UNIVERSITY OF PRISHTINA
“HASAN PRISHTINA”

FACULTY OF MATHEMATICAL

&

NATURAL SCIENCES

DEPRATMENT OF CHMEISTRY

Study program: Bachelor of Chemical Engeenering

First Year, First Semester

Nr	Subject	Instructor	O/E[1]	Hour	ECTS
1	Introduction in chemical engineering	Prof. Dr. Ramë Vataj	O	2+2	6
2	General chemistry	Prof. Asoc. Dr. M. Paçarizi	O	3+4	8
3	Mathematics I	Prof. Dr. Rexhep Gjergji	O	3+3	7
2	Physics I	Prof. Asoc. Dr. Naim Syla	O	2+2	6
5	English language I	Aurora Zuna	O	2+0	3

First Year, Second semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Mathematics II	Prof. Dr. Rexhep Gjergji	O	3+2	6
2	Physics II	Prof. Asoc. Dr. Naim Syla	O	2+2	5
3	Inorganic chemistry I	Prof. Ass. Dr. Ilir Shehu	O	3+3	7
4	Analytical chemistry I	Prof. Asoc. Dr. Fatbardh Gashi	O	3+5	9
5	English language II	Aurora Zuna	O	2+0	3

Second Year, Third semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Organic chemistry I	Prof. Ass. Dr. Arben Haziri	O	3+2	7
2	Physical chemistry I	Prof. Asoc. Dr. Teuta Selimi	O	3+3	7
3	Analytical chemistry II	Prof. Asoc. Dr. Fatmir Faiku	O	3+4	8
4	Thermodynamics in chemical engineering	Prof. Dr. Fetah Podvorica	O	2+1	5
5.1	Chemical process of water treatment	Prof. Asoc. Dr. Bardha Korça	E	2+1	3
5.2	Polymers material in chemical engineering	Prof. Ass. Dr. Avni Berisha	E	2+1	3

Student is obligated to take one of the courses as electives.

Second Year, Fourth semester

Nr	Subjects	Instructor	O/E	Hour	ECTS
1	Organic chemistry II	Prof. Ass. Dr. Arben Haziri	O	3+2	7
2	Physical chemistry II	Prof. Ass. Dr. M.Sadiku	O	3+3	7
3	Instrumental analysis	Prof. Dr. Tahir Arbneshi	O	3+4	8
4.	Environmental protection	Prof. Ass. Dr. S.Demaku	O	2+2	5
5.1	Transport phenomena	Porf. Asoc. Dr. Bashkim Taçi	E	2+1	3
5.2	Corrosion and environment	Prof. Dr. Fetah Podvorica	E	2+1	3

Student is obligated to take one of the courses as electives.

[1] O/E –Obligatori/Elective - Subject status,

Third Year, Fifth semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Coordination chemistry	Prof. Dr. Ismet Hashani	O	3+3	8
2	Stereochemistry	Prof. Asoc. Dr. Ramiz Hoti	O	3+2	7
3	Physico-chemical properties of nanostructures	Prof. Ass. Dr. Avni Berisha	O	2+2	6
4.	Molecular spectroscopy	Prof. Dr. Ramë Vataj	O	2+2	6
5.1	Pilots impiant in water treatment	Prof. Ass. Dr. Ilir Shehu	E	2+1	3
5.2	Atmospheric chemistry	Prof.Ass.Dr.Skender Demaku	E	2+1	3

Student is obligated to take one of the courses as electives.

Third Year, Sixth semester

Nr	Instructor	Instructor	O/E	Hour	ECTS
1	Technological process	Prof. Dr. Selim Jusufi	O	2+2	6
2	Biochemistry	Prof. Dr. Nevzat Aliaga	O	2+2	6
3	Mechanisms of organic reactions	Prof.Asoc.Dr. Sevdije Govori	O	2+2	6
4	Chemical processes in soil and sediments	Prof. Ass. Dr. Ilir Shehu	O	2+1	4
5.	Diploma work	Elective	O	0+5	5
6.1	Measurements and control processes	Prof. Dr. Selim Jusufi	E	2+1	3
6.2	Colloidal chemistry	Prof. Asoc. Dr. T.Selimi	E	2+1	3

Student is obligated to take one of the courses as electives.
The student should work a diploma thesis in any of research group in chemistry.

COURSE DESCRIPTIONS

Introduction to chemical engineering

The units of the International System of units, chemical industry pumps, types of pumps, systems division hetrogjene (decantation, filtration, centrifugation), gas cleaning, blending in liquid medium, heat exchange, evaporation, mass exchange, absorption, distillation, rectification, liquid-liquid extraction, solid body-liquid extraction, adsorption, drying, cooling, crystallization, transport of solid materials

***Literature**:*

1. Petrit Dodbiba, *Inxhinieria kimike 2, Proceset themelore*, ShBLU, Tiranë. 2002.
2. Felder and Rousseau, *Elementary Principles of Chemical Processes*, 3rd ed., Wiley, 2005.
3. James R. Couper, W. Roy Penney, James R. Fair, Stanley M. Walas, *Chemical Process Equipment: Selection and Design*, Second edition, Gulf Professional Publishing, Elsevier, 2005.

General chemistry

General chemistry provides knowledge of general chemistry: chemical laws, different forms of matter, substances in different forms (solid, liquid, gas and plasma state). General chemistry course includes the knowledge of many fields of chemistry: structure of matter - atoms and molecules; chemical bonding, the periodic table of elements - properties of elements; chemical thermodynamics and kinetics, elektrochemistry-bases of oxidation-reduction reactions etc..

Literature:

1. I. Filipovic; S. Lipanovic; Kimia e përgjithshme, (përkthim nga Xh. Ahmeti) Prishtinë, 1996.
2. R.Chang: General Chemistry ; 4th edition, New York, USA, 2006
3. J. McMurry and R. Fay, Chemistry ,4th edition, New Jersey, USA, 2004.

Inorganic chemistry I

Students in this course (subject) can be recognized with detailed Systematic study of chemical elements, focusing on each system group. In beginning of each group will thoroughly acquainted with the elements and characteristics of that group based on electronic configuration ionic radius, covalent radius, ionization energy, energy connectivity. Important for each element, will gain knowledge on nomenclature, outdoor situation, the main core, how to benefit in the laboratory and principles of profitability in the industry. Will also gain knowledge on the use of their practical needs, industrial and sciences. Adding to the special attention will be paid to the study of the elements and chemicals that have potential processes in the development in Kosovo.

Literature:

1. Filipovic. S. Lipanovc, Opca i Anorganska Kemija (I, II) Skolska Knjiga Zagreb, 1987. (I përkthyer në gjuhën shqipe, 1997).
2. M.F.Prifti :Kimia Inorganike ,shtëpia botuese e librit universitar,Tiranë 1999
3. Mortimer.Charles E, Chemistry fifth edition:, Përkthyer në shqip:K.Spahiu,E.Andoni,E.Millona,L.Pashko,K.Cake,E.Luzi,E.Frashëri,D.Siliqi, shblu 1998

Analytical Chemistry I

The purpose of studying this course is to teach students the theoretical basics of: characteristic reactions of inorganic and organic compounds. Qualitative and quantitative properties of solutions, notions saturation – activity, chemical equilibriums and the application of the law of mass interaction in protholytic reactions, reactions of complex formation, in heterogenic equilibriums and of electron conductivity reactions. Basic principles of fractional

precipitation or separation of ions (anions and cations) in analytical groups and methods of qualitative indication.

Literature:

1. Skoog /West/ Holler, Fundamentals of Analytical Chemistry. Sixth Edition
2. Skoog /West/ Nieman, Principles of Instrumental Analyses. Fifth Edition.
3. Mustafë R. Bacaj, Kimia Analitike I (KA-I) Prishtnë 2002
4. Sefer Matja etj., Kimia Analitike (KA-2)Tiranë 2003.

Organic Chemistry I

Structure and properties of organic compounds, Alkanes (structure, synthesis and reactions), Haloalkanes (structure, synthesis and reactions), Organometallic compounds, Alkenes (structure, synthesis and reactions), Spectroscopy and structure, Stereochemistry, Alkynes (structure, synthesis and reactions), Alicyclic Hydrocarbons Aromatic hydrocarbons (structure, synthesis and reactions).

Literature:

1. N. Daci,'Kimia Organike', Libri shkollor, Prishtine (2003)
2. K. Peter C. Vollhardt, N. E. Schore, 'Organic Chemistry-Structure and Reactivity', W. H. Freeman, New York (2003).
3. F. A. Carey, 'Organic Chemistry', McGraw Hill, New York (2006).

Physical chemistry I

State of matter and properties of gases, first law of thermodynamics, second law of thermodynamics, phase equilibriums, chemical equilibrium, atomic structure, chemical interaction, molecular spectroscopy

Literature:

1. Atkins P.; *The elements of Physical chemistry*, 2nd edition 1996, Oxford University Press Inc., New York, USA.
2. J. M. Smith, H.C. Van Ness, M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 5th Ed., McGraw-Hill, New York, 1996.
3. Fosset B.; Lefrou C.; Masson A.; Mingotaud C., *Chimie physique experimentale*, Hermann 2000, Paris, France.

Analytical Chemistry II

Introduction. Systematic approach to chemical analysis. Samples and sampling. Sample preparation. Evaluation of analytical data. Errors in the analytical system. Rejection of data. Calibration and standardization. The blind test. Absolute and comparative methods. Gravimetric methods. Particle size and purity of the precipitate. Precipitant reagents. The calculation results of gravimetric data. Gravimetric determinations. Titrimetric analysis Standard solutions. Primary and secondary standard solutions. Determination of the equivalent point. Acid titration - based on aqueous. Acid titration - based on nonwater environment. Precipitation titration. Titration methods based on reactions to the formation of complexes. Titration of oxido - reduction. Jodimetrike method. Jodometrike method.

Literature:

1. Daut Vezi, Bazat teorike të kimisë analitike, Tiranë, 2007.
2. Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Fundamentals of analytical chemistry, 2004.
3. J. Mendham, R. C. Denney, J. D. Barnes, M. J. Thomas, Text book of quantitative chemical Analysis, London, 1998.
4. John Dean, Analytical Chemistry Handbook, New York, 1995.
5. Z.Łoljić i M. Kałtelan-Macan, Analitička kemija, Volumetrija, Fakultet kemijskog inšenjerstva I tehnologije, Zagreb 2002

Thermodynamics in chemical engineering

The module is prepared for the purpose of the recognizing students of chemistry engineering application of the basic laws of thermodynamics and mathematical methods in solving the fundamental problems of chemistry, engineering, evaluation of thermodynamic properties of pure substances, mixtures and solvents as well as the calculation of phase equilibrium. Will also be given the basics of irreversible thermodynamic processes. After completing this course (course) the student will be able to: know the basic principles of chemical thermodynamics, will understand the laws of chemical thermodynamics and their application in chemistry engineering, will know to interpret the rules and principles of equilibrium phase, will teach balance of chemical reactions and their importance for engineering processes, will be recognized liquid-gas equilibrium.

***Literature**:*

1. S.I. Sandler, Chemical and Engineering Thermodynamics, 3rd Ed Wiley, New York, 1999.
2. J. M. Smith, H.C. Van Ness, M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 5th Ed., McGraw-Hill, New York, 1996.
3. P. Atkins and J. de Paula, Physical Chemistry, 9th Ed., Oxfor Univ Press, Oxford, 2010.

Chemical processes of waste water treatment

This module will provide students knowledge on methods of water treatment chemicals as well as those for drinking water treatment of urban and industrial wastewater, the wastewater treatment processes, methods used as physical that enable removal the various solid impurities then applying chemical methods using various substances to make precipitation of various components to form insoluble, and biological methods of removing various effluents polluting water and other modern methods . After completing this course (course) the student will be able to have knowledge of water treatment methods such as chemical, physical and biological also be known as the pot chemical filtration, coagulation, precipitation, ventilation, disinfection, the use of substances which make it possible adsorption processes to remove the unpleasant smell, removing excess amount of chlorine s wastewater then to the use of substances which form insoluble complexes etc..

Literature:

1. Environmental Chemistry (S.E.Manahan ,7 th ed)
2. Environmental Engineering,fourth edition, (Ruth. F. Weiner and Robin Matthews)
3. Kimia e Mjedisit Alqi Qulaj
4. Analiza kimike e ujit ;Bardha Korça ,prishtinë 2003

Polymer materials in chemical engineering

Within this course students will have the opportunity to know: polymeric materials, their classification, properties and processing, polymerization mechanisms and kinetic aspects of such mechanisms. Will be explored different class of polymers and processing methods and practical aspects of their use as modern materials engineering and materials science. After completing this module, students will be able to: describe the state of the rigid structure of polymers, to understand and apply technical criteria in the selection of materials suitable polymer, to propose appropriate techniques for morphological characterization of structural polymers; make the difference of polymers different classes and be able to recognize the possibilities of practical application of each polymer, to identify and propose practical options broom recycling of polymers .

Literature:

1. Polymer Chemistry. Proprieties and Applications. Andrew J. Peacock & Allison Calhoun. Carl hanser Verlag. 2006
2. Fundamentals of polymer engineering. Anil Kumar; Rakesh Kumar Gupta. Marcel Dekker, 2003.
3. The Elements of Polymer Science & Engineering. Alfred Rudin, Phillip Choi, Academic Press; 3 edition (December 31, 2012)

Organic Chemistry II

Alcohols and Thiols (structure, synthesis and reactions), Ethers and Epoxides (structure, synthesis and reactions), Aldehydes and Ketones (structure, synthesis and reactions), Carboxylic acids (structure, synthesis and reactions), Derivatives of carboxylic acids (structure, synthesis and reactions), Amines (structure, synthesis and reactions), Phenoles (structure, synthesis and reactions), Aryl halides (structure, synthesis and reactions), Polynuclear aromatic compounds (structure, synthesis and reactions), Heterocyclic compounds (structure, synthesis and reactions), Lipids (fatty acids and triglycerides, soaps and detergents, phospholipids, waxes), Carbohydrates (classification, stereochemistry, reactions, disaccharides, polysaccharides), Amino acids and proteins (structure, reactions, peptides, structure of proteins), Nucleic acids.

Literature:

1. N. Daci,'Kimia Organike', Libri shkollor, Prishtine (2003)
2. K. Peter C. Vollhardt, N. E. Schore, 'Organic Chemistry-Structure and Reactivity', W. H. Freeman, New York (2003).
3. F. A. Carey, 'Organic Chemistry', McGraw Hill, New York (2006).

Instrumental Analysis

Electroanalytical methods, electrochemical cells, electrode potential, theory and application of redox entitlements. Introduction in instrumental analytical techniques and their application. Methods, Conduktometry, Potentiometry, elektrogravimetry and Culonometry, voltametry, principles, errors, sources and typical applications. voltage, pH meter, conduktometry, electrochemical sensor.

Literature:

1. Skoog, Douglas A.; Holler, F. James; Nieman, Timothy A. Principles of Instrumental Analysis, 6ed.; Thompson: Belmont, CA, 2007. <ISBN 978-0-495-01201-6>
2. Analytical Chemistry A Modern Approach to Analytical Science, Ed. by R. J.-Mermet, M. Otto, M. Valcarcel, Founding Editors: R. Kellner, H.M. Widmer, Wiley - VCH, Weinheim, 2004.
3. Sergio Petrozzi: Practical Instrumental Analysis, Wiley-VCH, 2012.
4. Alqi Çullaj; Metoda instrumentale të analizës kimike. Tiranë : SHBLU, 2000.

Environmental Protection

Concern environmental problems are global in scope, which often require rapid solutions. Environmental protection is a new scientific discipline that involves the study of the entire human environment. Therefore the aim of this course (course) is that the student become familiar with the basic concepts, environmental protection, environmental chemistry of the atmosphere, hydrosphere and litosferës, environmental protection measures, seeing closely related ecosystems. To study the changes that occur in natural cycles caused by human activity as global warming (greenhouse effect), the thinning of the ozone layer, acid rain, photochemical smog, chemistry of water and land. Also student gains knowledge about chemical pollution and their impact on the environment.

Literature:

1. Kimia e Mjedisit, A.ÇULAJ, Tiranë 2005 ,
2. Ndotja dhe mbrojtja e ambientit jetësor Dervish ROZHAJA dhe Miodrag JABLANOVIQ- Prishtinë 1983,
3. Environmental Chemistry (S.E.Manahan ,7 th ed)

Transport Phenomena

Description of a fluid in motion. General conservation law. Momentum, heat and mass flux. Steady and unsteady transport process. Molecular and turbulent transfer mechanism. Flow pattern. Laminar pipe flow; velocity distribution and head loss. Turbulent pipe flow;

boundary layer theory, velocity distribution and head loss, dimensional analysis. Motion of fluid around the body. Flow in the mixing. Flow through the packed bed. Heat transfer. Steady and unsteady conduction heat transfer. Convection heat transfer for laminar and turbulent flow. Correlations for laminar and turbulent flow for systems of various geometrical characterictics. Over-all heat transfer. Radiation heat transfer. Mass transfer. Diffusion mass transfer. Mass transfer for laminar and turbulent flow. Models for convective mass transfer coefficients. Momentum, heat and mass transfer analogies.

Literature:

1. J. R. Welty, E. E. Wicks, R. E. Wilson; Fundamental of Momentum, Heat and Mass Transfer, 2nd Ed., J. Wiley, New York, 1976.
2. R. P. Bird, W. E. Stewart, E. N. Lghfoot, Transport Phenomena, J. Wiley, New York, 1960.
3. R. S. Brodkey, H. C. Heshey, Transport Phenomena, Mc Graw-Hill, New York, 1988.

Corrosion and environment

The aim of module is to present the students the fundamentals of theoretical basis and practical aspects of corrosion. The students will learn the theoretical basis that explain different types of corrosion, the methods to measure the corrosion rate, to know the form to calculate the corrosion rate, to learn passivation of metals, to know the forms to protect metals from corrosion and to learn the degradation of plastic materials, ceramics, etc. They will also learn the effect of metal embrittlement from hydrogen.

Literature:

1. M. G. Fontana "Corrosion Engineering", Mc Graw Hill, New York, 1997
2. L L. Shreir, R. A. Jerman, G. T. Burstein, Corrosion Metal Environment Reactions, Butterwirths, London, 1994
3. D. Landolt, Corrosion et chimie de surfaces des métaux, Ecole Polytechnique federale, Lausanne, 1997.

Coordination chemistry

Within this subject students will have the opportunity to benefit from the knowledge and wave properties of micro, implementation of Schrödinger wave equation, wave forms, space and the orbital (s, p, d, f), the terms of symbols and symbolism the atoms (as wave functions), hybridization (in inorganic compounds) Quantum mechanics, bonding theory, molecular orbital's theory, Implementation and TOM TLOV the formation of connections in inorganic molecules of H2 up to NE2, connections to multiple chemical CO and CO2 by TOM.

Literature:

1. B. Kamberi, Bazat e teroise se kimise se pergjithshme dhe inorganike, Libri shkollor, Prishtine (1999)
2. KENNETH W. WHITTEN, RAYMOND E. DAVIS, M. LARRY PECK, GEORGE G. STANLEY, Chemistry, Ninth Edition, Brooks/Cole Cengage Learning, 2010
3. S. Nesic, neorganska preparativna kemija, Beograd (1975)
4. C. Jelacic, hemijska veza i struktura molekula, Zagreb (1992)

Stereochemistry

Isomerisms of organic chemistry, Chiral compounds, Stereoisomers, enantiomers, Moleculare models, Optic activity, Polarized light, polarimetry, configuration of stereoisomers, Absolut configuration, R/S Systems, Fischer Projections, Enantiomers properties, Asymetric synthesis, Mutarrotation, Separation of racemic modifications, Separation methods, Acidity and basicity of organic compounds.

Literature:

1. M. B. Smith and J. March, "March's Advanced Organic Chemistry" John Willey & Sons Inc. 2001.
2. John Mc. Murry, "Fundamentals of Organic Chemistry", fifth ed. Brooks/Cole, 2000.
3. IUPAC Rules for the Nomenclature of Organic Chemistry, Section E: Stereochemistry (Recommendations 1996), Pure. Appl. Chem., 68 (1996) 2193.

4. J. M. Lehn, Supramolecular Chemistry, Werlag Chemie, Weinheim, 1995.

Physical-chemical properties of nanostructure

Within this course students will have the opportunity to know: 1) usability of the physical chemistry of solids to understand the unique properties of nanomaterials that are manifested in nanoscale 2) methods of fabrication of nanomaterials; 3) the characterization technics of nanomaterials; 4) the recent development of the application of nanomaterials in catalysis, electronics, optoelectronics, medicine, energy and the impact of nanotechnology in science in general. After completing this module, students will be able to: recognize the concept and scope of the study of nanotechnology, nanomaterials distinguish different (nonoparticlest, nanotubes, etc.) and recognize the methods of synthesis and properties of their techniques to recognize instrumental in studying possible nanomateriales, be able to assess the usefulness of the practical application of nanomaterials in various areas of science.

Literature:

1. Nanostructures & Nanomaterials. Synthesis, Proprieties & Applications. GuozhongCao,ImperialCollegePres,2004
2. Fundamentals and Applications of Nanomaterials, Zhen Guao, Li Tan, Artech House,2009(ISBN:978-1-59693-262-3)
3. Introductory Nanoscience: Physical and Chemical Concepts, Masaru Kuno, Garland Science; 1 edition (August 19, 2011)

Molecular spectroscopy

Within this course students will have the opportunity to know the applicability of various spectroscopic techniques in the study and characterization of materials, chemical compounds or elements, and also to recognize the theoretical basis of these techniques. After completing this module, students will be able to: recognize the theoretical basis of Molecular Spectroscopic techniques, have good foundation in practical terms about different techniques for the characterization of different materials, chemical substances or elements, to be able to assess the analytical techniques and to optimize the analysis of special material, component or element set.

Literature*:*

1. Douglas A. Skoog, F. James Holler, Timothy A. Nieman, "Principes d'analyse instrumentale", *traduction de 5^{e} édition*, 2003, De Boeck, Paris, Bruxelles.
2. Robert M. Silverstein, Francis X. Webster, David J. Kiemle, "Spectrometric Identification of Organic Compounds", *seventh edition*, 2005, John Wiley & Sons.
3. Francis Rouessac, Annick Rouessac, "Analyse chimique, Méthodes et techniques instrumentales modernes", 6^{e} édition, 2004, Dunod, Paris.

Plants for waste water treatment

Students gain knowledge of methods for water treatment processes, methods used for chemical treatment plants etc.. Learning outcomes: After completing this course (course) the student will be able to have knowledge of water treatment methods such as chemical, physical and biological also be known as the pot chemical filtration, coagulation, ventilation, disinfection, etc.

Literature*:*

1. Environmental Chemistry (S.E.Manahan ,7 th ed)
2. Environmental Engineering (Ruth. F. Weiner and Robin Matthews)
3. Kimia e Mjedisit Alqi Qulaj

Atmospheric chemistry

Atmospheric environmental problems are global in scope concerns, which often require rapid solutions, because air currents, water circulation, and porosity (capillaries) of land know no bounds in terms of atmospheric pollution. Atmospheric chemistry is a new scientific

discipline that involves the study of the entire human environment. Therefore the aim of this course (course) is that the student become familiar with the basic concepts, environmental chemistry of the atmosphere, hydrosphere and litosferës, measures for environmental protection, and environmental protection in general, seeing closely related ecosystems. To study the changes that occur in natural cycles caused by human activity as global warming (greenhouse effect), the thinning of the ozone layer, acid rain, photochemical smog. Also student gains knowledge about chemical pollution and their impact on the environment.

Literature:

1. Kimia e Mjedisit A.ÇULAJ, Tiranë 2005 ,
2. Meteorologjia S.AHMETAJ dhe S.GASHI-Prishtinë 2012
3. Ndotja dhe mbrojtja e ambientit jetësor Dervish ROZHAJA dhe Miodrag JABLANOVIQ- Prishtinë 1983,
4. Udhëzues intern për ushtrime laboratorike për Kimi të Mjedisit, përgatitur nga Merita SHEHDULA.

Technological processes

Raw in chemical industry. Technological schemes chemical technological processes. General important materials. Water. Fuels. Lime. Gypsum arising. Cement. Glass. Ceramics. Metallurgy. Giza. Steel. Copper. Lead. Zinc. Mercury. Aluminium. Inorganic chemicals. Liquid air. Hydrogen. Chlorine. Ammonia. Carbon dioxide. Acids. Nitric acid, sulfuric acid. Hydrochloric acid. Sodium carbonate.Sodium hydroxide (caustic soda). Artificial fertilizers. Nitrogenous fertilizers. Phosphorus fertilizers. Superphosphate. Potassium fertilizers. Mixed fertilizers (complex). Organic chemical and some similar branches. Oil and its derivatives. Mechanical and chemical processing of wood. Cellulose. Manufacture of paper. Manufacture of sugar. Fermentation industry. Manufacture of beer. Means for washing. Soaps and detergents. Plastic measures. Fenoplastet. Chemical cellulose fibers. Synthetic chemical fibers.

Literature:

1. Dr. Xhevdet Pula, Mr. Luljeta Beqiri, Teknologjia Kimike, Prishtinë 1985.
2. Dr. Dhimitër Haxhimihali, Teknologjia Kimike I , Tiranë 1992.
3. Dr. Dragan Vitorović, Hemijska Tehnologija, Beograd 1990.

Biochemistry

Proteins- properties and structures, Carbohydrates – their clasifications, Lipids, Enzymes, metabolisms of organic compounds, metabolisms of carbohydrates, Metabolisms of lipids, Metabolisms of proteins and aminoacids, metabolisms of nucleic acids, Biological oxidations, Vitamins,Hormones.

Literature:

1. Dr. Haqif Qerimi, "Biokimia", Prishtine, 2002
2. N. Aliaga "Praktikum i Biokimisë Eksperimentale".
3. P.Karlson"Biokemija" Zagreb, 1996.
4. Cal. Mc. Lughlin, V.E. Reichendecher,"Biochemistry"USA
5. Lubert Stryer, Biokemija, Zagreb 1996.

Mechanisms of organic reactions

The structure and reactivity of organic compounds. Polar reactions in acidic and basic conditions. Substitution reactions, elimination reactions and rearrangements. Reactions of free radicals. Catalytic reactions. Research on the reaction mechanism on the basis of study of product.

Literature:

1. M. B. Smith, J. A. March, *Advanced Organic Chemistry: Reactions, Mechanism, and Structure*, 6th ed., Wiley, New York (2007).
2. Peter Sykes**.,** *A Guidebook To Mechanism In Organic Chemistry* .,6th ed., Longman Publishing Group., New York (1987).

3. R.A. Jackson., *Mechanisms in organic reactions*., The Royal Society of Chemistry, Cambridge CB4 OWF, UK (2004).
4. R. A. Moss, M. S. Platz, M. Jones, Jr. *Reactive Intermediate Chemistry*, Wiley-Interscience, New York (2004).

Chemical processes in soil and sediments

This module provides a comprehensive review of contemporary behavioral and chemical reactions in the soil. Particular focus is given to the mineral solubility, surface exchange and microbial processes that influence the availability and environmental conditions in food plants then the behavior of heavy metals and other elements in the soil, nutrient different ionic forms of elemeneteve, soluble compounds and insoluble. A special attention was paid to the role of organic substances in the soil, humike substances and their reactions to the ground. This module provides knowledge and sedimentation processes, their creation, the methods used in sedimentuese processes. Through this module, students will be introduced to basic chemical processes and the growing importance of agrocultural productivity and protect vital natural resources.

Literature:

1. I.Chemical processes in soils: co-autors:M.A.Tabatabai and D.L.Sparks, published by:Soil science society of America,Inc, Madison,Wisconsin,USA 2005
2. II.Environmental Engineering,fourth edition, (Ruth. F. Weiner and Robin Matthews)
3. III.Kimia e Mjedisit Alqi Qulaj

Colloidal chemistry

Aggregate state, colloids, surfaces, specific properties, systems for the preparation of colloidal systems. Cleaning methods for determining particle, the interaction between particles, diffusion, solution, activity, sedimentation, mycelium, liquid crystals, emulsion. Adsorption, colloidal chemistry, adsorption, flotation, dispersion stability.

Literature:

1. Paul C. Hiemenz, Raj Rajagopalan, Principles of Colloid and Surface Chemistry, Academic Press 1997
2. Danglia H, Kimia koloidale (I, II, III) **1985**, Tiranë
3. Đaković Lj, Koloidna kemija **1990**, Novi Sad
4. Karagjozi H, Kimia fizike dhe koloidale 2 **1997**,Tiranë.

Study program: Bachelor of Chemistry

First Year, First semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Mathematics I	Prof. Dr. Regjep Gjergji	O	2+2	6
2	Physics I	Prof. Ass. Dr. Shukri Klinaku	O	2+2	6
3	General Chemistry	Prof. Asoc. Dr. M. Paqarizi	O	4+3	9
2	Stoichometrie	Prof. Dr. Tahir Arbneshi	O	1+2	5
5	English language I	Aurora Zuna	O	2+1	4

First year, Second semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Mathematics with statistics	Prof. Dr. Regjep Gjergji	O	2+2	6
2	Physics II	Prof. Ass. Dr. Shukri Klinaku	O	2+2	6
3	Inorganic chemsitry I	Prof. Ass. Dr. Avni Berisha	O	3+3	8
2	Informatics in chemistry	Prof. Asoc. Dr. Naser Troni	O	2+2	6
5	English language II	Aurora Zuna	O	2+1	4

Second Year, Third semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Analytical Chemistry I	Prof. Asoc. Dr. Naser Troni	O	3+4	9
2	Organic Chemistry I	Prof. Asoc. Dr. Majlinda Daci	O	3+2	8
3	Physical Chemistry I	Prof. Asoc. Dr. Bashkim Thaci	O	3+3	9
4.1	History of Chemistry	Prof. Asoc. Dr. Teuta Selimi	E	2+0	4
4.2	Chemical water analysis	Prof. Asoc. Dr. Bardha Korca	E	2+1	4

Student is obligated to take one of the courses as electives.

Second Year, Fourth semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Organic Chemistry II	Prof. Asoc. Dr. Majlinda Daci	O	3+2	8
2	Physical Chemistry II	Prof. Ass. Dr. Makfire Sadiku	O	3+3	9
3	Analytical Chemistry II	Prof. Asoc. Dr. Fatmir Faiku	O	3+4	9
4.1	Alternative sources of energy	Prof. Dr. Fetah Podvorica	E	2+1	4
4.2	Polymer chemistry	Prof. Ass. Dr. Avni Berisha	E	2+1	5

Student is obligated to take one of the courses as electives.

Third Year, Fifth Semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Organic chemistry III	Prof. Asoc. Dr. Ramiz Hoti	O	2+4	8
2	Analytical Chemistry III	Prof. Dr. Tahir Arbneshi	O	3+4	9
3	Higher course of general chemistry	Prof. Dr. Ismet Hashani	O	3+3	9
4.1	Chemistry of natural product	Prof. Dr. Nevzat Aliaga	E	2+1	4
4.2	Food chemistry	Prof. Dr. Selim Jusufi	E	2+1	4

Student is obligated to take one of the courses as electives.

Third Year, Sixth Semester

Nr	Subject	Instructor	O/E	Hour	ECTS
1	Organic chemistry IV	Prof.Asoc.Dr. Sevdije Govori	O	2+2	6
2	Biochemistry	Prof. Dr. Nevzat Aliaga	O	2+4	8
3	Chemical Technology	Prof. Ass. Dr. Ilir Shehu	O	2+2	6
4.	Environmental Chemistry	Prof. Ass. Dr. Bashkim Thaci	O	2+1	5
5.	Diploma work	Elective	E	0+4	5

The student should work a diploma thesis in any of research group in chemistry.

COURSE DESCRIPTIONS

General chemistry

General chemistry provides knowledge of general chemistry: chemical laws, different forms of matter, substances in different forms (solid, liquid, gas and plasma state). General chemistry course includes the knowledge of many fields of chemistry: structure of matter - atoms and molecules; chemical bonding, the periodic table of elements - properties of elements; chemical thermodynamics and kinetics, elektrochemistry-bases of oxidation-reduction reactions etc..

Literature:

1. I. Filipovic; S. Lipanovic; Kimia e përgjithshme, (përkthim nga Xh. Ahmeti) Prishtinë, 1996.
2. R.Chang: General Chemistry ; 4th edition, New York, USA, 2006
3. J. McMurry and R. Fay, Chemistry ,4th edition, New Jersey, USA, 2004.

Stoichiometry

stoichiometry is the field of chemistry that studies various calculations in many areas of chemistry. This will include: international system of measurement units, the relative atomic and molecular formulas, chemical equations, gaseous matter state, redox reactions, solutions and their concentration, thermodynamics and chemical kinetics, equilibrium in solution (pH factor, buffer solution, the hydrolysis, etc.).

Literature:

1. M.Sikirica; Stekiometria ; Prishtinë: 1997.
2. R.Chang: General Chemistry ; 4th edition, New York, USA, 2006

Inorganic chemistry

The aim of the course is to explain the physical and chemical properties of the elements as referred to the trends in the periodic system; to cover the main group of elements (period s, period p and period f) in terms of preparation, uses and its physical-chemical properties. In each group of elements, focusing will be in a properties of special element, as well as its most important compounds, their synthesis and properties.

Literature:

Shriver and Atkins' Inorganic Chemistry, Jonathanand , Rourke, Oxford University Press; 5th Revised edition (2009).

Analytical Chemistry I

The purpose of studying this course is to teach students the theoretical basics of: characteristic reactions of inorganic and organic analites. Chemical reactions applicable to chemical analysis, the sensitivity and their selectivity. Qualitative and quantitative properties of solutions, notions saturation – activity, chemical equilibriums and the application of the law of mass interaction in protholytic reactions, reactions of complex formation, in heterogenic equilibriums and of electron conductivity reactions. Basic principles of fractional precipitation or separation of ions (anions and cations) in analytical grups and methods of qualitative indication.

Literature:

Skoog /West/ Holler, Fundamentals of Analytical Chemistry. Sixth Edition
Skoog /West/ Nieman, Principles of Instrumental Analyses. Fifth Edition.
Mustafë R. Bacaj, Kimia Analitike I (KA-I) Prishtnë 2002
Sefer Matja etj., Kimia Analitike (KA-2)Tiranë 2003.

Physical chemistry I

Quantum theory, photo-electric theory, atomic specters, Schrodinger's equation, the method of molecular orbital ion H_2^+; method of molecular orbital for H_2.; molecular orbital spectroscopy,

rotational spectra, oscillation spectra, Raman's spectroscopy, oscillation spectroscopy. Electric properties of molecules, magnetic properties of molecules, energy, first law of thermodynamics, work, second law of thermodynamics, Carnot cycle; the efficiency of converting heat into work, entropy, thermodynamic functions and conditions of equilibrium; Helmholtz free energy, Gibbs free energy; solid solutions, phase diagrams; systems with three components.

Literature:

S .T. Gashi, Kimia Fizike I, Universiteti i Prishinës (2011)
Atkins P.; *The elements of Physical chemistry*, 2nd edition 1996, Oxford University Press Inc., New York, USA.
Fosset B.; Lefrou C.; Masson A.; Mingotaud C., *Chimie physique experimentale*, Hermann 2000, Paris, France.

Organic chemistry I

Structure and properties of organic compounds, alkanes (structure, synthesis, reactions), halogens of alkyls (structure, synthesis, reactions) , organic-metallic compounds, Alkenes (structure, synthesis, reactions), spectroscopy and structure, stereochemistry, alkynes (structure, synthesis, reactions), dienes, alicyclic hydrocarbons, aromatic hydrocarbons(structure, synthesis, reactions).

Literature:

N. Daci,'Kimia Organike', Libri shkollor, Prishtine (2003)
K. Peter C. Vollhardt, N. E. Schore, 'Organic Chemistry-Structure and Reactivity', W. H. Freeman, New York (2003).
F. A. Carey, 'Organic Chemistry', McGraw Hill, New York (2006).

History of chemistry

The origin of the term "chemistry". Epochs of the history of chemistry.
Prehistoric periods. *Alchemy in Western Europe, scholastic era, the end of alchemy.* The period of iatrochemistry. Independent chemistry until the discovery of oxygen. Other important chemists of the 17th century. Evolution of chemistry from the discovery of oxygen until the 19th century.
Development of quantitative research. Three major chemists.
Recent developments in various fields of chemistry until the beginning of the 20th century.
Quick overview of the development of chemistry during the first half of the 20th century. Modern chemistry.
Chemistry and its relation to biology and physics. Chemistry and arts.

Literature:

1. T.Çarçani ; Histori e kimisë Sh.B. " 8 Nëntori" Tiranë 1987
2. D.Grdenić; Povijest kemije, Školska knjiga, Zagreb.2001
3. D.Gerdenic; Alkemija, Novi Liber i Skolska knjiga, Zagreb 2003

Analytical chemistry II

Introduction, volumetric analysis, standard solutions, primary and secondary standard solutions, titration of neutralization, indicators of neutralization, curve of neutralization, neutralization of strong acids with strong bases, neutralization of weak acids with strong bases, neutralization of strong acids with weak bases, neutralization of poly-proton acids with strong bases, titration of precipitation, determination of equivalent point in titration of precipitation, determination of chloride, complex-metric titration, the curve of complex-metric titration, types of titration with EDTA, metallic indicators, redox titration, formal potential, the determination of equivalent point in redox titration, redox titration curves, redox indicators, methods of gravimetric analysis, gravimetric precipitation, colloid precipitation, crystal precipitation, co-precipitation, re-precipitation, occlusion.

Literature:

Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Fundamentals of analytical chemistry, 2004.
J. Mendham, R. C. Denney, J. D. Barnes, M. J. Thomas, Text book of quantitative chemical Analysis, London, 1998.
John Dean, Analytical Chemistry Handbook, New York, 1995.
Feti Zazani, Kimia analitike (Bazat teorike), Tiranë, 1988.

Organic chemistry II

Alcohol and tiols (structure, synthesis, reactions), Ethers and epoxides (structure, synthesis, reactions), Aldehydes and Ketones (structure, synthesis, reactions), carboxylic acids (structure, synthesis, reactions), derivates of carboxylic acids (structure, synthesis, reactions), Amines (structure, synthesis, reactions), phenols (structure, synthesis, reactions), Aril halogenides (structure, synthesis, reactions), polynuclear aromatic compounds (structure, synthesis, reactions), hetero-cyclic compounds (structure, synthesis, reactions), lipids (fat acids and triglycerides, soap and detergents, phospholipids, waxes), Carbohydrates (classification, stereochemistry, reactions, disaccharides, polysaccharides), Amino acids and proteins (structure, reactions, peptides, protein structures) , nucleic acids.

Literature:

N. Daci,'Kimia Organike', Libri shkollor, Prishtine (2003)
K. Peter C. Vollhardt, N. E. Schore, 'Organic Chemistry-Structure and Reactivity', W. H. Freeman, New York (2003).
F. A. Carey, 'Organic Chemistry', McGraw Hill, New York (2006).

Chemistry of polymers

The aim of this course is to study the use of polymers as modern materials which have a very wide use in everyday life during these last centuries. We will learn the basic concepts of monomers, the classification of polymers based on the properties and on reactions of synthesis. We will especially learn about synthetic polymers, describing their properties, synthesis of polymers which are used in industry such as: polyethylene (PS), polystyrene (PE), polyvinylchloride (PVC), etc.

Literature:

1. **The Chemistry of Polymers** (Third Edition),**John W. Nicholson,** RCS publishing, ***2006***
2. **Principles of Polymerization** (Fourth Edition), **George Odian,** John Wiley & Sons, ***2004***

Analytical chemistry III

Basic concepts of spectroscopic techniques: interaction of electromagnetic radiation with the matter, absorption and emission spectrometry based on molecular of UV/VIS zone, absorption and atomic spectrometry emission; principles, analytical and application characteristics; other optical methods; nephelometry, turbidimetry and fluorometry. Measure instruments: emission, absorption, distribution and light diffraction (spectrophotometer, polarimeter, refractometer).

Literature:

D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, 8th Ed., Brooks/Cole, London 2004,
Analytical Chemistry A Modern Approach to Analytical Science, Ed. by R. J.- Mermet, M. Otto, M. Valcarcel, Founding Editors: R. Kellner, H.M. Widmer, Wiley - VCH, Weinheim, 2004.

High course in general and inorganic chemistry

Students with the course of inorganic chemistry will have an opportunity to benefit from the knowledge wave settings and corpuscular microparticle, implementation of Schrodinger's wave equation. Spatial forms and functional orbital waves (s, p, d, f), symbolic and terms of atom symbols (according to functional waves), Hybridizations (in inorganic compounds),

quantum mechanics, valent bonding theory, theory of molecular orbitals. Implementing VBO theory and MOT in the formation of inorganic molecules from H_2 to Ne_2, Multiple chemical bonds in CO and CO_2 by MO theory.

Literature:

1. B. Kamberi, Bazat e teroise se kimise se pergjithshme dhe inorganike, Libri shkollor, Prishtine (1999)

2. KENNETH W. WHITTEN, RAYMOND E. DAVIS, M. LARRY PECK, GEORGE G. STANLEY, Chemistry, Ninth Edition, Brooks/Cole Cengage Learning, 2010

3. S. Nesic, neorganska preparativna kemija, Beograd (1975)

C. Jelacic, hemijska veza i struktura molekula, Zagreb (1992)

Organic Chemistry IV

Reactivity and structure of organic compounds; polar reactions in basic and acidic medium; reactive intermediers; reactions of subsitition, elemination and re-regulation, free radical and catalytic reactions; research of reaction mechanisms according to its product.

Literature:

M. B. Smith, J. A. March, *Advanced Organic Chemistry: Reactions, Mechanism, and Structure*, 6th ed., Wiley, New York (2007).

R. A. Moss, M. S. Platz, M. Jones, Jr. *Reactive Intermediate Chemistry*, Wiley-Interscience, New York (2004).

Chemical Technology

General important materials.Water. Fuels. Lime. Gypsum arising. Cement. Glass. Ceramics. Metallurgy. Pig iron. Steel .. Ferronickel. Copper. Lead. Zinc. Mercury. Aluminum. Inorganic technological chemistry.Liquid air. Hydrogen. Chlorine. Ammonia. Carbon dioxide. Calcium chloride. Acids. Nitric acid, sulfuric acid. Hydrochloric acid. Alkali. Sodium carbonate (calcinated soda). Sodium hydroxide (caustic soda). Artificial fertilizers. Nitrogenous fertilizers. Phosphorus fertilizers. Superphosphate. Potassium fertilizers. Mixed fertilizers (complex). Organic chemical industry and some similar branches. Oil and its derivatives. Mechanical and chemical processing of wood. Technical cellulose. Manufacture of paper. Manufacture of sugar. Fermentation industry. Manufacture of beer. Equipments for washing. Soaps and detergents. Plastic measures. Phenoplast. Chemical cellulose fibers. Synthetic chemical fibers.

Litarature:

1. Dr. Xhevdet Pula, Mr. Luljeta Beqiri, Teknologjia Kimike, Prishtinë 1985.

2. Dr. Dhimitër Haxhimihali, Teknologjia Kimike I , Tiranë 1992.

3. Dr. Dragan Vitorović, Hemijska Tehnologija, Beograd 1990.

Environmental chemistry

Hydrosphere: water, quality, quantity and chemistry. Water analysis, water pollution, types of water pollutants. Trace elements as water pollutants. Algal nutrients in water and eutrophication; pesticides in water; treatment of water; chemical analysis of environment; environmental chemistry of earth and geosphere; nature of earth, earth pollution. Nature and composition of atmosphere, chemical and photochemical reactions in atmosphere, nitrogenous gases in atmosphere; acidic rain, particles matter in atmosphere; photochemical smog, organic pollutants in atmosphere; radioactivity in environment, natural resources of radiation.

Literature:

1.Nexhat Daci, Kimia e mjedisit, Prishtinë, 1998. ASHAK.

2. Stanely E. Manahan, Environmetal Chemistry, fourth edition, Williard Grant press, Boston, 1984.

3. F.W.Filield and P.J. Haines, Environmental Analytical Chemistry, Blackie Academic and Professional, London, 1995.

Study program: Master of Inorganic & Physical Chemistry

First Year, First Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Chemical thermodynamics	Prof. Ass. Dr. Makfire Sadiku	O	2+3	6
2	The chemistry of the complex compounds and their steroisomerism	Prof. Dr. Ismet Hashani	O	2+2	6
3	Electrochemistry	Prof. Dr. Ramë Vataj	O	2+2	6
4	Modern methods for material studies	Prof. Ass. Dr. Avni Berisha	O	2+2	6
5.1	Environmental chemistry	Prof.Ass. Dr. Skender Demaku	E	2+2	6
5.2	Theoretical chemistry	Prof. Ass. Dr. Makfire Sadiku	E	2+2	6

The student has to select one elective subject.

First Year, Second Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Mechanisms of Inorganic Reactions	Prof. Dr. Ismet Hashani	O	2+2	6
2	Physical chemistry of surface phenomena	Prof. Asoc. Dr. Teuta Selimi	O	2+2	6
3	Spectrometric methods in chemistry	Prof. Dr. Ramë Vataj	O	2+2	6
4	Industrial electrochemistry	Prof. Dr. Fetah Podvorica	O	2+2	6
5.1	Inorganic Technology	Prof. Dr. Selim Jusufi	E	2+2	6
5.2	Corrosion and its prevetion	Prof. Dr. Fetah Podvorica	E	2+2	6

The student has to select one elective subject.

Second Year, Third Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Semiconducting and superconducting materials	Prof. Ass. Dr. Avni Berisha	O	2+2	6
2	Chemical kinetics	Prof. Ass. Dr. Makfire Sadiku	O	2+3	6
3	The physical chemistry of the macromolecules	Prof. Ass. Dr. Bashkim Thaçi	O	2+2	6
4	Chemistry of rare elements	Prof. Asoc. Dr. Teuta Selimi	O	2+2	6
5.1	Methods for structure determination of the inorganic compounds	Prof. Asoc. Dr. Musaj Paçarizi	E	2+2	6
5.2	Electrochemical sensors	Prof. Dr. Fetah Podvorica	E	2+2	6

The student has to select one elective subject.

Second Year, Fourth semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Research methodology	Prof. Dr. Tahir Arbneshi	O	2+1	6
2	Master thesis	Elective	O	20	24

The student should work a diploma thesis in any of research group in Inorganic or Physical Chemistry.

COURSE DESCRIPTIONS

Chemical thermodynamic

Introduction and Basic Concepts; First Law of Thermodynamics, Work, Heat, and Energy; Entropy and Second Law of Thermodynamics; Free energy; Phase equilibria of a pure substances; Fugacity; Ideal Solutions; Thermodynamic properties of ideal solutions; Chemical Equilibrium in Solutions; Chemical potentials; Vapor-liquid equilibrium; Chemical Reaction Equilibria.

Literature:

1. *P. W. Atkins, The elements of Physical Chemistry, Oxford Univ, Press, Oxford 1996*
2. *P. W. Atkins, Physical Chemistry 6th ed. Oxford Univ, Press, Oxford 1999*
3. *Robert .G. Mortimer, Physical chemistry, third ed. Elsevier Academic Press, 2008*

The chemistry of the complex compounds and their steroisomerism

In the frame of this subject the students will have the oppurtinity to gain knowledge from the complex compounds, methods of preparations, stereoisomerism of the compounds of type Ma_2b_2, Ma_4, $Ma_2b_2c_2$, $Ma_4b_2M(EN)_2b_2$, Magnetic properties of complexes, description of chemical bonds of complexes by new methods OMT, energy diagram of the bonds at complex compounds, complex compounds zith organic ligands.

Literature:

1. B. Kamberi, Bazat e teroise se kimise se pergjithshme dhe inorganike, Libri shkollor, Prishtine (1999)
2. S. Nesic, Neorganska preparativna kemija, Beograd (1975)
3. C. Jelacic, Hemijska veza i struktura molekula, Zagreb (1992)

Electrochemistry

An introduction in dynamic electrochemistry, faradic and non-faradic processes, the double layer, the double layer capacity, variables affecting the rate of electrode reactions in faradic processes, electron transfer mechanism at electrode surface, The Butler-Volmer equation, standard rate constant, transfer coefficient, the exchange current, current intensity potential equation, Tafel's equation, masse transfer effect on electrodes, masse transfer by diffusion and migration, the effect of supporting electrolyte. Fick's lows and the solutions of diffusion equations. Marcuse's theory for the elcetron transfer, rearrangement energy, mechanisms of multi stage electrode reactions, electrochemical methods applied in electrode kinetics.

Literature:

1. A. Bard, L. Faulkner, "Electrochemical Methods", second edition, John Wiley & Sons, Inc. New York, 2001.
2. P. Zanello, "Inorganic Electrochemistry", RSC, Cambridge, UK, 2003.
3. A. J. Bard, M. Stratmann, ``Encyclopedia of Electrochemistry``, Wiley-VCH GmbH & Co. KgaA, Weinheim, 2003.

Modern methods for material studies

To obtain knowledge on the working principle and the applicability of the most important methods used in materials characterisation. With this knowledge the student will be able to select an appropriate technique for a given characterisation problem as well as an appropriate measurement procedure.

Chemical Analysis and surface Analysis: Electrochemical (potentiometry, coulometry, electrogravimetry and voltammetry) and spectroscopic (atomic and molecular methods such as AAS and XRF), chemical analysis and surface analysis techniques such as RBS, SIMS and XPS.

Microscopy and diffraction: Optical microscopy, Scanning probe microscopy, Electron microscopy (both SEM and TEM).

Literature:

1. P. J. Flewit; R. K. Wild, Physical Methods for Materials Characterisation, 2nd edition, 2001, New York, USA.
2. R. A. Pethrick J. V. Dawkins, Modern Techniques for Polymer Characterisation, 1st edition, Jonh Wiley & Sons, 2007, New York.
3. D. P. Woodruff, T.A. Delchar, Modern Techniques for Surface Science, Cambridge Univ Press, 2007.

Theoretical chemistry

Introduction to Theoretical Chemistry and Chemical Physics; Mathematical Review, Review of Quantum Chemistry Basics; Harmonic Motion; Postulates of Quantum Mechanics; Hermitian Operators; Multidimensional Problems and Degeneracy;Variation Theory; Perturbation Theory; Time Dependence and Transitions, Derivatives of Schrödinger's Equation; Angular Momentum; Vibrational-Rotational Spectroscopy of Diatomic Molecules; Vibrational and Rotational Spectroscopy of Polyatomic Molecules; Molecular Electronic Structure; Computational Methods

Literature:

1. Lewars, Errol G.. Computational Chemistry. Introduction to the Theory and Applications of Molecular and Quantum Mechanics.: 2nd Edition, Kluwer Academic Publishers, 2011 .
2. Turrell, George. Mathematics for Chemistry and Physics: Academic Press,
3. J. Simons, An Introduction to Theoritical Chemistry,Cambridge University Press, 2003,

Mechanisms of Inorganic Reactions

During the presentation of this program the students will gain knowledge about inorganic reactions mechanisms, reactions kinetics, one electron reduction reactions and thier mechanism, two electron reactions, formation of intermediar phases during the inorganic reactions, the SN2 and SN1 reactions mechanism.

Literature:

1. B. Kamberi, Bazat e teroise se kimise se pergjithshme dhe inorganike, Libri shkollor, Prishtine (1999)
2. S. Nesic, neorganska preparativna kemija, Beograd (1975)
3. C. Jelacic, hemijska veza i struktura molekula, Zagreb (1992)
4. G. Gisbert, F. J. Kammer, Structure und Bindung-Atome und Molekule, Leipzig, (1982)

Physical chemistry of surface phenomena

Surface phenomena. Phenomena in the boundary surface liquid / gas (air). Surface tension of the liquid.Surface tension of the solution. Monomolecular Films. Boundary surface phenomena liquid / liquid.Boundary surface phenomena solid / liquid. Wetting. Adsorption from solution at the boundary surface solid / liquid.Molecular adsorption from solution on the surface of solid / liquid.Adsorption in boundary solid / liquid. Adsorption of surface active substances from solution .Surface active materials, washing, flotation.

Literature:

1.John.B.Hadson, Surface Science: An introduction ,1998
2. K.S. Birdi Handbook of Surface and Collid cemistry, 3 th edition, 2008
3.Đaković Lj,Koloidna kemija 1990, Novi Sad
4.L.H. Sperling, Introduction to Physical Polimer Science, 2005

Spectrometric methods in chemistry

Spectrometric technics applied in molecular structure determination, fundamental principles, notions and application. Atomic spectroscopy, atomic absorption and fluorescence spectrometry. Atomic emission spectrometry, masse atomic spectrometry, X ray atomic

spectrometry. Molecular absorption spectrometry (infrared, visible and ultraviolet). Molecular fluorescence and luminescence. Nuclear magnetic resonance. Mass spectrometry. The influence of some parameters on the interpretation of spectra and the finding of the molecule's structure by the different taught technics. Mass spectra of some elements and different class of chemical compounds. Some applications of mass spectrometry.

Literature:

1.Douglas A. Skoog, F. James Holler, Timothy A. Nieman, "Principes d'analyse instrumentale", traduction de 5e édition, 2003, De Boeck, Paris, Bruxelles.

2.Robert M. Silverstein, Francis X. Webster, David J. Kiemle, "Spectrometric Identification of Organic Compounds", seventh edition, 2005, John Wiley & Sons.

3.Francis Rouessac, Annick Rouessac, "Analyse chimique, Méthodes et techniques instrumentales modernes", 6e édition, 2004, Dunod, Paris.

Industrial electrochemistry

Introduction, General concepts, Electrochemical apparatus, electrodes, electrochemical cells, membranes, the nature of electrochemical reactions, industrial production of chlore and potasium hydroxyde, extraction and production metals, production of organic compounds with electrochemical processes, organic electrosynthesis, indirect electrosynthesis, water purification, preparation of metals, corrosion and its monitoring, cells and fuell cells, electrochemical sensors.

Literature:

1. D. Pletcher, F. Walsh, `` Industrial electrochemistry``, 2nd Edition, Chapman & Hall, New York, 1993.
2. W. Plieth, `` Electrochemistry for materials sciences``, 1st Edition, Elsivier Science, New York, 2008.
3. H. Lund, O. Hammerich, "Organic Electrochemistry", Marcel Dekker Inc. New York, 2001.

Corrosion and its prevetion

Corrosion reactions, the thermodynamic of the corrosion reactions, Pourbaix diagrams, the rate of corrosion reactions; uniform corrosion of metals in acidic, neutral and basic media; passivation of metals, alloys and semiconductors, protection from corrosion, inhibitorts, inorganic coatings, organic coatings, electrochemical protection.

Literature:

1. P. Roberge, Corrosion Engineering principles and practice, 2008, New York, USA.
2. D. Landolt, Corrosion et chimie de surfaces des métaux, Ecole Polytechnique federale, Lausanne, 1997.
3. Uhlig's Corrosion Handbook , New York 2005.

Semiconducting and superconducting materials

Electronic materials, Ohm's law and electrical conductivity, Band structure of solids, Conductivity of metals and alloys, Semiconductors, n-type Semiconductors, p-type Semiconductors, Application of semiconductors, Integrated circuit processing, Deposition of thin films, Magnetic materials, Diamagnetic and superparamagnetic materials, Photonic materials, Refraction/Reflection/Absorption and Transmission, Examples and the use of emission phenomena, Superconducting materials, synthesis and their properties.

Literature:

1. The science and engineering of materials, Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, CL Engineering; 6 edition (2010)
2. Fundamentals of Semiconductor Manufacturing and Process Control, Wiley-IEEE Press; 1 edition, (2006)
3. S. M. Sze; M. K. Lee, Semiconductors devices, 1st edition, John Wiley & Sons, 2012, New York.

Chemical kinetics

Formal kinetics and kinetics of nonreversible first and second order reactions; third, n and zero order nonreversible reactions and methods for determination of the reaction order; complex reactions; consecutive and parallel reactions, chemical induction; the temperature dependence of rate constants; reactions in flow; Activated complex theory; kinetics of chain reactions; photochemical reactions; catalyst; activated adsorption; isotherms of adsorption.
Literature:

1. P. W. Atkins, The elements of Physical Chemistry, Oxford Univ, Press, Oxford 1996
2. P. W. Atkins, Physical Chemistry 6th ed. Oxford Univ, Press, Oxford 1999
3. Robert .G. Mortimer, Physical chemistry, third ed. Elsevier Academic Press, 2008

The physical chemistry of the macromolecules

Chemical strukture of monomers and polymers, Types of polymerisation reactions, Polymerisation techniques, chemical degradation, molecular mass of polymers, Morphology of polymers, termic properties of polymers, mechanical properties of polymers, Rheology of polymers, Electrical peoperties of polymers, thermodinamics of polymer solutions, polymer mixtures, permeability of gases in polymers.

Literature:

1. Physical Chemistry of macromolecule, second edition , S. F. Sun, St. John's University Jamaica, New York, 2004.
2. Bailey R.T. North A.M and Pethrich R.A. Molecular notion in high polymers, Clarendon Press, Oxford 1981
3. E.A Collins,J.Bares and F.W.Billmeyer,Jr., Experiments in Polymer Science,john Wiley and Sons,New York,1973.

Chemistry of rare elements

Properties of rare metals. Classification of rare elements. Technological processes of rare elements.W , Mo, Ti, properties, compounds. Zr, V, Nb compounds Ta, Re,-, properties, U-, properties, compounds and selected applications. Ge, Ga., properties, compounds. In, Tl, properties, compounds. Se, Te, properties, compounds.Be, Li, properties ,compounds. Rb compounds, Cs properties, compounds and technological aplications.
Literature:

1.N.E.Topp,The chemistry of the rare-earth elements,Elsevier Pub.Co 1965
2.Ahmeti Xh., Kimia inorganike (përkthim) 1997, Prishtinë
3.Steven S.Zumdahl,Susan A. Zumdahl, Chemistry,Cengage Learning 2008

Methods for structure determination of the inorganic compounds

In the frame of this subject the students will have the oppurtinity to gain knowledge from methods of determining the structure of inorganic compounds. These will be elaborate, Electromagnetic spectra, UV-VIS spectroscopy, IR spectrophotometry, X-ray spectroscopy, nuclear magnetic resonance (NMR) spectroscopy.
Literature:

1. Çullaj, A: Metoda instrumentale të analizës kimike, Shtëpia Botuese e Librit Universitar, 2004, Tiranë,.
2. Kenneth J. H. Phillips : Ultraviolet and X-ray Spectroscopy of the Solar Atmosphere Cambridge University Press, 2009
3. R. Macomber : A Complete Introduction to MODERN NMR spectroscopy, 1997

Electrochemical sensors

The subject is intended to introduce the students whith the basics, construction and applicability of sensors in analytical and bioanalytical analysis. Will be described important chemical sensors like: electrochemical sensors for NO determination, electrochemical sensors

for H_2S determination, glucose biosensors, biosensors for pesticide determination, ion-selsective electrodes, etc.

Literature:

1. Electrochemical sensors, biosensors and their biomedical applications, X. Zhang, H. Ju, J. Wang, Elsevier (2008)

2. Electrochemical Sensor Analysis, Volume 49 (Comprehensive Analytical Chemistry); Elsevier Science (2007)

3. D. Pletcher, F. Walsh, `` Industrial electrochemistry``, 2nd Edition, Chapman & Hall, New York, 1993.

Study program: Master of Analytical & Environmental Chemistry

First Year, First Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Quality Analytical Control	Prof. Dr. Selim Jusufi	O	2+3	7
2	Advanced Analytical Chemistry	Prof. Asoc. Dr. Naser Troni	O	2+2	6
3	Green Chemistry	Prof. Ass. Dr.Skender Demaku	O	2+1	5
4	Sensors in Analytical Chemistry	Prof. Dr. Mujë Rugova	O	2+3	7
5.1	Analyses of Real Samples	Prof. Asoc. Dr. Naser Troni	Z	2+1	5
5.2	Analytical Chemistry of Complex Compounds	Prof. Asoc. Dr. Fatbardh Gashi	Z	2+1	5

The student has to select one elective subject.

First Year, Second Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Electroanalytic Methods	Prof. Asoc. Dr. Fatbardh Gashi	O	2+2	6
2	Chromatographic Methods	Prof. Dr. Tahir Arbneshi	O	2+3	7
3	Operational Techniques	Prof. Asoc. Dr. Fatmir Faiku	O	2+2	6
4	Pollution and Treatment of Waste Waters	Prof. Ass. Dr. Ilir Shehu	O	2+2	6
5.1	Solvent Chemistry	Prof. Asoc. Dr. Fatmir Faiku	E	2+1	5
5.2	Modern Methods in Trace Elements Analysis	Prof. Asoc. Dr. Naser Troni	E	2+1	5

The student has to select one elective subject.

Second Year, Third Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Radiochemical Methods of Analyses	Prof. Asoc. Dr. Naser Troni	O	2+2	6
2	Chemometric Analyses	Prof. Asoc. Dr. Fatbardh Gashi	O	2+1	5
3	Spectroscopic Methods of Chemical Analyses	Prof. Ass. Dr. Avni Berisha	O	2+3	7
4	Chemical Toxicology	Prof. Ass. Dr. Ilir Shehu	O	2+2	6
5.1	Environmental Analytical Chemistry	Prof. Asoc. Dr. Fatbardh Gashi	E	2+1	6
5.2	Extraction Techniques	Prof. Asoc. Dr. Fatmir Faiku	E	2+1	6

The student has to select one elective subject.

Second Year, Fourth semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Research methodology	Prof. Dr. Tahir Arbneshi	O	2+1	6
2	Master thesis	Elective	O	20	24

The student should work a diploma thesis in any of research group in Analytical or Enveronmental Chemistry.

COURSE DESCRIPTION

Advanced Analytical Chemistry

Chemical equilibriums and application of law of the mass action in protolithic reactions. Thermodynamics in homogenous and heterogeneoussystems.Thermodynamic constants of chemical reaction.Stoichiometric constants of chemical reaction.A systematic method for performing equilibrium calculations. Mass balance Equations. Charge balance equations. Chemical analytic characterisation of inorganic and organic analytes. Chemical reactions applied in analytic chemistry. Sensitivity and selectivity.New theories and classification of acids and bases.Theory of neutralisation in chemical reactions.Polyfunctional acids and bases.Titration curves for complex acid/base systems. The chemical reaction of precipitate.Titration curve for argentometric methods. The principles ofsystematic qualitative and quantitative analyses in chemical analyses. Separations of cations and anions with chemical reagents.Separation ofions by control of the concentration of a precipitating reagent.The theory of redox reactions.Equilibrium constants for oxidation reduction reactions (permanganometricand bromatometric methods).Potentiometric titrations of mixtures. Complex formation in chemical reactions in homogenous and heterogeneous systems. Classification of chemical analyses (micro analyses).

Literature:

Skoog /West/ Holler, Fundamentals of Analytical Chemistry. Sixth Edition
Skoog /West/ Nieman, Principles of Instrumental Analyses. Fifth Edition.
Mustafë R. Bacaj, Kimia Analitike I (KA-I) Prishtnë 2002
SeferMatjaetj., Kimia Analitike (KA-2)Tiranë 2003.
I. Filipovic P. Sabioncello: Laboratorijskiprirucnik I dioknjiga II
W.L. Masterton and E.J. Slowinski, Chemical Principles with Qualitative Analysis, London, 1978.

Radiochemical Methods of Analyses

The structure of atom.Types of radioactive emissions.Emission of alpha particles.Beta emission.Gamma emission.Theoretical and practical principles of radiometric methods.Radioactive elements and radioactive isotopes.Atomic reactor.The conservation ofradioactive waste.Generation of radioactive isotopes.The different techniques for detection and measurement of radioactivity and their applications.Neutron activation methods.Radioactive neutron source.Characterisation of nuclear reactions.Interaction of radioactivity with matter.Interaction of radioactivity with surround, detection and protection from radioactive emission.Isotopic reactions.Isotope ilution method.Radio nuclear chemistry.Radiochemistry of radio tracers.Radioactive titrations.Stable isotopes.Water as a future carburant. Radioactive family's. Radiochemistry of natural samples.Use of radioactive isotopes for human purposes.etc.

Literature:

1. I. Filipovic P. Sabincello: LaboratorijskiprirucnikPjesa e I, Librii II^{-te}.
2. D.A.Skoog, DM. West and F.J. Holler; Foundamentals of analytical Chemistry, NewYork- London 1992.
3. Michael Munowitzh : Principles of Chemistry 2000. USA, First edition.
4. G. Friedlander and J.W. Kenedy; Nuclear and Radiochemistry, libër I përkthyer nga Univ. Beogradit.
5. D.A.Skoog, F.J. Holler and T.A. Nieman; Principles of Instrumental Analyses, Fifth Edition 1998

Operational Techniques

Suitable operational techniques in chemical analysis, General remarks from laboratory work, Laboratory notebook, Sampling with real samples. Drying process of samples in laboratory, The statement of water in solid compounds, sample weights, precipitation as physical

chemical process, coo precipitation mass in precipitates. Precipitation in presence of H_2S, filtration, vacuum filtration, filtration under pressure, in situ filtration, centrifugation.
Cooling process of precipitates and storage of them in dry place (preservation of samples). Washing, drying and ignition process of precipitates. Drying and calcination of precipitates in filtered pots. Evaporation (volatilization) of H_2SO_4, Operational techniques in volumetric methods. Clean of glass volumetric flasks. Calibration of volumetric flasks. Use special burets and burets for measurements. The classification of methods for separation.

***Literature*:**

Kolthoff, Sandell, Anorganska kvantitativna analiza, Beograd, 1963.
Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Fundamentals of Analytical Chemistry, 2004.
J. Mendham, R. C. Denney, J. D. Barnes, M. J. Thomas, Text Book of Quantitative Chemical Analysis, London, 1998.

The Chemistry of Solutions

The nature of solutions, Concentration, The solution of gasses in liquid, Solution of liquid in liquid, The effect of temperature in solubility, The effect of pressure in solubility, Electrolytes, Non electrolytes, Colligative properties of solutions, Lowering the vapor pressure of the solvent, Increasing of boiling points, Decreasing of melting points, Osmosis and the osmotic pressure of solution, The effects of electrolytes in colligative properties, Colloidal solutions, Coagulation of colloids, Peptization of Colloids, The equilibrium in homogenous systems, Equilibrium in heterogenius systems (the system solid-gas, the system solid-liquid, the system liquid-gas), Equilibrium in the electrolytic solutions, Equilibrium in the acidic and basic solution, Equilibrium in the solution of Complexes, Redox Equilibrium.

Literature:

1. Ivan Filipoviq, StjepanLipanoviq, Kimia e përgjithshmedheinorganike (pjesa I, Prishtinë, 1996.
2. BedriKamberi, Bazatteorikesëkimisëtëpërgjithshmedheinorganike, Prishtinë, 1997.
3. Holtzclaw Robinson, General Chemistry, Massachusetts, 1988.

The Analyses of Real Samples

The analyses of real samples.Sampling procedures.Conservation, package and storage of samples.Filtration of samples under pressure. Sampling in homogeneous of liquids and gases.The determination of water in samples.Aqua reagents for dissolving or decomposing samples.Qualitative and quantitative analyses of real samples. Decomposition of bioorganicsamples by ignition. Decomposition of organic compounds for elemental analyses.The nature of separation methods.Separation by precipitation. Separation by extraction. Trace organic compounds.Analysis of analyst and their compounds in biological samples. Analytical aspects of sampling, storage and sample preparation of organic materials. Storage for determination of trace elements.Chemical speciation and characterisation of analytes in chemical samples.Application of some complex compounds as collector. (extraction with chelates). Application of redox substances for decomposition of samples in chemical analyses.

Literature:

1. K. Grashoff., K Kremling., M. Erhardt. Methods of Seawater Analyses.Weinheim Germany 1999.
2. D.A.Skoog, DM.West and F.J. Holler; Foundamentals of Analytical Chemistry, New York- London 1992.
3. D.A.Skoog, F.J. Holler and T.A. Nieman; Principles of Instrumental Analyses, Fifth Edition 1998.
4. W.L. Masterton and E.J. Slowinski, Chemical Principles with Qualitative Analysis, London, 1978.
5. I. Filipovic P. Sabioncello: Laboratorijskipririrucniklibrii II-të

The Extraction Techniques

Definition and classification of methods for separation, Sample preparation, Extraction methods, The distribution coefficient, Types of extraction, Simple extraction, Application of extraction procedures, The extraction separation of metal ions as chelates, The effect of pH and reagent concentration on distribution ratios, Extraction with diphenylthiocarbazone, Extraction with 8-hydroxyquinolate, Extraction with other chelating agents, The extraction of metal chlorides, The extraction of nitrates, Liquid-liquid extraction, Liquid-solid extraction, Solid-liquid extraction, Supercritical extraction technique "Head-space".

Literature:

C. E. Meloan, Chemical Separation, principles, techniques, and experiments, John Wiley & Sons inc, New York, 1999.

Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Fundamentals of analytical chemistry, 2004.

Analytical Control of Quality

The module „Analytical control of quality“ as a theoretical compilation of materials which enables students to learn about the importance of systematical and multidisciplinary approach to chemical analysis. During this course the student will learn about: Assurance of quality and the determination of quality in chemical analysis. Division of methods of quantitative analysis. Errors in chemical analysis. Correctness. Precision. Standard experimental deviation (s). Variability s^2. Relative standard deviation (RSD). Distance (w). Absolute error. Relative error. Types of errors in experimental results. Systematic errors. Major errors. Eventual errors. Methods for the presentation of analytical errors. Statistic processing of results. Statistic processing of eventual errors. Usage of statistics. Q test. T_n test. Usage of statistics for proving the correctness of hypothesis. Comparison of experimental value to the real value. Comparison of the two experimental averages. The system of quality. Quality management. Elements of the system of quality. Quality assurance in analytical laboratories. Principes of assuring the quality of measurable data (parameters). Quality control. Documentation. Validation. Quality assessment. Accreditation of laboratories.

Literature:

1. Allqi Çullaj, Sigurimi I cilësisë dhe kontrolli i cilësisë në analizat kimike, Tiranë 2002

2. Marija Kaštelan-Macan, Kemijska Analiza u sustavu kvalitete, Školska Knjiga - Zagreb, 2003.

3. J.N. Miller and J.C. Miller, Statistics and Chemometrics for Analytical Chemistry, Prentice Hall, London, 2000.

4. J.K. Taylor, Quality Assurance of Chemical Measurements, Lewis Publishers, Inc., Michigan, 1988.

Chemical Sensors in Analytical Chemistry

Introduction to principles of chemical sensig; Signal transduction; Physico-chemical and biological transducers; Sensor types and technologies. Terminology and working vocabulary; Main technical definitions: calibration, selectivity, sensitivity, reproducibility, detection limits, response time; Problems and trade-offs. Thermal sensors; electrochemical sensors (amperometric, potentiometric, conductimetric); Semiconductor transducers (ISFET, ENFET); Optical transducers (absorption, fluorescence, bio/chemiluminescence, SPR); Piezoelectric and acousticwave transducers. ***Biochemical sensors.*** Enzymes; Oligonucleotides and Nucleic Acids; Lipids, Membrane Receptors and transporters; Immunoreceptors; Catalytic biosensors: mono-enzyme electrodes; bi-enzyme electrodes: enzyme sequence electrodes and enzyme competition electrodes.

Literature:

1. Principles of Chemical and Biological Sensors, D. Diamond Editor, John Wiley& Sons, 2000.
2. Chemical Sensors and Biosensors, Brian Eggins, John Willey & Sons, 2002.

3. Sensors, Nanoscience, Biomedical Engineering, and Instruments. Richard Dorf Editor, CRC Taylor & Francis, 2006.
4. Optical Biosensors. Present & Future. Editors: F. Ligler, C. Rowe Taitt, Elsevier, 2002.
5. Introduction to Bioanalytical Sensors, Alice Cunningham, John Wiley& Sons, 1998.
6. Chemical Sensors and Biosensors for Medical and Biological Applications, Ursula Spichiger-Keller,Wiley-VCH, 1998.

Chromatographic Methods

Modern techniques for analytical separations will be examined both individually and collectively in terms of basic theory and practical application. The course focuses primarily on the theory of separations, analytical gas chromatography (especially high resolution capillary GC), and modern high performance liquid chromatography (especially reversed phase LC). Time permitting, GC/MS and LC/MS will also be covered briefly. Discussion covers the driving force of each technique, instrumentation, factors influencing quality of separation, and interpretation of results.

Literature:

C. E. Meloan, Chemical Separation, principles, techniques, and experiments, John Wiley & Sons Inc, New York, (1999).
D. Harvey, Modern Analytical Chemistry, McGraw-Hill, Boston, (2000).
S. Ahuja, Handbook ofBioseparations, Academic Press, California, (2000).
James M. Miller Chromatography - Concepts and Contrast, John Wiley, (2005).

Research Methodology

Introduction to research methodology, definition of research, characteristics of research, types of research, the research process, formulating research problem, reviewing the literature.
Literature of Chemistry. Primary sources – journals and patents, secondary resources, listing of titles, abstracts, CA, collective indexes, bielstein, compendia and tables of information, reviews, annul reviews, awareness service, general treatise, monographs on specific areas, text books, other books, Literature searching : (i) Using printed materials; (ii) Searching on – line ; Database, Scifinder, Scopus, CA on CD; Locating research article; Citation Index, Impact Factor Writing scientific report, planning, preparation, draft, revision and refining; Writing project proposal to funding agency; Paper writing for international journals, submitting to editors. Conference presentation; preparation of effective slides.

Literature:

1. Martha Davis, Kaaron Joann Davis, Marion Dunagan: Papers *and* Presentations, (International Edition) *Academic Press*,
2. R. Botlle, The Use of Chemical Literature, Butterworths, London, 1982.
3. J. Ash, E. Hyce, Chemical Information System, J. Willey & Sons New York. 1985.

Spectroscopic Methods of Chemical Analyses

Structural characterization of organic compounds based on spectrometric modern methods. Fundamental principles of spectrometry. Mas Spectrometry,IR Sprctrometry, Principple and function of IR Spectrometer. NMR Spectrometry. Aplication of twodimensional and threedimensional NMR Spectrometry in organic and bioorganic chemistry. Corelation chemical chifts (COSY, RELAYH, HETCOR and others).

Literature:

1. R. M. Silverstein, F. X. Webster, D. J. Kiemle, Spectrometric Identification of Organic Compounds, (seventh ed.), John Willey & Sons Inc. New York, 2005.
2. Eds. W. R. Croasmun, R. M. K.Carlson,Two-dimensional NMR Spectroscopy, Applications for Chemists and Biochemists, VCH, Weinheim, 1994
3. M. Hesse, H. Meier, B. Zeeh, Specrometric methods in Organic Chemistry, Georg Thieme Verlag Stuttgart, New York. 1997.

Study program: Master of Organic Chemistry

First Year, First Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Physical-Organic Chemistry	Prof. Ass. Dr. Arleta Rifati	O	2+2	6
2	Stereochemistry of Organic Compounds	Prof. Asoc. Dr. Ramiz Hoti	O	2+3	7
3	Chemistry of Natural Organic Products	Prof. Asoc. Dr. Sevdije Govori	O	2+2	6
4	Heterocyclic Chemistry	Prof. Asoc. Dr. Sevdije Govori	O	2+2	6
5.1	Chemistry of Syntetic Polymers	Prof. Ass. Dr. Arleta Rifati	E	2+1	5
5.2	Photochemistry	Prof. Asoc. Dr. Sevdije Govori	E	2+1	5

The student has to select one elective subject.

First Year, Second Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Advanced Organic Chemistry	Prof. Asoc. Dr. Ramiz Hoti	O	2+2	6
2	Mechanisms of Organic Reactions	Prof. Asoc. Dr. Sevdije Govori	O	2+3	7
3	Organic Chemical Technology	Prof. Dr. Selim Jusufi	O	2+2	6
4	Metabolism of Biochemical Molecules	Prof. Dr. Nevzat Aliaga	O	2+2	6
5.1	Pharmaceutical Chemistry	Prof.Ass. Dr. Arben Haziri	E	2+1	5
5.2	Aplication of Isotopes in Organic Chemistry	Prof. Ass. Dr. Arleta Rifati	E	2+1	5

The student has to select one elective subject.

Second Year, Third Semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Modern Methods of Organic Syntheses	Prof. Ass. Dr. Arben Haziri	O	2+3	7
2	Chromatographyc Methods	Prof. Dr. Tahir Arbneshi	O	2+2	6
3	Spectroscopy of Organic Compounds	Prof. Asoc. Dr. Ramiz Hoti	O	2+2	6
4	Analyse of Organic Compounds	Prof. Asoc. Dr. Majlinda Daci	O	2+2	6
5.1	Chemistry of Coal	Prof. Asoc. Dr. Majlinda Daci	E	2+1	5
5.2	Chemistry of Narkotics	Prof. Ass. Dr. Arben Haziri	E	2+1	5

The student has to select one elective subject.

Second Year, Fourth semester

Nr	Subject	Instructor	O/E	Hours	ECTS
1	Research methodology	Prof. Dr. Tahir Arbneshi	O	2+1	6
2	Master thesis	Elective	O	20	24

The student should work a diploma thesis in any of research group in Organic Chemistry.

COURSE DESCRIPTION

Physical Organic Chemstry

Structure and chemical bonding, Quantum mechanics, Electronegativity, Modern bonding theories, Atoms and molecules, Bonding length and angles, Molecule attraction, Acids and bases, Carbon hybrid orbital, Nitrogen and oxygen hybrid orbital, Rezonance, Chemical reactivity and molecular structure, Protonik acids and bases, Resonance effect, electronic effects, Steric effect, tautomerization, Organic reactions, Terminology and classification, Polar reactions, Radical reactions, Pericyclic reactions. Organic reactions, rate of reactions and equilibra.

Literature:

1. Seyhan Ege, Organic Chemistry, Structure and Reactivity, 3rd edition, D.C.Heath, Lexington, 1994.
2. N.M.Daci, Kimia Organike, botimi i tretë, Libri Shkollor, 2003, Prishtinë.
3. G. Marc Loudon, Organic Chemistry, 3rd edition, The Benjamin Cummings Publishing Company, Inc., California, 1995.
4. Hendrikson – Cram – Hamond, Organic Chemistry, Mc Graw –Hill Book Company, New York, 1986

Stereochemistry of Organic Compounds

Goal of the course: Stereochemistry is chemistry in dimensions. Our major objectives are to develop a feeling for molecules as threedimensional objects. Through these course students can study properties of organic compouns and stereospecific and stereoselective reactions. Students can enlarge their teoritical and practical knowledge of organic chemistry and to hold new methodes of stereoselective syntheses of organic compounds.

Content: Stereoisomers and their structure. Molecular symmetry in achiral molecules, elements of symmetry, operations and groups of symmetry (homotopic and heterotopic groups, enantiotopic and diastereotpic groups). Asymetric syntheses. Important biological stereoisomeric systems, chirality of supramolecular systems.

Literature:

1. E. L. Eliel, S. H. Wilen, Stereochemistry of Organic Compounds, Willey Interscience, New York, 1994
2. Clayden, Greeves, Warren and Wothers, Organic Chemistry, Oxford Univ. press, 2001
3. John McMurry, **Organic Chemistry**, Brooks/ColeCengage Learning, 2012, Canada, Australia, JAPAN, korea, Mexico, Singapore, Spain, United Kingdom, USA.

Chemistry of Natural Organic Products

Carbohydrates, structure and classification. Glycosides. Disaccharides and polysaccharides. Reactions of carbohydrates. Lipids, glycolipids, prostaglandins. Terpenes. Steroids. Alkaloids. Isolation of natural products and their chemical determination. Identification, structure characterization and their biological application.

Literature:

1. Raphael Ikan.,*Selected Topics in the Chemistry of Natural Products*, World Scientific Publishing Co Pte Ltd, Singapore, **2007**.
2. Stephen P. Stanforth: *Natural product chemistry at a glance*, Blackwell Publishing Ltd, **2006.**

Heterocyclic chemistry

Nomenclature of heterocyclic compounds. Structure and reactivity of heterocyclic compounds. Tautomerism. Classification of heterocyclic compounds. Three-membered rings, four-membered rings, five-membered rings, six-membered rings. Some polycyclic heterocycles. Application of heterocyclic compounds with significant physiological activity.

Literature:

1. J.A.Joule& K.Mills., Heterocyclic Chemistry,4th Ed, Wiley, 2008
2. G. W. Gribble and J. A. Joule, Progress in Heterocyclic Chemistry, Elsevier, Oxford, UK, **2009**
3. Katritzky, A. R. and Pozharskii, A. F., Handbook of Heterocyclic Chemistry, 2nd edn, Pergamon Press, Oxford, **2000**

Advanced Organic Chemistry

Goal of the course: Organic Chemistry is chemistry of carbon compounds. Our major objectives are learning the structure of organic compounds and relationship with their properties. Through these course students can study properties of organic compouns and their reactions. Students can enlarge their teoritical and practical knowledge of organic compounds and to hold new methodes for syntheses of organic compounds.

Content: Structural determination of organic compounds. Types of organic chemical reactions. Substitution reactions, adition reactions, elimination reactions, rearangement reactions. Study of reactivity of organic molecules and relationship with their strycture.

Literature:

1. Francis A. Carey, Richard J. Sundberg, Advanced Organic Chemistry, (Fourth Ed.), Kluver Academic/Plenum Publishers, New York, Boston, Dordrecht, London, Moscow, 2000.
2. Clayden, Greeves, Warren and Wothers, Organic Chemistry, Oxford Univ. press, 2001
3. John McMurry, Organic Chemistry, Brooks/ColeCengage Learning, 2012, Canada, Australia, JAPAN, korea, Mexico, Singapore, Spain, United Kingdom, USA.

Mechanism in Organic Reactions

The structure and reactivity of organic compounds. Polar reactions in acidic and basic conditions. Reactive intermediate. Substitution and elimination reaction,mechanism. Rearrangements reaction mechanism. Reactions of free radicals. Catalytic reactions . Pericyclic reactions.

Literature:

1. M. B. Smith, J. A. March, *Advanced Organic Chemistry: Reactions, Mechanism, and Structure*, 6th ed., Wiley, New York (2007).
2. R. A. Moss, M. S. Platz, M. Jones, Jr. *Reactive Intermediate Chemistry*, Wiley-Interscience, New York (2004).

Organic Chemical Technology

The module of Organic Chemical Technology affords students to known fundamental principples and processes of organic chemical technology. Throught these course students can study about carburants, their refinment and employment.CoalTechnology. Fuel and their technology. Octan nummber, lubrificants. Chemical treatment of wood. Fabrication of letter and cellullose. Plastases. Hygienic products. Mineral pigments minerale (colors). Soaps and detergents. Explosives. Technology of sucrose, wine, fermentation products and technology of fats.

Literature*:*

1. A. Malja, M. Frashëri, H. Bimbashi, Teknologjia kimike 2, shblu, Tiranë 1995.
2. H. Haxhi, Teknologji kimike organike I-IV, Tiranë 1972.
3. J. H. Perry, Chemical Eengineers Handbook, London 1990.

Metabolism of biochemical molecules

Metabolism of nucleic acid, nucleotide structure, purine and pyrimidine bases, nucleotides and nucleosides, purine nucleotide synthesis, synthesis of pyrimidine nucleotides, synthesis of deoxy ribonucleotides. Hydrolysis of purine nucleotides, Synthesis and hydrolysis of pyrimidine bases, Synthesis of ATP and GTP, Synthesis of UTP, CTP and TTP, hydrolysis of

ATP, GTP, UTP, CTP and TTP, RNA synthesis, DNA synthesis, RNA Hydrolysis Hydrolysis of DNA.

***Literature*:**

1) D. E. Metzler, Biochemistry, the chemical reaction on living cells, (second ed.), Elseiver Academic Press, 2005
2) N. Aliaga "Biokimia" F.SH.M.N 2008 Prishtinë
3) N. Aliaga " Praktikumi i Biokimisë Eksperimentale me Bromatologji" Prishtinë, 2006
4) P.Karlson"Biokemija"
5) Cal. Mc. Lughlin, V.E. Reichendecher,"Biochemistry"USA

Modern Methods of Organic Synthesis

Synthetic design, Retrosynthetic design, Steps in planning synthesis, Choice of synthetic methods, Domino reaction, Computer retrosynthetic analysis, Stereo chemical consideration in planning synthesis, The concept of protection functional groups, Transformation of functional groups, Formation of C-H bonds, Formation of C-C bonds, Organometallic reagents, Formation of C=C bonds, Formation of triple CC bonds, Formation of C-X bonds, Formation of C-O bonds, Formation of C=O bonds, Formation of C-N bonds, Formation of C=N bonds, Formation the bonds between C and S, Synthetic methods of heterocyclic compounds, Synthetic methods for carbocyclic systems, Protein synthesis, Oligonucleotides synthesis,

Literature:

1. G. S. Zweifel, M. H. Nantz,'Modern Organic Synthesis', W. H. Freeman, New York (2007)
2. K. Peter C. Vollhardt, N. E. Schore, 'Organic Chemistry-Structure and Reactivity', W. H. Freeman, New York (1999).

Chromatographic Methods

Modern techniques for analytical separations will be examined both individually and collectively in terms of basic theory and practical application. The course focuses primarily on the theory of separations, analytical gas chromatography (especially high resolution capillary GC), and modern high performance liquid chromatography (especially reversed phase LC). Time permitting, GC/MS and LC/MS will also be covered briefly. Discussion covers the driving force of each technique, instrumentation, factors influencing quality of separation, and interpretation of results.

Literature:

1. C. E. Meloan, Chemical Separation, principles, techniques, and experiments, John Wiley & Sons Inc, New York, (1999).
2. D. Harvey, Modern Analytical Chemistry, McGraw-Hill, Boston, (2000).
3. S. Ahuja, Handbook of bioseparations, Academic press, California, (2000).
4. James M. Miller Chromatography - Concepts and Contrast, John Wiley, (2005).

Spectroscopy of Organic Compounds

Goal of the course: Structural characterization of organic compounds is based on spectrometric modern methods. Our major objectives are learning about spectrometric methods of analyses and their application for structure determination of organic and bioorganic molecules. Through these course students can study principples of spectrometric methods including twodimensional and thridimensional NMR Spectrometric methods.

Content: Fundamental principles of spectrometry. Mas Spectrometry,IR Sprctrometry, Principple and function of IR Spectrometer. NMR Spectrometry. Aplication of twodimensional and threedimensional NMR Spectrometry in organic and bioorganic chemistry. Corelation chemical chifts (COSY, RELAYH, HETCOR and others).

Literature:

1. R. M. Silverstein, F. X. Webster, D. J. Kiemle, Spektrometric Identification of Organic Compounds, (seventh ed.), John Willey & Sons Inc. New York, 2005.
2. Eds. W. R. Croasmun, R. M. K.Carlson,Two-dimensional NMR Spectroscopy, Applications for Chemists and Biochemists, VCH, Weinheim, 1994
3. M. Hesse, H. Meier, B. Zeeh, Specrometric methods in Organic Chemistry, *Georg Thieme Verlag* Stuttgart, New York. 1997.

Analysis of Organic Compounds

Goal of the course: students can offer required information about methodes of analyses of organic compounds, especialy about chemical methodes based in characteristic functional group reactions and instrumental methodes also.

Content: Chemical analysis, elemental analysis of organic compounds, Qualitative and quantitative analysis. Characteristic reactions of functional groups. Instrumental methodes of analyses. Planning and achievenment of analyses of organic compounds.

Literature:

1. R. L. Shriner, R. C. Fuson, D. Y. Curtin, T. C. Morrill, The Systematic Identification of Organic Compounds: *A Laboratory Manual*, 6th ed. New York: John Willey 1980
2. A. Vogel, Vogel-s Textbook of Practical Organic Chemistry, Including Organic Analysis, 5th ed. London: Longman Group Ltd., 1989.
3. Donald L. Pavia, Gary M.Lampman, George S. Kriz, Randall G. Engel
4. Introduction to Organic Laboratory Techniques, (a small scale approach) *(First Edition), Saunders College Publishing, 1998*, Fort Worth, Philadelphia, San Diego, New York, Orlando, Austin, San Antonio, Toronto, Montreal, London, Sydney,Tokyo.
5. R. M. Silverstein, F. X. Webster, D. J. Kiemle, Spectrometric Identification of Organic Compounds, JohnWilley& Sons, Willey International Edition, New York, 2005.

Research methodology

Introduction to research methodology, definition of research, characteristics of research, types of research, the research process, formulating research problem, reviewing the literature.
Literature of Chemistry.
Primary sources – journals and patents, secondary resources, listing of titles, abstracts, CA, collective indexes, bielstein, compendia and tables of information, reviews, annul reviews, awareness service, general treatise, monographs on specific areas, text books, other books,
Literature searching :
(i) Using printed materials; (ii) Searching on – line ; Database, Scifinder, Scopus, CA on CD; Locating research article; Citation Index, Impact Factor
Writing scientific report, planning, preparation, draft, revision and refining; Writing project proposal to funding agency; Paper writing for international journals, submitting to editors. Conference presentation; preparation of effective slides.

Literature:

1. Martha Davis, Kaaron Joann Davis, Marion Dunagan: Papers *and* Presentations, (International Edition) *Academic Press*,
2. R. Botlle, The Use of Chemical Literature, Butterworths, London, 1982.
3. J. Ash, E. Hyce, Chemical Information System, J. Willey & Sons New York. 1985

Chemistry of synthetic polymers

Polymers and their importance, meaning and separation of synthetic polymers, polymerization by additional reactions, polymerization by polikondensation reactions, Formation of polyamindes, Formation of phenolplastes, synthetic polyamide fibres (polysteric fibres, acrylic, poliuretane, polycarbonate , polypropylene, polyanylate fibres), as a separate

material of nanotechnology, separation of polymers based on their physico-chemical properties, thermoplastic polymer (plastomer), termostabil polymers (duromer), elostomer polymers.

Literature:

1) John MCMurry "Organic Chemistry", International Student Editional 2004. Brooks/Cole.
2) Extrusion of polymers: theory and practice / Chan I. Chung. – Munich: Hanser; Cincinnati: Hanser/Gardner, 2000.

Photochemistry

General principles of photochemistry, exiting electronic state: electronic configuration, vibrational and spin. Rules which includes electronic transitions: radial transitions: apsorption and emission, Co-efficient apsorption, radial values, Quantic yield, Nonradial transitio, Internal converting, Energy transpher, electronic transpher , Theory of photoreaction, Aplication of photochemical principples, Light as a synthetic agent (laboratoric and industrial), Photosynthese and artificial preserving of solar energy.

Literature:

1. Principles of Molecular Photochemistry: An Introduction, N. J. Turro, V. Ramamurthy and J. C. Scaiano, University Science Books: Mill Valley, CA, 2008.
2. Advances in Photochemistry (Series).
3. Handbook of Photochemistry, S. Murov, I. Carmichael and G. L. Hug, Marcell Dekker, 1993.
4. Handbook of Organic Photochemistry, Two Vols., J. C. Scaiano (Ed.), CRC Press, 1990.

Pharmaceutical chemistry

ADME (Absorption, Distribution, metabolism and Excretion), Biological activity (BA), Hansch Equation, Drug design, Development of new drugs, Lipinski's rule of five, Distribution coefficient, Z factor, IC_{50} Activity, Effective concentration EC_{50}, Pre-clinical trials, Clinical trials, Clinical phases, Enzymatic inhibition, Mechanisms of action, New active centres, Pharmacodynamics, Pharmacokinetics, Pharmacology, QSAR, Mobix, Celebrex, Vioxx, Tamiflu.

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Application of isotopes in organic chemistry

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Chemistry of Coal

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