic strength, common ion effect, complex formation, pH. Formation of crystalline and colloidal precipitates. Coprecipitation.	4	8				**12**	**2**	Text book reading. Problem solving.
7. Gravimetric analysis. Principles and techniques. Gravimetric form, weighing form, gravimetric factor. Precipitation of crystalline and colloidal precipitates. Aplication of gravimetric analysis. Lab. work Gravimetric determination of Ba^{2+} by precipitation with sulphate.	2	6		6		**14**	**2**	Text book reading. Problem solving. Preparation of laboratory work reports.
8. Acid-base equilibrium. Acid-base theories (Arrhenius, Lewis, Bronsted-Lowry). pH. Strong and weak acids/bases, polyprotic acids/bases, ampholytes. Buffers, buffering capacity. Preparation of buffers. Applications. pH calculations.	4	6				**10**	**2**	Text book reading. Problem solving.
9. Titrimetric methods of analysis. General aspects. Terms and definitions. Titration modes and techniques. Titrimetric standards. Calculations.	2					**2**	**1**	Text book reading.

10. Acid-base titration. pH indicators. Titration curves. Equivalence point, titration jump. Selection of indicator. Application of acid-base titrations. Lab. works Preparation of NaOH standard solution. Titration of $H_2C_2O_4$. Titration of $HCl+H_3BO_3$ mixture. Titration of NH_4Cl salt.	4	6		9		**19**	**4**	Text book reading. Problem solving. Preparation of laboratory work reports.
11. Redox reactions. Galvanic cell. Redox potentials. Nernst equation. Calculation of redox potentials. Effect of main factors on the potential. Redox titrations. Indicators, titration curves, titration jump, selection of indicator. Permanganatometry. Iodometry. Chromatometry. Lab. works Preparation of iodine standard solution. Titration of thiosulfate. Preparation of oxalic acid standard solution. Titration of permanganate.	4	2		6		**12**	**2**	Text book reading. Problem solving. Preparation of laboratory work reports.
12. Complex-formation reactions. Monodentate and polydentate ligands. Chelates. Complex formation and stability. Stepwise, overall and conditional stability constants. Complex-formation titration. Titration with monodentate ligands. Complexonometric titration. EDTA. Metal-EDTA complexes. Titration curves. Indicators. Applications. Lab. works Preparation of EDTA standard solution. Titration of Cu^{2+} ions. Titration of Bi^{+3} ions.	4			3		**7**	**1**	Text book reading. Preparation of laboratory work reports.
13. Precipitation titrations. Titration curves. Determination of equivalence point, adsorption indicators.	1					**1**	**1**	Text book reading.
Total	**32**	**32**		**48**		**112**	**23**	

Assessment strategy	**Weight,%**	**Deadline**	**Assessment criteria**
Laboratory work	20	Every week	Safe work in the laboratory. Ability to get reliable results. All laboratory works must be done, laboratory reports must be compiled.
Colloquiums (2) or Final exam	80	Every 8 weeks June	Open answer questions and numerical calculation problems.

Author	**Year of publication**	**Title**	**Issue of a periodical or volume of a publication**	**Publishing place and house or web link**
Compulsory reading				
D.A. Skoog,	1992	Fundamentals of Analytical		Orlando (USA), Saunders

D.M. West, F.J. Holler	1997 2007 2010	Chemistry		College Publishing
A. Padarauskas, V. Vičkačkaitė	1997	Nusodinamoji titrimetrija (Precipitation titrimetry)		Vilnius, VU leidykla,
A. Padarauskas, V. Vičkačkaitė	1998	Kompleksometrija (Complexometry)		Vilnius, VU leidykla,
J. Škadauskas	1997	Katijonų ir anijonų radimas tirpaluose (Identification of cations and anions in solution)		Vilnius, VU leidykla,
Optional reading				
D. Harvey	2000	Modern Analytical Chemistry		McGraw-Hill Higher Education (USA)
N. Kreivėnienė, V. Krylova	2006	Cheminė analizė (Chemical analysis)		Kaunas, KTU leidykla