ARISTOTLE UNIVERSITY OF THESSALONIKI

FACULTY OF SCIENCES

SCHOOL OF CHEMISTRY

ACADEMIC YEAR 2021-2022

A GUIDE TO THE COURSES

Thessaloniki 2021

The English version of the "Guide to the Courses" of School of Chemistry was edited by the Committee for the Programme of Undergraduate Courses which was elected for the academic period 2020-2021 and is consisting of the following members, in alphabetical order: Dimitrios Achilias (Professor), Georgios Gallios (Professor), Stella Girousi (Professor), Alexandros Zografos (Associate Professor), Nikolaos Nenadis (Assistant Professor), Anastasia Pantazaki (Professor), Georgios Psomas (Associate Professor, Chair of the Committee for the Programme of Undergraduate Courses), Constantini Samara-Konstantinou (Professor), Michael Sigalas (Professor), Sotirios Sotiropoulos (Professor).
Edited by: Georgios Psomas, Associate Professor

The English version of the "Guide to the Courses" of School of Chemistry was revised by the Committee for the Programme of Undergraduate Courses which was elected for the academic period 2021-2022 and is consisting of the following members, in alphabetical order: Dimitrios Achilias (Professor), Stella Girousi (Professor), Margaritis Kostoglou (Professor), Fani Mantzouridou (Assistant Professor), Anastasia Pantazaki (Professor), Georgios Psomas (Associate Professor, Chair of the Committee for the Programme of Undergraduate Courses), Michael Sigalas (Professor), Sotirios Sotiropoulos (Professor), Dimitra Voutsa (Professor), and Alexandros Zografos (Associate Professor).
Edited by: Georgios Psomas, Associate Professor

The Hellenic Quality Assurance & Accreditation Agency has certified that the Programme of Undergraduate Studies of the School of Chemistry complies with the principles of the "Standards for Quality Accreditation of Undergraduate Programmes" of HQA and the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG 2015) corresponding to level 6 of the National and European Qualifications Framework. Date of initial accreditation: 16/09/2021. Valid until: 15/09/2025.

Contents

πᾶσά τε ἐπιστήμη χωριζομένη δικαιοσύνης καὶ τῆς ἄλλης ἀρετῆς πανουργία, οὐ σοφία φαίνεται.

Πλάτωνος, *" Μενέξενος"* 247a

1. HISTORY AND ORGANIZATION OF THE DEPARTMENT

1.1 Establishment-Mission of the Department

The School of Chemistry of the Aristotle University of Thessaloniki was established during the German occupation by the Legislative Decree 430/1943. However, since the establishment of the University of Thessaloniki by Law 3341/1925, it has been provided that "*The School of Physical and Mathematical Science awards a degree in Industrial Chemistry*" and for this reason had been created by a relevant Presidential Decree of 1929, Laboratories "Chemistry" and "Agricultural Chemistry". The French-educated pharmacist/chemist Tryphon Karantassis was the first professor to teach Chemistry at the University of Thessaloniki.

In the course, and before the establishment of the School of Chemistry, T. Karantassis trisected the Laboratory of General Chemistry and created the Laboratories of Organic, Inorganic and Physical Chemistry in which, shortly before the declaration of the war of 1940, Georgios Varvoglis, Konstantinos Kavassiadis and Leandros Kapatos took over as full professors, respectively. This structure formed the basis of the newly established School of Chemistry, whose chemical laboratories operated in the basement of the building of the Faculty of Philosophy, the only building of the University at the time.

A decisive milestone in the course and development of the Department was the construction of the old building of the Chemistry and for this purpose a fundraiser was held and the assistance of businessmen of the city was requested. The building was founded in 1951 and, with the grant of the State, its construction was completed and was inaugurated in 1957. Since then, the School of Chemistry has experienced rapid growth. The scientific research and teaching staff increased rapidly and the scientific subjects that were being treated gradually expanded to cover all practical fields of Chemistry. In addition to the original core (Organic, Inorganic, and Physical Chemistry), new Chairs/Laboratories were created including Analytical Chemistry, Inorganic Chemical Technology, Organic Chemical Technology, Food Chemistry, Biochemistry, Environmental Pollution Control and Quantum Chemistry. The result of this development of the School was the need for building expansion, which was realized in 1978 with the construction of the nine-story new building of Chemistry.

A second important milestone in the course of the Department and of all the Higher Education Institutions of the country was the educational reform of 1982. By Law 1268/1982, the Schools acquired an administrative entity while the role of Dean of the Faculty was weakened. The institutions of Professor Chair and Don were abolished, and a new academic unit was established,

the Department. The Departments were joined by all members of the Teaching and Research Personnel (TRPs). With few changes since then, this administrative organization remains the same. Today's organization of the School of Chemistry of the Aristotle University of Thessaloniki includes four Departments in which the existing Laboratories have been integrated, as follows:

Department of General and Inorganic Chemistry, which includes the Laboratory of Inorganic Chemistry and the Laboratory of Quantum and Computational Chemistry.

Department of Organic Chemistry and Biochemistry, which includes the Laboratory of Organic Chemistry and the Laboratory of Biochemistry.

Department of Physical, Analytical, Environmental and Educational Chemistry, which includes the Laboratory of Physical Chemistry, the Laboratory of Analytical Chemistry, the Environmental Pollution Control Laboratory and the Laboratory of Chemical Education, Application of Information and Communication Technologies in Chemistry.

Department of Chemical Technology and Industrial Chemistry, which includes the Laboratory of Chemical and Environmental Technology, the Laboratory of Chemistry and Technology of Polymers and Colors, and the Laboratory of Chemistry and Food Technology.

Nowadays, the School of Chemistry of the Aristotle University of Thessaloniki is looking with optimism at the future and the scientific challenges that are coming. It has experienced Teaching and Research Staff with high scientific training, able to cope with the difficulties that exist and stand well in the competitive international environment.

1.2 Building Facilities

The School of Chemistry is housed in two buildings of the university complex, the Central Chemistry Building and its new wing.

Central Chemistry Building (Old Chemistry Building)

⇨ *Basement*: Classroom C and supplementary laboratory premises.

⇨ *Ground floor*: Laboratory of Physical Chemistry, Laboratory of Chemical Education, Application of Information and Communication Technologies in Chemistry and Classroom A.

⇨ ^{1st}*floor: Laboratory* of Organic Chemistry and Auditorium "N. Alexandrou".

⇨ ^{2nd}*floor*: Laboratory of Inorganic Chemistry and Laboratory of Quantum and Computational Chemistry.

⇨ ^{3rd}*floor*: Laboratory of Biochemistry and Environmental Pollution Control Laboratory.

New Chemistry Wing

⇨ *Ground floor*: Library and Auditorium.

⇨ *Ground floor*, *1st*, *2nd* and *3rd floor*: Laboratory of Chemical and Environmental Technology.

⇨ *4th*, *5th* and *6th floor*: Laboratory of Analytical Chemistry.

⇨ *7th*, *8th* and *9th floor*: Laboratory of Color and Polymer Chemistry and Technology, and Laboratory of Food Chemistry and Technology.

The **Administration Office** of the School of Chemistry is part of the Administration Office of the Faculty of Science and is located on the 1st floor of the prefabricated building next to the New Chemistry Wing. On the ground floor of this building, there is also the Classroom B.

1.3 The University Campus

The **Central Campus of A.U.Th.,** located in the center of Thessaloniki, extends over an area of about 334,000 m^2 and hosts the majority of its facilities. For access to the Central Campus of A.U.Th., urban bus services may be used. More information is provided in the University's website https://www.auth.gr/uni_sites

2. STRUCTURE AND AMDMINISTRATION OF THE SCHOOL

2.1 Administrative Bodies – Administration Office

The School of Chemistry is governed by the Assembly of the School, the Administrative Council, and the Head of School. The Assembly of the School consists of 30 members of the Teaching and Research Personnel, the Directors of the Departments, the Head of School, the Deputy Head of School, 1 member of Special Teaching Personnel, 1 member of Special Technical Personnel, 5 undergraduates and 5 postgraduate students. The Head convenes the Assembly and the Administrative Council, having set the items on the agenda, and presides over their work. The Head also maintains the registry of faculty members and supervises compliance with the decisions of the Assembly.

- Head of the School of Chemistry for the period 2020-2022 is Professor Panagiotis Spathis.
- Deputy Head of the School of Chemistry for the period 2020-2022 is Professor Theodoros Karapantsios.
- Head of the Administration Office is Mrs. Lydia Stavrakaki.

Departments

Each Department is managed by the Director and the General Assembly. The General Assembly consists of all faculty members who are integrated into the Department, 1 member of Special Teaching Personnel, 1 member of Special Technical Personnel, and a number of undergraduate and postgraduate students equal to 15% of the number of faculty members. The General Assembly elects the Director of the Technical, makes proposals for the Programme of Studies, takes care of the finances of the Department and decides on the teaching tasks of the educational staff. The Director of the Department convenes the General Assembly, having set the items on the agenda, presides over it and checks whether its decisions are being implemented.

Directors of Departments

- Director of the Department of General and Inorganic Chemistry is Associate Professor Fotini Noli.
- Director of the Department of Organic Chemistry and Biochemistry is Associate Professor Eleni Nikolakaki.
- Director of the Department of Physical, Analytical and Environmental Chemistry is Professor Constantini Samara-Konstantinou.

- Director of the Department of Chemical Technology and Industrial Chemistry is Professor Eleni Deligianni.

Directors of Laboratories

- Director of the Laboratory of Inorganic Chemistry is Professor Catherine Dendrinou-Samara.
- Director of the Laboratory of Quantum and Computational Chemistry is Professor Michael Sigalas.
- Director of the Laboratory of Organic Chemistry is Associate Professor Ioannis Lykakis.
- Director of the Laboratory of Biochemistry is Professor Theodora Choli-Papadopoulou.
- Director of the Laboratory of Analytical Chemistry is Professor Viktoria Samanidou.
- Director of the Environmental Pollution Control Laboratory is Professor Dimitra Voutsa.
- Director of the Laboratory of Physical Chemistry is Professor Dimitra Sazou.
- Director of the Laboratory of Chemical Education, and Application of Information and Communication Technologies in Chemistry is Professor Panagiotis Giannakoudakis.
- Director of the Laboratory of Chemical and Environmental Technology is Professor Theodoros Karapantsios.
- Director of the Laboratory of Color and Polymer Chemistry and Technology is Professor Dimitrios Bikiaris.
- Director of the Laboratory of Food Chemistry and Technology is Associate Professor Adamantini Paraskevopoulou.

2.2 Former Heads and Deputy Heads of the School of Chemistry

Served as Heads of the School of Chemistry:

Georgatsos Ioannis (1983-1987)

Tsipis Konstantinos (1987-1991)

Kyriakidis Dimitrios (1991-1995)

Nikolaidis Dimitrios (1995-1999)

Papadoyiannis Ioannis (1999-2003)

Giannakoudakis Andreas (2003-2007)

Papoutsis Achilleas (2007-2011)

Giannakoudakis Andreas (2011-2013)

Papoutsis Achilleas (2013-2015)

Choli-Papadopoulou Theodora (2015-2017)

Spathis Panagiotis (2017-2022)

Served as Deputy Heads of the School of Chemistry:

Karagiannidis Petros (1993-1995)

Kouimtzis Themistoklis (1995-1997)

Matis Konstantinos (1997-2001)

Spyroudis Spyros (2001-2003)

Tsiamis Christos (2003-2005)

Choli-Papadopoulou Theodora (2005-2007)

Arzoglou Panteleimon (2007-2009)

Litinas Konstantinos (2009-2011)

Themelis Dimitrios (2011-2013)

Koutouli-Argyropoulou Evdoxia (2013-2015)

Samara-Constantinou Constantini (2015-2017)

Achilias Dimitrios (2017-2020)

Karapantsios Theodoros (2020-2022)

2.3 Departments - Laboratories

DEPARTMENT OF GENERAL AND INORGANIC CHEMISTRY

Laboratory of Inorganic Chemistry

Laboratory of Quantum and Computational Chemistry

DEPARTMENT OF ORGANIC CHEMISTRY AND BIOCHEMISTRY

Laboratory of Biochemistry

Laboratory of Organic Chemistry

DEPARTMENT OF PHYSICAL, ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

Laboratory of Analytical Chemistry

Environmental Pollution Control Laboratory

Laboratory of Physical Chemistry

Laboratory of Chemical Education, and Application of Information and Communication Technologies in Chemistry

DEPARTMENT OF CHEMICAL TECHNOLOGY AND INDUSTRIAL CHEMISTRY

Laboratory of Chemical and Environmental Technology

Laboratory of Color and Polymer Chemistry and Technology

Laboratory of Food Chemistry and Technology

3. ACADEMIC STAFF OF SCHOOL OF CHEMISTRY

3.1. Academic Staff per Department/Laboratory

Department of General and Inorganic Chemistry		
Akrivos Periklis	Professor	Lab. of Inorganic Chemistry
Dendrinou-Samara Catherine	Professor	Lab. of Inorganic Chemistry
Sigalas Michael	Professor	Lab. of Quantum and Computational Chemistry
Hatzidimitriou Antonios	Associate Professor	Lab. of Inorganic Chemistry
Noli Fotini	Associate Professor	Lab. of Inorganic Chemistry
Psomas Georgios	Associate Professor	Lab. of Inorganic Chemistry
Angaridis Panagiotis	Assistant Professor	Lab. of Inorganic Chemistry
Charistos Nikolaos	Assistant Professor	Lab. of Quantum and Computational Chemistry
Koukaras Emmanouel	Assistant Professor	Lab. of Quantum and Computational Chemistry
Lazarides Theodoros	Assistant Professor	Lab. of Inorganic Chemistry

Department of Organic Chemistry and Biochemistry		
Choli-Papadopoulou Theodora	Professor	Lab. of Biochemistry
Giannakouros Thomas	Professor	Lab. of Biochemistry
Koumbis Alexandros	Professor	Lab. of Organic Chemistry
Litinas Konstantinos	Professor	Lab. of Organic Chemistry
Pantazaki Anastasia	Professor	Lab. of Biochemistry
Fylaktakidou Konstantina	Professor	Lab. of Organic Chemistry
Lykakis Ioannis	Associate Professor	Lab. of Organic Chemistry
Nikolakaki Eleni	Associate Professor	Lab. of Biochemistry
Sarli Vasiliki	Associate Professor	Lab. of Organic Chemistry
Zografos Alexandros	Associate Professor	Lab. of Organic Chemistry
Stathakis Christos Χρήστος	Assistant Professor	Lab. of Organic Chemistry

Department of Physical, Analytical and Environmental Chemistry		
Avranas Antonios	Professor	Lab. of Physical Chemistry
Anthemidis Aristidis	Professor	Lab. of Analytical Chemistry
Giannakoudakis Andreas	Professor	Lab. of Chemical Education, and Application of IC in Chemistry

Giannakoudakis Panagiotis	Professor	Lab. of Chemical Education, and Application of IC in Chemistry
Girousi Stella	Professor	Lab. of Analytical Chemistry
Papadopoulos Nikolaos	Professor	Lab. of Chemical Education, and Application of IC in Chemistry
Poulios Ioannis	Professor	Lab. of Physical Chemistry
Sazou Dimitra	Professor	Lab. of Physical Chemistry
Samanidou Viktoria	Professor	Lab. of Analytical Chemistry
Samara-Konstantinou Constantini	Professor	Environmental Pollution Control Lab
Sotiropoulos Sotirios	Professor	Lab. of Physical Chemistry
Theodoridis Georgios	Professor	Lab. of Analytical Chemistry
Voutsa Dimitra	Professor	Environmental Pollution Control Lab
Zachariadis Georgios	Professor	Lab. of Analytical Chemistry
Zotou Anastasia-Stella	Professor	Lab. of Analytical Chemistry
Lambropoulou Dimitroula	Associate Professor	Environmental Pollution Control Lab
Tsiplakidis Dimitrios	Associate Professor	Lab. of Physical Chemistry
Gavriil Dimitrios	Assistant Professor	Lab. of Physical Chemistry
Stergiopolous Thomas	Assistant Professor	Lab. of Physical Chemistry
Tzanavaras Paraskevas	Assistant Professor	Lab. of Analytical Chemistry
Tsogkas Georgios	Assistant Professor	Lab. of Analytical Chemistry

Department of Chemical Technology and Industrial Chemistry		
Achilias Dimitrios	Professor	Lab. of Color and Polymer Chemistrty and Technology
Bikiaris Dimitrios	Professor	Lab. of Color and Polymer Chemistrty and Technology
Gallios Georgios	Professor	Lab. of Chemical and Environmental Technology
Deligianni Eleni	Professor	Lab. of Chemical and Environmental Technology
Karapantsios Theodoros	Professor	Lab. of Chemical and Environmental Technology
Kiosseoglou Vasilios	Professor	Lab. of Food Chemistrty and Technology
Kostoglou Margaritis	Professor	Lab. of Chemical and

		Environmental Technology
Lazarides Nikolaos	Professor	Lab. of Chemical and Environmental Technology
Spathis Panagiotis	Professor	Lab. of Chemical and Environmental Technology
Triantafyllidis Konstantinos	Professor	Lab. of Chemical and Environmental Technology
Tsimidou Maria	Professor	Lab. of Food Chemistrty and Technology
Zouboulis Anastasios	Professor	Lab. of Chemical and Environmental Technology
Blekas Georgios	Associate Professor	Lab. of Food Chemistrty and Technology
Katsogiannis Ioannis	Associate Professor	Lab. of Chemical and Environmental Technology
Mantzouridou Fani	Associate Professor	Lab. of Food Chemistrty and Technology
Paraskevopoulou Adamantini	Associate Professor	Lab. of Food Chemistrty and Technology
Hatzidimitriou Eufimia	Assistant Professor	Lab. of Food Chemistrty and Technology
Nenadis Nikolaos	Assistant Professor	Lab. of Food Chemistrty and Technology
Nikolaidis Nikolaos	Assistant Professor	Lab. of Color and Polymer Chemistrty and Technology

3.2 SPECIAL TEACHING FELLOWS (STFs) / SPECIAL TECHNICAL PERSONNEL

➢ **DEPARTMENT OF GENERAL AND INORGANIC CHEMISTRY**

Technical Personnel/Special Technical Personnel

Vasiliadou Saoula

➢ **DEPARTMENT OF ORGANIC CHEMISTRY AND BIOCHEMISTRY**

Special Teaching Fellow

Papi Rigini

Technical Personnel/Special Technical Personnel

Gartagani Christina

Ioannou Konstantinos

Zarife Fotini

➢ **DEPARTMENT OF PHYSICAL, ANALYTICAL AND ENVIRONMENTAL CHEMISTRY**

Special Teaching Fellow
Antoniou Kyriakos
Evgenidou Eleni
Kouras Athanasios
Manoli Evaggelia

Technical Personnel/Special Technical Personnel
Karapetsa Christina
Zougrou Fotini

➢ **DEPARTMENT OF CHEMICAL TECHNOLOGY AND INDUSTRIAL CHEMISTRY**

Special Teaching Fellow
Fotopoulos Apostolos
Lykidou Smaro
Ordoudi Stergiani
Peleka Efrosini
Prohaska Chariklia

Technical Personnel/Special Technical Personnel
Lazaridou Elpida

➢ ***LIBRARY***

Special Teaching Fellow
Brouma Maria

Technical Personnel/Special Technical Personnel
Mpika Vasiliki

3.3 Administration Office Staff

Name	***Email***	***Telephone (+30+)***
Stavrakaki Lydia	*Head of Administration Office* orfeas@chem.auth.gr	2310 997680
Dentsora Urania-Evaggelia	dentsoral@chem.auth.gr	2310 997690
Kafantari Maria	kafantari@chem.auth.gr	2310 997640
Kesoglou Alexandra	akesoglou@chem.auth.gr	2310 997570
Kompogianni Elissavet	kompogianni@chem.auth.gr	2310 997660
Kornaraki Sofia	kornaraki@chem.auth.gr	2310 997670
Zarzani Lydia	lzarzani@chem.auth.gr	2310997660

4. 4. UNDERGRADUATE STUDIES IN THE SCHOOL OF CHEMISTRY

4.1 Organization of Undergraduate Studies

The undergraduate studies in the School of Chemistry are organized in accordance with the provisions of the legislation in force, the decisions of the Assembly of School and the Rules of Procedure of the Aristotle University of Thessaloniki.

➢ Duration of Studies

Studies in the School of Chemistry have a total duration of 8 semesters. The educational work of each academic year is structured in two semesters: winter and spring semester. The courses of the winter semester start in the last week of September and end around in the middle of January. The courses of the spring semester start around in the middle of February and end around the end of May.

➢ Characterization of courses

Compulsory Courses or Core Courses

These are courses that the Assembly of School considers to be necessary for the scientific training of a chemist. The students must attend and be successfully examined in all these courses (135 ECTS units) to obtain a degree in Chemistry. Participation in the laboratory exercises of these courses, when provided, is compulsory.

Semi-compulsory Courses

These are courses, from which the student is obliged to choose a number (6 courses, 3 in 5th and 3 in the 6th semester) from a defined set of courses (13) in order to complete 30 ECTS units. The participation in the laboratory exercises of these courses, when provided, is compulsory.

Elective Courses

They are divided into 2 sub-categories:

Core Elective Courses. In the 2nd, 3rd and 4th semester of their studies, students are called to choose 3 courses in this category (1 in the winter and 2 in the spring semester) from a list of 10 courses. In addition, they must choose the course "Foreign language for Chemistry" (with the possibility to select among English, German, French or Italian), which does not contribute with ECTS units to the degree.

Specialization Stream Elective Courses. In the 7th and 8th semester of their studies, students are called to choose 8 courses (+ a research Diploma Thesis), or 10 courses (+ a bibliographic Diploma Thesis), or 12 courses in this category from a special list containing at least 14 courses per direction.

A prerequisite for a Specialization Stream Elective Course to be taught is to have been selected and declared to the Secretariat of the Department by at least five (5) students. The participation in the laboratory exercises of these courses, when provided, is compulsory.

Optional Courses

They are courses offered by other Schools of the University, and/or the School of Chemistry, and their ECTS units are indicated on the certificate of analytical score but they are not considered in the total number of ECTS units required for the Diploma. They include courses required for the issue of a certificate for obtaining a License to Practice as an oenologist, as well as the Practice in Profession.

➢ Course Declarations

Students must submit an electronic declaration for all courses (including the compulsory ones) that are going to attend in each semester, before the start of the courses of the respective semester (within a period of two weeks). A student who will not submit this declaration will not be able to attend the courses of the indicative Programme. The replacement of a declared semi-compulsory course is not allowed after the expiration of the deadline for the submission of the electronic declaration. The replacement of a declared elective course shall also not be permitted after the expiration of the period within which the electronic declaration may be submitted, but it is possible before the next winter or spring semester in which this is taught. The same applies to all Specialization Stream Elective courses, except for one, which is allowed to be replaced with a similar course after the end of the electronic declaration by fourth-year students. This will be done during the electronic declaration of the due courses, for period of at least ten (10) days after three (3) weeks since the end of the examination period. Specialization Stream or Core Elective Courses that are replaced with other courses are deleted from the student's card.

➢ Brief Description of the Programme

To obtain the Diploma in Chemistry, students must:

1. Attend courses, distributed into 8 semesters, which, in addition, must include the course "Foreign language for Chemistry", while, for foreign students, the course "Greek for foreigners" offered by the School of Modern Greek of the University is also compulsory.

2. Complete at least **240** ECTS units consisting of:

i) **135** ECTS units from the compulsory courses of the core Programme.

ii) **15** ECTS units from 3 Elective courses of the core Programme.

iii) **30** ECTS units from 6 semi-compulsory courses of the core Programme.

iv) **60** ECTS units from 12 Specialization Stream Elective courses, or from 10 Specialization Stream Elective courses and a Bibliographic Diploma Thesis, or from 8 Specialization Stream Elective courses and a Research Diploma Thesis (The Specialization Stream selection courses, taught in the 7thand the 8thsemesters of studies, are listed in the individual list of each Specialization Stream).

In each semester, students attend courses corresponding to **30** ECTS units.

- **Grading of Courses**

The evaluation degree (B) of each student's performance in a course, is expressed on a ten-point scale (0-10) with an accuracy of half (½) unit. The degree results from the relationship:

$B = x_1B_1 + x_2B_2$

where:

B_1 is the grade of the written examination, on a decimal scale; concerning the total subject matter of the course (may also be the average of the grades in examinations of parts of the subject).

B_2 is the grade, on a decimal scale, attributed to the student based on the performance in laboratory exercises and/or from essays, as well as from any other additional work.

$x_1 = (\omega_1 + \omega_4 + \omega_5)/125$, for a course of 5 ECTS units, or $(\omega_1 + \omega_4 + \omega_5)/250$, for a course of 10 ECTS units.

$x_2 = (\omega_2 + \omega_3 + \omega_6)/125$, for a course of 5 ECTS units, or $(\omega_2 + \omega_3 + \omega_6)/250$, for a course of 10 ECTS units

In order for a student to be considered to have been successfully tested in a course, the grade of assessment of his/her performance must be at least equal to 5.

- **Diploma Degree**

The Diploma degree is the sum of the grade of each course after multiplying it by a coefficient that is equal to the ratio of the ECTS units of that course to 240. If the student has been graded in more than one courses that, according to the Programme, correspond to the minimum number of ECTS units required to obtain the degree (240), has the right to request that the grades of

some Elective courses not be considered when calculating the final degree, provided that the number of ECTS units corresponding to the remaining courses is at least equal to those required to obtain the Diploma.

➢ Studies Counseling

Following a decision taken each academic year by the Assembly of School, faculty members are assigned the duties of studies counseling, to provide guidance and advice to the new students of the School with the aim to a successful and timely completion of their studies https://www.chem.auth.gr/

4.2 Core Courses

1st Semester (Winter)

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*
Y01	General and Inorganic Chemistry I	3	1	4	10
Y02	Basic Principles of Analytical Chemistry	2	2	6	10
Y03	Applied Mathematics in Chemistry I	3	2	-	5
Y04	Physics I	4	-	-	5

2nd Semester (Spring)

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*
Y05	Inorganic Chemistry II	2	-	3	5
YN06	Organic Chemistry I	4	2	-	10
Y07	Physical Chemistry I	3	1	3	5
Y08	Quantitative Chemical Analysis	2	1	4	5
	Core Elective Course				5
(A01,A02,A03,A04) Foreign Language for Chemistry		3	-	-	2

3rd Semester (Winter)

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*
YN09	Organic Chemistry II	4	2	-	10
Y10	Physical Chemistry II	3	1	3	10
Y11	Quantum Chemistry & Introduction to Spectroscopy	2	2	-	5
	Core Elective Course				5

4th Semester (Spring)

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*
YE12	Laboratory of Organic Chemistry I	-	1	4	5
Y13	Physical Chemistry III	3	1	3	10
Y14	Chemical Technology	2	2	2	5
Y15	Biochemistry I	3	1	3	5
	Core Elective Course				5

5th Semester (Winter)

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*
YE16	Laboratory of Organic Chemistry II	-	1	4	5
YN16	Organic Chemistry III	3	1	-	5
Y17	Biochemistry II	3	1	3	5
	Semi-Compulsory 1				5
	Semi-Compulsory 2				5
	Semi-Compulsory 3				5

6th Semester (Spring)

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*
Y18	Instrumental Chemical Analysis I	2	-	4	5
Y19	Inorganic Chemistry III	3	1	4	10
	Semi-Compulsory 1				5
	Semi-Compulsory 2				5
	Semi-Compulsory 3				5

4.3 Core Elective Courses

(Choose 1 course of "Foreign Language for Chemistry" & 3 courses from the following list)

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*	*Semester*
(A01) English / (A02) French / (A03) German / (A04) Italian for Chemistry		3	-	-	2	2nd
A05	Introduction to Informatics	2	-	2	5	2nd
A06	Processing and Evaluation of Laboratory Data	3	1	-	5	3rd
A07	Management in Chemical Industry	2	1	-	5	3rd
A08	Applied Mathematics in Chemistry II	3	1	-	5	2nd
B02	Radiochemistry and Nuclear Chemistry	2	1	-	5	4th
B03	Chemical Processes	2	2	-	5	4th
B04	Spectroscopy of Organic Compounds	3	1	-	5	4th
B05	General Biology	2	-	-	5	2nd
B06	Physics II	4	-	1	5	2nd
B07	Geology & Geochemistry	2	-	2	5	3rd

* The course "Foreign Language for Chemistry" is compulsory for students in the second semester and its does not contribute with ECTS units to the degree.

4.4 Semi-Compulsory Courses

(Choose 6 courses from the following list)

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*	*Semester*
H01	Physical Processes	2	2	2	5	5th
H02	Macromolecular Chemistry	3	1	-	5	6th
H03	Industrial Organic Chemistry	2	1	-	5	5th
H04	Food Chemistry I	2	1	-	5	5th
H05	Food Processing and Preservation	2	1	-	5	6th
H06	Environmental Pollution Control	3	-	3	5	6th
H07	Environmental Chemistry	3	1	-	5	5th or 7th
H08	Green Chemistry	3	1	-	5	6th
H09	Electrochemical Reactions	3	-	2	5	5th
H10	Computational Chemistry	2	-	2	5	6th
H11	Materials Chemistry	3	1	-	5	6th
H12	Metrology, Chemometrics and Quality Control	2	1	-	5	5th
H13	Real, Virtual and Hybrid Laboratories on Principles and Laws of Chemistry in Formal and Informal Education	2	-	2	5	6th

4.5 Specialization Stream Elective Courses

7th Semester (Winter) and 8th Semester (Spring)

- Research Diploma Thesis (Winter or Spring Semester) + 8 specialization stream courses from the list of the corresponding specialization stream OR

- Bibliographic Diploma Thesis (Winter or Spring Semester) + 10 specialization stream courses from the list of the corresponding specialization stream OR

- 12 specialization stream courses from the list of the corresponding specialization stream

Elective Courses of Specialization Stream A **"Theoretical Chemistry mad Chemical Education"**						
Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*	*Semester*
K104	Structuring, Presentation and Transmission of Chemical Information	2	-	2	5	7th
KN106	Introduction to Pedagogy	2	-	2	5	7th
K109	History and Epistemology of Physical Sciences	3	-	-	5	7th
K205	Analytical Instruments	1	1	3	5	7th
K213	Dynamical Physico-Chemical Systems with Chaotic Behavior	3	-	2	5	7th
KN306	Chemistry of Heterocyclic Compounds	3	-	-	5	7th
K101	Molecular Modeling	2	-	2	5	8th
KN102	Molecular Symmetry and Group Theory	2	-	2	5	8th
K103	Application of Excel Sheets in Chemistry	3	1	-	5	8th
K105	Didactics of Chemistry and the Role of Experimenting in Chemistry Teaching	2	-	2	5	8th
K107	Development of Multimedia Material and e-Learning in Chemistry and Chemistry Teaching	2	-	2	5	8th
K108	ITC in the Chemical Laboratory	3	-	1	5	8th
K110	Statistical Thermodynamics	3	1	-	5	8th
ΕΨ900	Psychology of Education	3	-	2	5	7th
ΠΡ06	Student Internship in the Profession (optional)				5	7th or 8th

Π(01,02,03,04,05,06,07,08,09,10,11) Research Diploma Thesis				20	7th or 8th
ΠΒ(01,02,03,04,05,06,07,08,09,10,11) Bibliographic Diploma Thesis				10	7th or 8th
Optional Courses for the granting the Certificate of Pedagogical and Didactic Adequacy (obligatory: ΠΡ07 or ΠΡ08, Κ105, ΚΝ106 and ΕΨ900)					
ΠΡ07 Student Internship in Education or ΠΡ08 Student Internship in Laboratory of the School of Chemistry				5	7th or 8th

Elective Courses of Specialization Stream B

"Chemical Analysis – Environment - Electrochemistry"

Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*	*Semester*
Κ201	Electrochemical Energy Systems and Environmental Protection	3	-	-	5	7th
Κ202	Modeling and Optimization of Chromatographic Separations	2	1	3	5	8th
Κ203	Separation Methods in Chemical Analysis	2	-	2	5	7th
Κ204	Electroanalysis	2	-	3	5	7th
Κ205	Analytical Instruments	1	1	3	5	7th
Κ206	Specific Topics in Colloid Chemistry	2	-	2	5	7th
Κ207	Chemistry and Ecosystem Management	3	-	-	5	8th
Κ208	Pollution Prevention and Environmental Protection	3	-	1	5	7th
Κ215	Quality Assurance in Environmental Control and Management	3	-	1	5	8ο
Κ209	Instrumental Chemical Analysis II	2	-	3	5	7th
Κ210	Archaeometry and Chemistry of Archeology Materials	2	-	3	5	8th
Κ211	Specific Methods of Analysis	2	-	3	5	8th
Κ212	Bioanalytical Chemistry	2	-	3	5	8th
Κ213	Dynamical Physicochemical Systems with Chaotic Behavior	3	-	2	5	7th
Κ108	ITC in the Chemical Laboratory	3		1	5	8th

ΠΡ06 Student Internship in the Profession (optional)					5	7th or 8th
Π(01,02,03,04,05,06,07,08,09,10,11) Research Diploma Thesis					20	7th or 8th
ΠΒ(01,02,03,04,05,06,07,08,09,10,11) Bibliographic Diploma Thesis					10	7th or 8th
Optional Courses for the granting the Certificate of Pedagogical and Didactic Adequacy (obligatory: ΠΡ07 or ΠΡ08, K105, KN106 and ΕΨ900)						
ΠΡ07 Student Internship in Education or ΠΡ08 Student Internship in Laboratory of the School of Chemistry					5	7th or 8th
K104	Structuring, Presentation and Transmission of Chemical Information	2	-	2	5	7th
KN106	Introduction to Pedagogy	2	-	2	5	7th
K105	Didactics of Chemistry and the Role of Experimenting in Chemistry Teaching	2	-	2	5	8th
K109	History and Epistemology of Physical Sciences	3	-	-	5	7th
ΕΨ900	Psychology of Education	3	-	2	5	7th

Elective Courses of Specialization Stream C "Chemical Synthesis - Biochemistry and Bioapplications"						
Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*	*Semester*
K301	Bioinorganic Chemistry	2	1	-	5	8th
K302	Organometallic Chemistry and Catalysis	3	1	-	5	7th
K303	Physical Methods in Inorganic Chemistry	3	-	-	5	8th
KN304	Nanochemistry	2	1	-	5	7th
K305	Organic Synthesis	3	1	-	5	7th
KN306	Chemistry of Heterocyclic Compounds	3	-	-	5	7th
KN307	Chemistry of Natural Products	3	-	-	5	8th
K308	Clinical Biochemistry	3	-	-	5	7th
K309	Structural Biochemistry - Elements of Bioinformatics	2	-	1	5	8th
K310	Molecular Cell Biology – Control of	3	-	-	5	7th

	Metabolism					
K312	Pharmaceutical Chemistry	3	-	-	5	8th
K313	Bioorganic Chemistry	3	-	-	5	8th
K314	Biotechnology	2	1	-	5	8th
K315	Enzymology	2	1	-	5	7th
K316	Radioanalytical Chemistry and Applications of Nuclear Techniques	2	-	2	5	7th
K101	Molecular Modeling	2	-	2	5	8th
ΠΡ06 Student Internship in the Profession (optional)					5	7th or 8th
Π(01,02,03,04,05,06,07,08,09,10,11) Research Diploma Thesis					20	7th or 8th
ΠΒ(01,02,03,04,05,06,07,08,09,10,11) Bibliographic Diploma Thesis					10	7th or 8th
Optional Courses for the granting the Certificate of Pedagogical and Didactic Adequacy (obligatory: ΠΡ07 or ΠΡ08, K105, KN106 and ΕΨ900)						
ΠΡ07 Student Internship in Education or ΠΡ08 Student Internship in Laboratory of the School of Chemistry					5	7th or 8th
K104	Structuring, Presentation and Transmission of Chemical Information	2	-	2	5	7th
KN106	Introduction to Pedagogy	2	-	2	5	7th
K105	Didactics of Chemistry and the Role of Experimenting in Chemistry Teaching	2	-	2	5	8th
K109	History and Epistemology of Physical Sciences	3	-	-	5	7th
ΕΨ900	Psychology of Education	3	-	2	5	7th

Elective Courses of Specialization Stream D **"Chemical Technology and Industrial Chemistry"**						
Course		*Lectures*	*Tutorial*	*Lab*	*ECTS*	*Semester*
K401	Technology of Inorganic Materials - Nanotechnology	2	1	-	5	8th
K402	Laboratory of Industrial Processes	-	1	2	5	7th

K403	Biotechnological Processes	2	1	-	5	8th
K404	Transport Phenomena	2	2	-	5	8th
K405	Technology of Polymeric Materials	2	1	-	5	8th
K406	Fundamental Principles of Environmental Technology	3	1	-	5	7th
K407	Laboratory Techniques for the Synthesis and Characterization of Polymers	1	-	3	5	7th
K408	Colour Chemistry and Technology	2	-	2	5	8th
K410	Laboratory Food Testing	1	-	6	5	7th
K411	Food Quality Management	2	1	-	5	8th
K412	Food Chemistry II	2	1	-	5	8th
K413	Technology and Biotechnology of Foods and Beverages	2	1	-	5	7th
K414	Chemistry, Technology and Applications of Surface Active Agents	2	-	2	5	7th
ΠΡ06 Student Internship in the Profession (optional)					5	7th or 8th
Π(01,02,03,04,05,06,07,08,09,10,11) Research Diploma Thesis					20	7th or 8th
ΠΒ(01,02,03,04,05,06,07,08,09,10,11) Bibliographic Diploma Thesis					10	7th or 8th
Optional Courses for the granting the Certificate of Oenological Education						
ΠΡ03	Oenology I	2	-	2	5	7th
ΕΒ932	Principles of Microbiology	3	-	3	5	7th
ΠΡ04	Oenology II	2	-	2	5	8th
ΠΡ05	Elements of Viticulture	2	-	2	5	8th
ΕΗΟ13	Elements of Economy	3	-	-	5	8th
Student Internship in Winery or Oenological Laboratory (3-month duration)					5	7th or 8th
Optional Courses for the granting the Certificate of Pedagogical and Didactic Adequacy (obligatory: ΠΡ07 or ΠΡ08, Κ105, ΚΝ106 and ΕΨ900)						
ΠΡ07 Student Internship in Education or ΠΡ08 Student Internship in Laboratory of the School of Chemistry					5	7th or 8th

K104	Structuring, Presentation and Transmission of Chemical Information	2	-	2	5	7th
KN106	Introduction to Pedagogy	2	-	2	5	7th
K105	Didactics of Chemistry and the Role of Experimenting in Chemistry Teaching	2	-	2	5	8ο
K109	History and Epistemology of Physical Sciences	3	-	-	5	7th
ΕΨ900	Psychology of Education	3	-	2	5	7th

4.6 Certificate of Oenological Education

Ability to attend all courses that are necessary to grant the certificate is given only to the students who attend the courses of Specialization Stream D "Chemical Technology and Industrial Chemistry" (Decision 587 / 31.1.2014 of the Assembly of the School).

For the issuance of the certificate, which is possible only by obtaining the BSc Diploma of the School of Chemistry, students must have successfully selected, attended and been examined in the following courses or courses of other Schools of AUTh:

(a) Before the 7th semester of their studies:

1. "B05 General Biology" (elective course of 2nd semester)
2. "H04 Food Chemistry I" (semi-compulsory course of 5th semester)
3. "H05 Food Processing and Preservation" (semi-compulsory course of 6thsemester)

(b) During the 7th and 8th semester of their studies:

4. "K410 Laboratory Food Testing" (elective course of specialization stream D, 7th semester)
5. "K411 Food Quality Management" (elective course of specialization stream D, 8th semester)
6. "K403 Biotechnological Processes" (elective course of specialization stream D, 8th semester)

(c) During the 7th semester of their studies:

7. "K315 Enzymology" (optional course for the Specialization Stream of "Chemical Synthesis - Biochemistry and Bioapplications")

(d) During the 7th and 8th semester or after the completion of the 8th semester of their studies:

8. "ΠΡ03 Oenology I" (optional course of specialization stream D, 7th semester) provided that they (a) have been successfully examined the semi-compulsory course "H04 Food Chemistry I" and (b) have attended the optional course "K410 Laboratory Food Testing".
9. "ΠΡΟ04 Oenology II" (optional course of specialization stream D, 8th semester) provided that they (a) have been successfully examined the semi-compulsory course "H05 Food Processing and Preservation" and (b) have attended the optional course "PRO03 Oenology I".
10. "ΠΡΟ05 Elements of Viticulture" (optional course of 8th semester) (School of Agriculture, AUTh, Viticulture Laboratory)
11. "EB932 Principles of Microbiology" (optional course of specialization stream D, 7th semester) (School of Biology, AUTh)
12. "EHO13 Elements of Economics" (optional course of specialization stream D, 8th semester) (School of Politics and Economics, AUTh).

Practice exercise in a winery or oenological laboratory with duration of at least three (3) months is also necessary for the issuance of the certificate.

4.7 Certificate of Pedagogical and Didactic Adequacy (PDA)

For the granting of the PDA, the students must have chosen, attended and been successfully examined in the following courses, which fall into the following sections:

A. Topics of education and training (2 of 4 courses A1-A4)

B. Learning and teaching topics (2 of the 6 courses B1-B6)

C. Specific didactic and Student Internship (courses C1 and C2)

For the students who following the courses of Specialization Stream A, all the essentials courses are counted in the Diploma degree, while for students of other Specialization Streams (B, C and D) all courses (except B1) are optional and do not counted in the Diploma degree.

Older active students can also select and attend these courses in order to be granted the PDA.

Table of courses in relevance with PDA of School of Chemistry

1st THEMATIC AREA TOPICS OF EDUCATION AND TRAINING				
	Course	*Semester*	*Code*	*Type of course*
A1	Introduction to Pedagogy	7th	KN106	Elective course of specialization stream A & Optional elective course of specialization streams B, C, and D
A2	School Pedagogy I	7th	ΣΧΠ Ι 400	Optional elective course
A3	School Pedagogy II	8th	ΣΧΠ ΙΙ 400	Optional elective course
A4	Psychology of Education	7th	ΕΨ900	Elective course of specialization stream A & Optional elective course of specialization streams B, C, and D
2nd THEMATIC AREA LEARNING AND TEACHING TOPICS				
	Course	*Semester*	*Code*	*Type of course*
B1	Real, Virtual and Hybrid Laboratories on Principles and Laws of Chemistry in Formal and Informal Education	6th	H13	semi-compulsory
B2	Structuring, Presentation and Transmission of Chemical Information	7th	K104	Elective course of specialization stream A & Optional elective course of

				specialization streams B, C, and D
B3	Development of Multimedia Material and e-Learning in Chemistry and Chemistry Teaching	8th	K107	Elective course of specialization stream A & Optional elective course of specialization streams B, C, and D
B4	History and Epistemology of Physical Sciences	7th	K109	Elective course of specialization stream A & Optional elective course of specialization streams B, C, and D
B5	ITC in the Chemical Laboratory	8th	K108	Elective course of specialization streams A and B, & Optional elective course of specialization streams C and D
B6	Educational issues on the introduction of Information and Communications Technologies in the school praxis	8th	Π1901	Optional elective course
3rd THEMATIC AREA SPECIFIC DIDACTIC AND STUDENT INTERNSHIP				
	Course	*Semester*	*Code*	*Type of course*
C1	Didactics of Chemistry and the Role of Experimenting in Chemistry Teaching	8th	K105	Elective course of specialization stream A & Optional elective course of specialization streams B, C, and D
C2	Student Internship in Education	7th or 8th	ΠΡ07	Optional course

4.8 Internship

1. Internship is a relatively short-term work from an undergraduate student in a Host Institution, outside the University, conducted under the guidance of a Teaching-Research member (DEP) of the School that belongs, preferably, from the members of Internship Committee (IC) in the School.
2. Undergraduate students carry out internships, both in Public and to Private Host Institutions, with a subject related to their studies in order to come to a first contact with daily work practice and gain experience and the necessary extroversion for their effective entry into the labor market after the end of their studies. Their presence in the premises of the Host Institutions is daily and full time, while their behavior must be impeccable.
3. The Internship, which is an optional course with 5 ECTS credits, **is not graded** and lasts **two months**. It takes place in places of services, companies, institutions, etc., in accordance with the rules of safety, hygiene, consistency, ethics and good cooperation, by undergraduate students who have attended the courses of 6th semester, so that the progress of their studies is not prohibited. The best period is considered the one including the months of July and August of each year, but it is not impossible to be conducted at other periods.
4. Undergraduate students must inform in writing the IC if there is a problem during their internship and must submit to the IC, immediately after internship completion, a report of the proceedings accompanied by a written certificate of successful completion signed by the person in charge of the cooperating institution.
5. The results of the internship are evaluated every year in the context of a workshop organized by the IC. The latter is delegated by the Assembly of the School with the president of the committee to be a full professor or an associate professor.
6. The modification of the above is possible only after a proposal of the IC and its approval by the Assembly of the School. The latter is also responsible for resolving any problems of administrative nature or others related to the internship.

Ways of conducting the internship by undergraduate students

An internship can be conducted:

1. Through ESPA

Undergraduate students can practice through the Programme "AUTh Internship", which is co-financed by the European Social Fund (ESF) and from National Resources, in the framework of the Operational Programme entitled “Development Of Human Resources, Education and Lifelong Learning 2014-2020". **The internship through ESPA takes place only in Greece and the Programme does not allow participation of foreign students whose presence at the Institution**

is due to the Erasmus Programme. Students can participate in the Programme "AUTh Internship" only once.

Pre-applications for the Programme are usually made during October and November and the announcement is posted on the website of the School.

The selection of the students is based on the selection criteria set by IC and have been approved by the Assembly of the Scholl. The scoring of those interested is made after taking into account their average score in the undergraduate courses that have been successfully examined but also the corresponding ECTS of these courses.

The Host Institutions are then selected by the students. In case that there are more than one student for a particular position, CVs of the students interested for the position are sent to the host coordinator of the respective Host Institution for selection.

Every student must submit the necessary supporting documents and documents for the inclusion in the Programme (e.g. signed employment contracts, tax number, AMKA or IKA registration number, etc.). The documents are submitted to Internship Office that undertakes the processing of procedures.

At web address **dasta.auth.gr** are listed in detail all the criteria that must be met by the student, the obligations, and the procedure to be followed in collaboration with the Scientific Officer of the Internship for the Department and the Internship Office of AUTh.

2. With the assistance of the Internship Office of AUTh (except ESPA)

This is possible only when the funding is provided by the Host Institutions. More information is provided by the Internship Office of AUTh. (tel.:2310 997136, E-mail: praktiki@auth.gr).

Composition of the Internship Committee of the Department

IC members are appointed by the General Assembly of the School. Coordinator of the Internship Programme in the School of Chemistry is Assistant Professor Eufimia Hatzidimitriou (e-mail: effiehd@chem.auth.gr , 2310997823). The members of the IC and the evaluation committees are mentioned at the School's website https://www.chem.auth.gr/tmima/epitropes-tmimatos/ .

4.9 ECTS credits

EUROPEAN ACADEMIC CREDITS TRANSFER SYSTEM

The European Union promotes cooperation between universities as a means of improving the quality of education for the benefit of students and higher education institutions. Student mobility is a key-element of this collaboration between universities. The Erasmus Programme clearly shows that studying abroad can be a very valuable experience. They are the best way to get in touch with other countries, ideas, languages and cultures, emerging them as an important element in the development of academic and professional careers.

Full recognition of studies and degrees is a prerequisite for the establishment of an open European space for education and training, in which students and teachers can move freely within the framework of the Socrates / Erasmus Programmes. That is why the European Credit Transfer System (ECTS) was set up under the Erasmus Programme to improve the academic recognition of studies abroad. ECTS is at the same time a tool for connecting institutions and expanding the options available to students.

THE MAIN CHARACTERISTICS OF ECTS

The ECTS system is based on three key-elements: information on study Programmes and academic results, mutual agreement between partner-institutions and students, and the use of ECTS academic credits which show the student's workload. These three basic elements are applied through the use of three basic documents: the information file, the application form / academic agreement and the certificate of study.

By its very nature, ECTS does not regulate in any way the content or structure or equivalence of study Programmes. ECTS as a code of good practice facilitates the academic recognition of studies abroad. Full academic recognition means that a period of studies abroad (including examinations or other forms of assessment) replaces a comparable period of study at the university of student’s country, although the content of the approved Programme may differ.

The use of ECTS is voluntary and is based on mutual trust and certainty in the academic performance of partner institutions. Each institution selects its partners.

The following tools are used in ECTS:

- ECTS academic credits, numerical credits provided in the courses and represent the required workload of the student for their completion,
- the information folder, which provides written information to the students and the teaching staff of the schools, on the organization and structure of studies and course modules,

- the certificate of studies, which shows the level of academic knowledge of students in a comprehensive, understandable and easy to transfer from one institution to another way,
- the academic agreement, which covers a study Programme to be carried out and the ECTS credits to be awarded for its satisfactory completion, and is binding on the home and host institutions as well as the student.

The full range of courses of school using ECTS must first be available to mobile students, including doctoral courses. Students should be given the opportunity to attend regular courses - and not courses designed specifically for them - and should not be excluded from being able to meet the institution's requirements for a degree.

ECTS also provides the opportunity for further studies abroad. With ECTS, the student is not required to return to the institution of origin after the period of study abroad - he may choose to remain in the host institution - possibly for a Diploma - or to move to a third institution. It is the institutions themselves that decide whether to accept such a thing and what conditions the student must meet in order to be awarded a Diploma or to enroll in a third institution. The certificate of studies is particularly useful in this regard because it contains the history of students' academic achievements, which helps institutions to make relevant decisions.

GENERAL CONDITIONS FOR THE USE OF ECTS

The success of the ECTS system presupposes voluntary participation, transparency, flexibility and a climate of mutual trust and confidence. Staff should be informed and trained on the application of ECTS principles and mechanisms.

Institutions committed to the above commitments find that the transparency and discipline of ECTS make academic recognition a relatively simple process, in which decisions are made openly on the basis of sound information. In any case, there are decisions that may be vital to the future of the students concerned - academic decisions or decisions on simple practical issues. A basic principle of ECTS is that such decisions must be taken in accordance with the principle of "treating the ECTS student as a full-time student of the institution".

THE ECTS ACADEMIC UNITS

The ECTS academic unit is a numerical value from 1 to 60. It is distributed in the courses in order to reflect the required workload of the student to complete it. This number represents the work required for each course in relation to the total work required to complete an entire year of academic study at the institution, i.e. lectures, internships, seminars, tutoring, personal study - in the library or at home - and exams or other assessment activities. ECTS is therefore based on the student's full workload and is not limited to attendance hours.

ECTS academic credits are more relevant than an absolute measure of a student's workload. They determine the percentage of the workload of the year that a course represents in the school that grants the credits.

Under ECTS, 60 credits equal the workload of an academic year, with 30 credits typically representing a semester and 20 credits representing a three-month period.

ECTS credits ensure that the Programme entails a reasonable workload for the period of study abroad.

Two examples:

1. a student who chooses a course that includes a 120 ECTS academic Programme for one academic year must work twice as much as the average local student in the host institution, and
2. a student with a work Programme of 30 ECTS credits for a full academic year will have much less work than the average local student and in practice follows a part-time study Programme.

The ECTS academic credits are distributed according to the "top-down" system. The starting point is the complete structure of the Programme and the usual succession of courses that the student must complete during the academic year to complete the specialization according to the official duration of studies.

The ECTS procedure requests the institutions to describe the teaching materials uniformly. In some cases, the distribution of ECTS credit units may be a simple mathematical or mechanistic equation, while in other cases, much time may be required for the institutions to negotiate.

The Programmes consisting of units where all courses are equal or there is a units system based on the workload of the student just require the application of modification factor. In Norway for instance, the units system in the Universities contains 40 units per academic year. That means that the units from Norway are multiplied by a factor of 1,5 in order to find the corresponding ECTS units.

The academic ECTS units are distributed among all courses, either compulsory or elective courses. There are also academic ECTS units distributed to working Programmes, to Diploma Theses and to Internship in the Profession, if these forms are a part of the Programme of Studies.

The level or the difficulty to pass a course are not depicted on the ECTS credit units. In the ECTS system, the level of course is described by the offering institution in the information folder. You may find there the targets and the goals of a course, the pre-requisite knowledge, the teaching methods used, the mode of evaluation and the Syllabus of the course. These data may be completed, if necessary after communication between professors. All these may aid the student and the coordinator of the institution of origin to evaluate the proper of mobility of a specific course and the

level of its recognition from the institution of origin. The professors are responsible for the evaluation of the workload and the distribution of credit units. Therefore, a more advanced or higher-level course does not necessarily provide more ECTS credit units than a less advanced course, just because of its level.

Attendance hours and ECTS academic credits

In the simplest case there is a relationship between attendance hours and ECTS academic credits. ECTS credits, however, are not based solely on attendance hours, but on the total workload of those hours. When a year of a course at an institution consists exclusively of traditional lectures, tutorials and exams, it is very likely that attendance hours are directly related to the student's workload, and therefore to the ECTS academic credits for each course. The exact nature of the relationship may change in subsequent courses - this is evident when different consecutive hours of attendance are provided in consecutive years of a course, although a total of 60 ECTS credits must be allocated for each year

Things get complicated when a Programme devotes much of its attendance time to supervised laboratory work or design lessons. It is obvious that one of these follow-up hours does not involve the same total work as a traditional delivery hour, and if treated in the same way will not be properly converted into ECTS academic credits. An hour in the lab should be evaluated as a quarter or half an hour of lecture, depending on the institute's practice.

When research work is largely unsupervised, the easiest way is to consider how much time in the academic year is needed to complete it full-time, i.e. calculating time in weeks instead of hours.

Elective and Optional courses

As aforementioned, the distribution of credits in the elective or optional courses must be done under the same conditions as for the core courses or the compulsory courses, i.e. on the basis of the percentage of the workload that they represent in relation to the total workload of an academic year. A course that may be optional or optional at one institute may be a core or compulsory course at another institute. In some institutions, elective or optional courses are not included in the regular Programme but can be added to the Programme. In this case, ECTS academic credits must be allocated to the optional courses according to the workload they would represent if included in the Programme.

Formal duration of studies and average time for their completion

In some higher education systems, the average time required to complete the studies is longer than the formal duration of the studies. ECTS credits should always be allocated according to the official time or duration of study and not the average time that local students may need to complete their studies.

This may create problems for students from other countries, as the 60-credit Programme for these students can be considered to require much more work than the average local student.

In addition, in some institutions, students are allowed to split their exams into different exam periods, and even postpone them until they are sure that they will have the best chance of success. Students from other countries usually do not have this flexibility, because they have to demonstrate their results in order to continue their studies at the beginning of the next academic year at the institution of origin. If any of these situations may create disadvantages for students from other countries compared to local students, and cause them to have difficulty concentrating 60 credits, the problem should be clearly explained in the information portfolio so that students and coordinators can draw up a realistic Programme in terms of workload, but without creating disadvantages for the mobility student regarding the exams.

PERFORMANCE OF ECTS ACADEMIC UNITS

Academic credits and their performance to students

ECTS academic credits are divided into courses. Students are rewarded only if they successfully complete the course and meet the assessment requirements. In other words, students do not receive ECTS academic credits simply because they attend classes or study abroad; they must prove that they have fulfilled the obligations set out in its assessment regulations. The assessment process may take various forms; written or oral examinations, assignments, a combination of the two or other means such as e.g. seminar presentations. Information about the above should be included in the information folder.

Objective difficulties in participating in the exams

Some Programmes consist of integrated modules covering more than one academic year. Students take the exams at the end of the course. This system may create problems for overseas students who attend a semester or a year at the host institution. These students are required to attend only one part of the course and cannot be evaluated for this part and cannot receive ECTS credits from the host institution because they have not completed the course.

Institutions facing this problem and wishing to use the ECTS system can choose to customize the Programmes they offer so that they can be selected by international students. If they choose to maintain the current situation, it is recommended to apply flexibility in the distribution of

ECTS credits in the different parts of the course and to organize mid-term evaluation procedures for students from abroad.

Evaluation of Diploma Thesis and internships

As with all courses, learning outcomes and assessment methods should be described in the information folder. In these cases, the rules of the host institution may prevail, or a joint evaluation by the institutions of origin and the host (and the companies) may be provided.

Credits are not awarded subject to good grades: the number of credits for a course is fixed and applies to all students who succeed in the assessment. The quality of the student's performance in the Programme is provided through grading.

TRANSFER OF ECTS ACADEMIC UNITS

Institutions of origin and reception prepare and exchange certificates for each student participating in ECTS before and after the course of study abroad. A copy of this certificate is issued to the student for his / her personal file. The home institution recognizes the number of academic credits that its students have received from partner institutions abroad, and as a result the credits for the completed course replace those that would have been awarded by the home institution. The learning agreement provides the student with an advance guarantee that the academic credits (at the host institution) will be transferred to the approved Programme.

There are usually two ways to transfer credit; some home institutions organize courses per year or semester. In this case, the learning agreement between the institutions and the student will indicate a set of courses chosen to replace the year or semester at the institution of origin. Upon return, the student who has succeeded in the assessment receives a set of credits, which can be mentioned in this form on the student's certificate and not as a list of independent courses. This ensures full academic recognition of the studies.

Other institutions of origin define their level of study based on a list of courses that the student must successfully attend in a certain number of years. These learning agreements should include courses or groups of courses that correspond to courses of the institution of origin for which academic recognition is provided. In practice, courses of the institution of origin may be mentioned in the learning agreement corresponding to the courses of the host institution. Upon return, the student who has succeeded in the assessment receives academic credits depending on the courses of the host institution. The total number of academic credits thus recognized must correspond to the total number provided by the host institution. This ensures full academic recognition of the studies.

The second way is more difficult, but the transfer of credits per course is necessary for some national systems and for the special requirements of certain professions. If the Programme at the

home institution includes elective courses, credit transfer can be a very simple affair: institutions can use ECTS student mobility to expand the range of alternatives available to their students.

THE PARTIAL FAILURE

Crediting is the responsibility of the host institution, and sometimes students return home with fewer credits than they had hoped to obtain. If the host institution offers its students a second assessment opportunity, the mobility student could benefit from this process. When the host institution procedures are exhausted, the question of the student's progress rests with the institution of origin, in accordance with the regulations of the latter.

In case of serious failure, the student may repeat the period of study at the institution of origin, extending the duration of study. However, the credits for the courses that the student successfully completed (at the host institution) must be transferred. In the case of a partial failure, the home institution may allow the student to be evaluated upon return and then reward the credit units. In this respect, the rules differ greatly between institutions.

THE ECTS COORDINATORS

Institutions using ECTS system designate an ECTS-coordinator at the institution level and an ECTS-coordinator for each participating school or faculty. The role of the coordinators is to deal with administrative and academic issues of ECTS and to provide advice to students.

The ECTS Institution coordinator

The essential role of the institution coordinator is to ensure that the institution is committed to the principles and mechanisms of ECTS.

The ECTS School coordinator

The School coordinator is usually the point of contact between students and teaching members within the school, and deals with most practical and academic ECTS implementation issues. The communication between the home institution and the host institution is usually done by the school coordinators.

Both coordinators ensure the smooth integration of students from other countries in their institution. They also ensure that their students who travel to other countries make progress at the host institution by maintaining regular contact with them.

THE INFORMATION FOLDER

Each institute that uses ECTS system creates information folders that provide a guide for potential partners and students as well as staff at partner institutions, on courses, teaching materials, academic and administrative arrangements. The purpose of the information folders is to facilitate information on the content of studies, to help teachers to guide students in choosing the right Programmes and to plan their studies abroad, and to provide practical information.

THE CERTIFICATE OF STUDIES

The transfer of credits to ECTS takes place through the exchange of certificates of study between the home and host institutions and vice versa.

The Certificate of Studies presents the student's academic results in the ECTS before and after the study period abroad. Each course attended by the student is recorded on the Certificate of studies not only together with the ECTS credits but also with the grade of the student awarded according to the local grading scale and, possibly, the grade according to the ECTS grading scale. The combination of ECTS points and credits represents the student's performance expressed in qualitative and quantitative terms, respectively.

A signed copy of the Certificate of studies is provided to all interested parties: the institution of origin, the host institution and the student.

Certificates of studies issued by the institute of origin

ECTS certificates for students going abroad include all the details of previous higher education and are attached to the student application form sent to the host institution or institutions.

Certificates of studies issued by the host institution

The Certificate of studies is the main document that accompanies the student's request for full recognition of studies and transfer of ECTS credits and proof of study abroad.

Further studies abroad

The ECTS student may then return to the home institution or remain in the host institution - possibly for a Diploma - or move to a new host institution. The institutions themselves decide whether to allow this alternative and which conditions the student must meet in order to transfer his enrollment or even obtain a Diploma. The Certificate of studies is a very useful tool for the decision of the institutions, as it provides them with a detailed history of the student's academic results.

THE ECTS RATING SCALE

ECTS guarantees the academic recognition of studies abroad, providing a measure of evaluation and comparison of student's results and their transfer between institutions. A distinction must be made between credit units, which reflect the quantity of work, and grades, which express quality.

Test and evaluation results are usually expressed in grades. However, many different grading systems coexist in Europe. In addition, the issue of transfer of grades is the main concern of students participating in ECTS:

(A) on the one hand, the interpretation of grades varies considerably from one country to another, and possibly from one subject area to another, or between institutions,

B) on the other hand, the failure to transfer grades can have serious consequences for the mobility students.

The ECTS grading scale was therefore developed with the aim of assisting institutions in converting the degrees awarded by host institutions to ECTS students. This scale provides information about the student's academic performance that complements those provided by the institute's grades, without substituting local grading. Higher education institutions decide how to apply the ECTS rating scale to their own system.

The transfer of degrees is done with the help of a common scale that is understood throughout Europe. Such a common scale has the following characteristics:

- is precisely designed and any institution can use it to award ECTS grades for the courses attended by the student at that institution,
- therefore, the ECTS score complements the information provided by the institution's score, without replacing it,
- the ECTS grading scale is understood by other institutions, which can provide the appropriate grade of their own scale for each student who leaves or returns with ECTS grades,
- the ECTS grade refers, together with the grade awarded by the institution, to the student's Certificate of studies which lists the student's academic results before and after the study period.

In other words, the common scale does not interfere with the normal grading procedures within each institution. The ECTS rating scale is based on the combined use of appropriate keywords and numerical ratings to help improve the transparency of these words.

The ECTS rating scale

Degree ECTS	Degree of school	% Students	Definition
A	9, 10	10	EXCELLENT – excellent results with insignificant shortcomings
B	8	25	VERY WELL – above average, with some shortcomings
C	7	30	WELL – good work with some significant shortcomings
D	6	25	ENOUGH WELL – acceptable level of work, but with serious shortcomings
E	5	10	SATISFACTORY – the work meets the minimum criteria
FX	3, 4	-	FAIL – more effort is required for successful completion of the course and the award of credits
F	0, 1, 2	-	FAIL – much more effort is required

The number of scores on the ECTS rating scale is a compromise product; a less detailed ECTS rating scale would provide very little information while a more detailed one would require a level of accuracy that does not exist, and would require much more work on the rating. The definitions of the five points of success have been chosen in such a way that the greatest emphasis is given to the points "A" and "E".

The parallel use of the term "excellent" and the statistic "the top 10% of students" represent two approaches to a common goal. The scale does not impose a definition of "excellent" for each institute. Instead, it imposes this definition on ECTS grade A. The choice of 10% was made after much thought. A more restrictive definition would be difficult to apply in some institutions, while a broader definition would degrade the results of truly excellent students.

In addition, the grading scale is not based on the assumption of any grade distribution to students, but rather is based on the definition of "excellent" according to ECTS. Ultimately, the definition of "excellent" according to ECTS and the degree corresponding to it are designed to facilitate transportation without, however, substituting or degrading the importance of the degree awarded by the host institution.

How to use the ECTS scale

It is impossible to define a single relationship between the scoring systems of European countries. In most countries, there is a nationwide rating system that is by no means universal. In addition, the definition of grade "satisfactory" on a given scale may differ between institutions,

while the degree to which the available range is used varies considerably between institutions, years and subject areas.

Therefore, one of the foundations of the ECTS rating scale is to design it with the appropriate precision so that institutions can decide for themselves how to implement it.

The way to adjust an institution score on the ECTS rating scale is as follows:

- The institution examines the distribution of grades awarded to students. In order for the ratio 10-25-30-25-10 to emerge, the limits between grades must be set at 10%, 35%, 65% and 90% of the total number of successful candidates.
- It may not be appropriate, or even feasible, to set statistical limits on the grades awarded to the top 10% of students. In addition to statistics, keywords need to be studied. Although the scale is statistically well-founded, these data should be combined with a realistic descriptive approach. For example, when awarding an ECTS "A" grade, a UK institution awarding "first-class Honors" to 8% of its students may decide to adopt the same definition of "excellent" for the ECTS grade. An Italian institute that scores 14% of its students with "30 elode" will probably not be able to further distinguish these students. On the other hand, the award of "Matriculade Honor" by a Spanish institute is given to less than 5% of students and is therefore an extremely limited definition of excellent for ECTS purposes.
- The low resolution of official grades in Spain, the Netherlands and possibly Greece can create difficulties in setting limits for ECTS grades. As an extreme example, 70% of the students in a class received a grade of 7 in the official grading of a Dutch institution. This grade includes ECTS grades "C" and "D". But in normal practice, the official grade is 7 even when the examiner has scored differently, for example with 6.8 or 7.2. In these countries examiners' grades can be used to make a realistic distribution of students on the ECTS scale.
- The distribution of points used to create the ECTS scale is important. The distribution of grades can vary from one year of study to another, and there may be differences between study Programmes in terms of quantity or quality. The closer an institution is to a specific correlation between its grades and the ECTS rating scale, the easier the rating process. However, ease of use should not lead to significant and systematic deviations from the definitions of the grading scale, in other words students should not be underprivileged.
- When the number of students participating in a class is too small, a strict distribution of this small number in the model 10-25-30-25-10 does not help. From experience, however, it has been observed that:

  i) grades in different classes of similar level follow a similar distribution, and

  ii) the distribution of grades over a five-year period is more likely to produce a balanced result.

- The information provided by the ECTS grade links the student's performance to the performance of the other students in the class. Of course, a high-level student who is placed in a lower-level class is expected to get a better grade than would be expected based on their overall performance. Similarly, a student accustomed to descriptive courses will feel disadvantaged if the host institution emphasizes computational skills. Problems of this kind are not solved by any grading scale; the information conveyed in the Certificate of studies should reflect reality and not a hypothetical or ideal situation.
- The grades must be attached to the award of credits for separate courses when they are presented in the Certificate of studies. That is why it is important that the distribution of points expressing the average of the year is not considered appropriate for determining these grades, because the average grades of the year almost always show a distribution that differs significantly from that of courses that compose the average. For example, more students achieve a very good grade in a particular course than those who would receive this grade as an average for year-round courses. This may have serious consequences for the definition of ECTS grade "A", and fewer consequences for "B".
- ECTS scores from A to E involve the award of credits. No credits are awarded for FX and F grades. However, the distinction between FX and F helps determine the future Programme of some students with unsatisfactory performance. Institutions that do not provide for separation of failure levels use only F grade and ignore FX.
- When the institution of origin and the host institution decide on how to convert their points to and from ECTS points, the transfer of grades takes place.

CALCULATION OF THE ECTS CREDITS OF EACH COURSE

The ECTS (**E**uropean **C**redit **T**ransfer **S**ystem) academic units of a course are a numerical value that reflects the student's overall effort to attend and successfully passes the exams of a course. This number represents the workload required for each course concerning the total workload required to complete a full year of academic study (60 ECTS credits).ECTS credits correspond to the hours the student spent for the course (attendance of lectures and tutorials, laboratory practice, internships, participation in seminars, assignments, personal study, participation in exams, or other assessment procedures).Each course corresponds to 5 or 10 ECTS credits. The research Diploma Thesis comprising experimental work (research) corresponds to 20 ECTS credits, while the bibliographic one corresponds to 10 ECTS credits. The minimum number of ECTS credits required to obtain a Diploma in Chemistry is 240

The admissions and the methodology followed so that the "workload" of the student for the success of the educational goal of each course to be converted into units of the ECTS system, are summarized as follows:

- The total working time of the student is considered to be 40 hours per week.
- Each semester lasts 18 weeks.
- Each semester includes 14 weeks of teaching and workshops.
- The students' working hours per semester are (18 weeks × 40 hours per week) 720 hours (actual workload).
- Each semester corresponds to 30 ECTS credits resulting in approximately 25 hours of employment per ECTS credits (720: 30 = 24), and therefore each 5 ECTS course corresponds to approximately 125 hours of the total workload.
- The following mathematical formula is used to assign the workload of a course to its ECTS credits:

where:

ω_1 = teaching hours (theory and tutoring) of the course per week (× 14 weeks),

ω_2 = hours of laboratory practice per week (× number of weeks during which each student exercises),

ω_3 = hours for projects,

ω_4 = hours for study,

ω_5 = hours for exams and

ω_6 = hours for any other additional engagement.

ω_1, ω_2, and ω_5 are measurable quantities, while ω_3, ω_4, and ω_6 are evaluated and determined mainly by the teaching staff (although the participation of the students with the course evaluation sheets is considered important for their rationalization).

5. PROGRAMME OF UNDERGRADUATE STUDIES

The Programme of Undergraduate Studies of School of Chemistry is organized according to the provisions of current legislation, the decisions of the Assembly of the School, and the internal regulations of the Aristotle University of Thessaloniki. More details are given in Section 6 of the Guide. The following is a detailed report of the courses and their contents. You will find the Programme of studies on the website of School of Chemistry:
https://www.chem.auth.gr/spoudes/programma-proptyxiakon-spoudon/

This is designed so that during the first three years of studies a broad development of the Science of Chemistry is realized through the compulsory contact of students with the basic disciplines of Chemistry (Analytical, Inorganic, Organic and Physical Chemistry). From the second year of studies, the in-depth development of the basic disciplines starts as well as their contact with more specialized disciplines (Biochemistry, Chemical Technology). In the third year of studies, the possibility of shaping the preference for the Specialization Stream each student wishes to follow in the next year of studies through the selection of semi-compulsory courses. The student can make professional plans during the fourth year of studies through elective courses relevant to the Specialization Stream selected and the Diploma Thesis that can be carried out with some prerequisites.

The students are taught, during the first three years, the compulsory courses of the core Programme (1^{st}-6^{th} semester) together with the semi-compulsory and core elective courses, for the completion of their background of basic theoretical and laboratory knowledge in the disciplines of Chemistry. In the fourth year of studies, the students have the opportunity to choose a Specialization Stream and are taught relevant elective courses (7^{th} and 8^{th} semester), to acquire specialized knowledge in disciplines of Chemistry which they prefer through the attendance of the corresponding modern and emerging trends. During their fourth year of studies, students can carry out a Diploma Thesis (research or bibliographic).

Under the Programme of Undergraduate Studies, students also have the opportunity to:

• obtain a Certificate of Computer Operation after successful examination in four relevant courses.

• perform an Internship.

• participate in the ERASMUS+ Programme, which allows them to pursue a scholarship or part of their studies (Erasmus+ Studies) at a European Higher Education Institution, without paying tuition or internship (Erasmus+ Train) in a business, research center, training center or other organization based in Europe, with full academic recognition (see relevant section).

More details are available in the online guide (e-guide): https://qa.auth.gr/el/studyguide/600000182/current.

Learning outcomes of the Programme of Undergraduate Studies are the acquisition by the students of:

- fundamental theoretical knowledge in the individual disciplines of Chemistry so that they can describe the basic concepts and principles that govern them,
- specialized knowledge in applied disciplines of Chemistry, such as Materials Chemistry, Food Chemistry, Macromolecular Chemistry, Chemical Catalysis, and Environmental Chemistry and their applications so that they can analyze in depth the concepts and principles that govern them,
- basic knowledge and laboratory skills through their involvement with modern analytical techniques and technologies,
- ability for experimental design, making scientific hypotheses and results evaluation,
- skills of written and oral presentation of scientific data,
- adequate qualifications for teaching the science of Chemistry in schools and educational institutions, only if they have successfully attended and examined in relevant courses (listed in the Study Guide),
- Adequate qualifications to practice the profession of oenologist, only if they have successfully attended and examined in relevant courses (listed in the Study Guide).

A detailed report of all the courses and their contents follows. You may find the updated study Programme on the website of School of Chemistry:
https://www.chem.auth.gr/spoudes/programma-proptyxiakon-spoudon/

6. REGULATION OF OPERATION OF THE PROGRAMME OF UNDERGRADUATE STUDIES

6.1. General provisions of the Programme of Undergraduate Studies

The undergraduate studies in the School of Chemistry are organized under the provisions of the current legislation, the decisions of the Assembly of the School, and the internal regulations of the Aristotle University of Thessaloniki.

The educational work of each academic year is structured in two semesters, the winter and the spring. The courses of the winter semester start during the last week of September or the first days of October and end within the second ten days of January. Spring semester courses begin in the second week of February and end at the end of May.

The studies in the School of Chemistry have a total duration of eight semesters. In the first six semesters ("Core" Programme) compulsory courses are taught in the basic (Inorganic, Organic, Physical, and Analytical Chemistry) and other disciplines of Chemistry (Biochemistry, Quantum Chemistry, Chemical technology), compulsory support courses (Physics, Mathematics), semi-compulsory courses in chemistry (Macromolecular Chemistry, Environmental Chemistry, Food Chemistry, Materials Chemistry, etc.) and elective courses in Chemistry and other Natural Sciences. In the last two semesters, elective courses are taught exclusively in the following four (A-D) specialization streams:

- Specialization Stream A “Theoretical Chemistry and Chemical Education”
- Specialization Stream B “Chemical Analysis – Environment - Electrochemistry”
- Specialization Stream C “Chemical Synthesis - Biochemistry and Bioapplications”
- Specialization Stream D “Chemical Technology and Industrial Chemistry”

In one of the last two semesters, research or bibliographic Diploma Thesis may be carried out, which are also elective courses. The selection of students in the different specialization streams is based on the procedure described in detail below.

Definitions

To understand the Programme of Undergraduate Studies and its operation, it is necessary to know the following concepts:

ECTS Credits. They correspond to the total "workload" of the student (hours of theoretical and tutoring, hours of laboratory practice, hours of study, etc.) per course described in detail below.

Each course corresponds to certain ECTS credits. The minimum number of ECTS credits required to obtain a Diploma in Chemistry is 240.

Compulsory courses. Courses that the Assembly of School considered as necessary for the scientific training of a graduate chemist. The student must attend these courses and be successfully examined to be awarded a Diploma in Chemistry. ECTS credits per compulsory course amount to 5 or 10.

Semi-compulsory courses. Group of courses of different disciplines of Chemistry from which each student must choose six (in the third year of studies). The ECTS credits per semi-compulsory course amount to 5.

Elective courses. They are divided into two subcategories:

(a) *Core Elective Courses*. Group of courses related to Chemistry and other Physical Sciences from which each student is obliged to choose three (in the first and second year of studies). The ECTS credits per course of course selection are 5. These courses also include 2 ECTS credits related to the Terminology of Chemistry in Foreign Language, from which each student must choose one (in the first year of studies). The ECTS credits of this course are not counted as necessary for obtaining the Diploma.

(b) *Specialization Stream Elective Courses*. Groups of courses per Specialization Stream from which each student who has joined in a specific one must choose (in the fourth year of study) eight or ten, if he/she will carry out a research Diploma Thesis or a bibliographic one, respectively, or twelve in the case that he/she will not carry out any Thesis. The ECTS credits per course amount to 5.

In order to teach a semi-compulsory course or core course or Specialization Stream elective course, it must have been selected by at least five students.

Optional courses. Specialized courses of the School or other Schools of the University, such as, for example, the courses Oenology I, Oenology II and Elements of Viticulture, which can be attended by the students of Specialization Stream D to be granted when he/she completes the studies, a certificate of oenological education, which is necessary for obtaining a license to practice the profession of Oenologist. The conditions for issuing the above certificate are listed below. The ECTS credits of each optional course also amount to 5, are not counted in the required ones for obtaining the degree, are registered in the student's record, and are listed in the Certificate of Detailed Score. These courses also include the “Internship in the Profession”, which is conducted according to what is also mentioned below.

Course code numbers. Each course is encoded with a capital letter followed by a two- or three-digit number when it is related to a core or specialization stream course, respectively. The capital letters

used are common in the Greek and Latin alphabet. These imply a compulsory course (Y), semi-compulsory (H), optional of the core (A or B), or Specialization Stream (K). The code of a compulsory course with two capital letters indicates that it has derived from the separation of the course into a theoretical (YN) and one with Laboratory/practice (YE). The code of an elective course for specialization stream with two capital letters (KN) implies that it has derived from another course that had at least a different title. The first digit of the three-digit number in the code of the specialization courses indicates the specialization stream (1 for A, 2 for B, 3 for C, 4 for D). The code number of the research Diploma Thesis consists of the letter Π and a two-digit number corresponding to the Laboratory in which it is carried out, while that of the bibliographic Diploma Thesis consists of the letters ΠΒ and a two-digit number corresponding to the Laboratory in which it is carried out. Finally, the code number of the optional courses consists of the letters ΠΡ and a two-digit number (except two of those that are courses of other Schools).

Calculation of the ECTS credits of each course

The admissions and the methodology followed so that the "workload" of the student for the success of the educational goal of each course to be converted into units of the ECTS system, are summarized as follows:

- The total working time of the student is considered to be 40 hours per week.
- Each semester lasts 18 weeks.
- Each semester includes 14 weeks of teaching and workshops.
- The student's working hours per semester are (18 weeks × 40 hours per week) 720 hours (actual workload).
- Each semester corresponds to 30 ECTS credits resulting in approximately 25 hours of employment per ECTS credits (720: 30 = 24), and therefore each 5 ECTS course corresponds to approximately 125 hours of the total workload.
- The following mathematical formula is used to assign the workload of a course to its ECTS credits:

$[\omega_1 + \omega_2 + \omega_3 + \omega_4 + \omega_5 + \omega_6] / 25$ = total of ECTS credits

where:

ω_1 = teaching hours (theory and tutoring) of the course per week (× 14 weeks),

ω_2 = hours of laboratory practice per week (× number of weeks during which each student exercises),

ω_3 = hours for projects,

ω_4 = hours for study,

ω_5 = hours for exams and

ω_6 = hours for any other additional engagement.

ω_1, ω_2, and ω_5 are measurable quantities, while ω_3, ω_4, and ω_6 are evaluated and determined mainly by the teaching staff (although the participation of the students with the course evaluation sheets is considered important for their rationalization).

Course registration

The student must submit an electronic statement for all the courses (and the compulsory ones) that he/she is going to attend in each semester, before the beginning of the courses of the respective semester and within the first two weeks. A student who does not submit this statement will not be able to attend the courses of the indicative Programme. The replacement of a stated semi-compulsory course is not allowed after the expiration of the time available for the submission of the electronic statement.

The same applies to the replacement of a stated elective course of the core Programme, which is possible before the next winter or spring semester in which it is taught, as well as to the replacement of the specialization stream courses, except for one of them, which can be replaced by a corresponding course even after the expiration of the time available for the submission of the electronic statement by a fourth-year student, which will take place during the period of the statement of the due courses, which is submitted electronically usually three (3) weeks after the end of the exam and for at least ten (10) days.

Any core or specialization stream course that is replaced by a similar course must be deleted from the student's record. To teach any semi-compulsory course, elective course (core or specialization), or optional course, it must have been stated by at least five (5) students.

Laboratory practice in the context of teaching the courses

The participation of students in all laboratory practice provided for each course (compulsory, semi-compulsory, core elective, Specialization Stream elective, optional) is mandatory.

Course Evaluation

Each course is evaluated at the end of the semester by the students through an electronic platform. Information about the course evaluation process is provided on the website of the Quality Assurance Unit (MODIP) of AUTh.

https://qa.auth.gr/el/

6.2 Regulation of operation of laboratories

(Approved by the General Assembly of the School of Chemistry in session no. 3 / 7.5.84 and updated in session no. 715 / 9.3.2020)

A. LABORATORY OPERATION

1. The days and hours of the students' practice are determined according to the study Programme by the respective Laboratory.
2. The time of arrival and departure of students must be followed exactly. Departure takes place after the end of the practice or its completion.
3. The presence in laboratory practice is mandatory.
4. Students are not allowed to depart from the Laboratory during the exercise unless permission is given by the person in charge of the Laboratory course.
5. The regular operation of the Laboratory should not be interrupted throughout the academic year. For such a purpose:

   a) Faculty members should avoid employing students for periodic exams etc. during laboratory exercise.

   b) Students should avoid having Assembly meetings or generally occupying trainees during their practice in the Laboratories. In any such case, however, the students' representatives should inform the person in charge of the Laboratory course at least one day in advance.

B. STUDY, EXAMINATION, AND CONDUCT OF EXERCISES

1. A necessary condition for the successful completion of courses that include laboratory exercises is the successful attendance of all laboratory exercises according to what applies in each laboratory.
2. The number of allowed absences is specified by the regulations of each Laboratory, as well as the possibility or not of replacement. In any case it cannot exceed 10% of the number of laboratory exercises. Each student whose absences exceed this percentage will be required to retake the next academic year at a time determined by each Laboratory, depending on the student's ability to practice.
3. Each trainee student must know the theoretical part of the exercise, properly prepared, provided that he has been informed by the competent staff of the Laboratory. The way of exercising, i.e. administration of reagents, delivery of notebooks, tasks, etc. as well as the way of evaluating the performance of each student and the grade is determined by each Laboratory and becomes known to the trainees / minds at the beginning of the laboratory course.

C. CLEANLINESS AND ORDER IN THE LABORATORY

1. Smoking is prohibited in all indoor areas of the building facilities of the School of Chemistry.
2. Mobile phones must be switched off during laboratory courses.
3. Before the start of the Laboratory exercises, students must update their knowledge about safety issues (emergency exits, protective equipment, use of fire extinguishers, etc.) by the head of the Laboratory.
4. For safety reasons and the operation of the Laboratory during the exercises, those who participate in the exercise, i.e. teachers and learners, will neither eat nor drink in the laboratory, nor will they be unjustifiably removed from them.
5. Students are required to wear a white apron in good condition, to protect their clothes from corrosive substances and have an obligation to keep seats and utensils clean. It is recommended that trainee students wear protective goggles and have their hair properly combed for self-protection.
6. After the end of the laboratory exercises, the students must clean the utensils they have used as well as the space of their workbench.
7. Students leave their coats outside each lab in areas designated by each Lab and wear the white apron before entering the halls. They are responsible for their valuables.
8. Violation of the above entails penalties, which can range from simple observation to removal from the Laboratory.
9. Students do not perform experiments or measurements that are not included in the Programme or have not been indicated by the people in charge of the Laboratory.
10. The presence of foreign persons in the Laboratories during the exercises is not allowed.

D. RECEIPT OF MATERIAL AND REAGENTS

1. The instruments, utensils and reagents for the exercises are administered by the Laboratory.
2. The glassware is charged to the trainee students and in case of loss the trainee student is obliged to replace them.

E. RESPONSIBILITIES OF STAFF

1. The exercise supervisors, faculty members and Special Teaching Fellows (STFs), are required to arrive at least 10 minutes before the start of the exercises and together with the technical staff members must have taken care of the preparation of the reagents and instruments, so that the exercise can begin smoothly. Students must arrive at the specified time.

2. Throughout the exercises, the exercise supervisors must be present at the Laboratory. Students should never be left alone as trainees.

F. SAFETY IN THE LABORATORY

The Committee on Occupational Safety and Health and the Head (and his / her Deputy) of Laboratory Waste Management inform the School about the requirements of the current legislation and the Foundation and the School and take care of this regulation with a joint Recommendation to General Assemble of School. Students and members of the teaching staff are obliged to follow the safety rules set by the School.

The following rules are included in the safety regulation:

a) Pharmacy: According to the existing provisions

The minimum required materials for first aid kits and pharmacies in the workplace are:

a) Acetylsalicylic acid.

b) Paracetamol.

c) Antihistamine tablets.

d) Cortisone tablets (prednisolone 4 mg).

e) Cortisone injection (methylprednisolone 125 mg).

f) Antacid tablets.

g) Antispasmodic tablets.

h) Loperamide antidiarrheal tablets.

i) Ophthalmic solution for washing.

j) Antiseptic eye drops.

k) Antihistamine ointment.

l) Ointment for healing wounds.

m) Gloves.

n) Hand sanitizer.

o) Sterile gauze boxes of five centimeters, ten centimeters and fifteen centimeters.

p) Gauze impregnated with antibiotic (Fusidic acid).

q) Cotton.

r) Plasterboard 0.08 meters wide.

s) Pieces of plaster with sterile gauze.

t) Bandage 2.50 x 0.05 meters.

u) Bandage 2.50 x 0.10 meters.

v) Triangular bandage.

w) Hemostatic bandage.

x) Saline solution 250 or 500 mL.

y) Oxygen.

z) Pure alcohol.

za) Antiseptic solution (solution ext. use Povidone Iodine 10%).

zb) Tongue press.

zc) Disposable cups (paper or plastic).

b) Working with toxic substances.

The use of chemicals by trainee students must be done with care for their protection and safety. The general instructions of the Institution are followed. Students should be aware of the toxicity of the chemicals they use and avoid exposure by inhalation, ingestion or skin contact.

Here are some rules for preventing toxic substances.

1. Volatile toxic: Work must be done on normally operating exhausts.
2. Food and other edible items must not be kept in the Laboratory.
3. Oral pipettes are not used for aspiration of toxic solutions or substances. The appropriate equipment is provided by the Laboratory.
4. Students are advised to have a clean towel or paper towels in place. Toilets or washbasins must have hand soap and a hand-held paper towel dryer.
5. Trainee students (of course the responsible staff of the laboratories) should know if the chemicals they use are toxic and to what extent. Toxicity will be indicated on the reagent labels.
6. Accident assistance must be immediate.
7. When working with highly toxic substances, protective gloves available from the Laboratory are used.

c) Working with flammable substances.

1. Lamps with fire must not be lit without reason.
2. Large amounts of solvents should not be present in laboratory areas.
3. The instructions given for the way of heating and handling of flammable substances (water baths, mantles, etc.) are meticulously followed.
4. The greatest risk of accidents with flammable substances is due to the lack of the necessary tidiness, both in the laboratory and during exercise. Flammable substances are not allowed to remain on the bench when the trainee students are working and especially when there are lighted lamps.

d) Work with radioisotopes

In the case of working with radioisotopes, the safety rules provided for work with toxic substances apply in addition to the following:

1. Employees must be aware of the nature of the radiation, the half-life and the penetration of the radiation with which they work. This information must be posted in the laboratory.
2. Workers must place absorbent paper in a special place on the counter where they will leave only utensils with the radioactive substance. The special tape with the radioactivity signal should be affixed to this position. This paper should be replaced after each major experiment or at least once a month.
3. When the employee uses the original bottle containing the radioactive substance, he should always wear thick disposable plastic gloves.
4. All utensils used must have the special radioactivity tape.
5. Students should pour the liquid radioactive waste into special containers and place the radioactive utensils also in special containers that should each have a visible label with the type of isotope (^{3}H, ^{14}C, ^{32}P).
6. The solid waste should be placed in special nylon bags and will be stored in a place to be determined by the head of the Laboratory.
7. Those working with radioisotopes whose radiation is equal to or greater penetrating than that of ^{32}P should use disposable gloves for all operations and work behind Plexiglas at least 0.5 cm thick.

e) General safety rules

1. Work in laboratories is not allowed without the supervision of the responsible staff of the laboratories.
2. Experiments other than those provided for in the exercise Programme may not be performed.
3. Postgraduate, doctoral candidates and other research staff do not conduct research experiments in the undergraduate student dormitory for as long as their exercises last.
4. Use the special waste bins for the various rubbish (filter papers, broken glasses, etc.), and do not throw them in the sewers. The same applies to solvents of any kind, which are collected in specially labeled containers under the responsibility of the person in charge of waste management from each Laboratory and in accordance with the instructions of the Board of the Faculty of Sciences.
5. The Responsible of each Laboratory has the responsibility to indicate-determine a specific place of temporary storage of waste within the laboratory so as to ensure safety and hygiene conditions for all employees.

6. Gas taps and pressure gauges are always checked with special care. The suitability of the gas cylinders must be checked every six months before the start of the laboratory exercises by the Director of the Laboratory.
7. There must be fire extinguishers with fire extinguishers in each training room. Fire extinguishers must be located below the marked position and must not be moved. The control of the condition of the fire extinguishers is done under the responsibility of the Technical Service of AUTh annually according to the current legislation.
8. After each use, the retreading of the fire extinguishers is the responsibility of the Responsible Laboratory and the Building Supervisor who participates on behalf of the School in the Security and Crisis Management Committee of the Faculty of Sciences is informed.
9. The control of the proper operation of the fumes is done under the responsibility of each Laboratory.
10. Special safety rules are defined by the regulation of each of the 11 Laboratories of the Department. Additional rules should be communicated to the Department of Safety and Health at Work of the Department.

6.3 DIPLOMA THESIS REGULATION

The Diploma Thesis that is optional (elective course), is either research project, which it is equivalent to 20 ECTS credits, or bibliographic, which is equivalent to 10 ECTS credits. The research dissertation can be prepared jointly by two students, but with separate research objects, while part or all of it can be prepared, under the supervision of a faculty member of the School, and outside the premises of the School, as, for example, at a Research Center, University abroad (Erasmus students) or Industry.

Thesis can be prepared at the earliest in the 7th semester of studies by any student who has been successfully examined in courses of the core Programme with over 90 ECTS credits. Its elaboration is not necessarily related to the integration of the student in one direction, although it is recommended that the students prepare a dissertation under the supervision of faculty members or STF doctorates (under the supervision of faculty members) of the School that mainly teaches direction courses.

The main educational purpose of a research dissertation is considered to be the further development of the individual scientific skills of the student who prepares it upon completion of a specific scientific project in a subject of Chemistry. Its sub-objectives include, for example, the preparation of a work Programme for solving a scientific problem, training in specific laboratory / experimental techniques and the evaluation of results based on their correlation with bibliographic data and, finally, the written and oral presentation of the scientific work produced during its elaboration.

The main educational purpose of a bibliographic Diploma Thesis is the search and recording of scientific knowledge through the most recent relevant publications, and training in the use of this knowledge for the development of science and the progress of society, as well as written and oral its presentation.

The dissertation presupposes the daily cooperation of the trainee with the supervising faculty member or STF. The unjustified absence of the trainee for a long period of time provides the right to the faculty member or STF to request the termination of the cooperation. The student has a corresponding right in case of insufficient cooperation and communication with the supervising faculty member or STF. In this case, however, the student must repeat the process for defining a dissertation topic.

Any student who is preparing a dissertation can apply:

a) The cessation of its preparation which is accepted if the supervisor co-signer has been informed. In case of submission of the relevant application within one month from the beginning of the

semester, both (2) and four (4) courses must be mentioned, with which the dissertation will be replaced.

b) The modification of its subject which is accepted if the consent of the supervisor(s) who co-signs it.

(c) The replacement of the supervising entity who is accepted only in the event that he / she is legally absent for a long period of time and provided that the application proposes his / her replacement who consents to the supervision of the dissertation on the specific subject and co-signs.

An application for conversion of a bibliographic Diploma Thesis into a research dissertation is not accepted in order not to circumvent the process by which the topic of the dissertation prepared by each student is defined. The final text of the dissertation is delivered in full to the responsible faculty member or STF at least 10 days before its presentation, in order to make the necessary suggestions and changes. The dissertation is completed with its public oral presentation at the Laboratory where it was prepared (up to ten days after the end of each examination period) and the delivery of two copies, one at the respective Laboratory and the Library of the School. The degree of the dissertation is accepted by the Secretariat only if the Director of the respective Laboratory and the Library of the School confirm the previous ones.

The dissertation must be submitted no later than ten days after the end of the September examination, the year immediately following the academic year, unless the supervising faculty member or PhD student and the student request it, not to count a certain period of time due to objective difficulties. In case this is not presented within the stipulated time period, the student must immediately arrange for the replacement of the dissertation with elective courses that have a cumulative number of ECTS credits equal to that of the Thesis.

Indicative Guide for Writing the Thesis

The library of the School of Chemistry provides all the information electronically (models) but also in the form of seminars for the writing of the Bachelor's and Master's / Doctoral Theses. The Indicative Thesis Writing Guide aims to give some directions that students should follow, and contains basic rules for the structure, writing and presentation of the work prepared by the student. However, its final form will always be determined in collaboration with the supervising faculty member, so that it is as complete as possible. The dissertation should include:

Title

The title, which must express as soon as possible but with the greatest possible clarity the exact object of the work, is determined in collaboration of the student with the supervising faculty member.

Summary

The summary briefly describes the entire content of the paper (approximately 1 page) with emphasis on its purpose, the experimental methodology followed, the results obtained and, finally, the conclusions. The summary can also be written in English.

Table of Contents

The table of contents lists the individual sections, as well as the sub-sections of the work, with the corresponding page, so that there is easier access by the reader.

Introduction

The introduction is in a way the theoretical part of the dissertation and aims to introduce the reader to the scientific object it deals with. Therefore, in this section, more general information is given, as well as a review with the corresponding bibliography in the relevant research that has been carried out until the elaboration of the dissertation. This section should not exceed 50% of the total book size, with 30% of its preferred. Finally, the purpose and necessity of conducting the dissertation with emphasis on the investigation of a scientific subject and the (possible-desirable) development of a scientific excellence are described.

Experimental / Research part

The experimental part describes in detail the methodology of the work and the experiments performed. Reference is also made to the techniques and equipment used. At this point a brief description of the principle of operation of each scientific instrument and the techniques used could be made (1-2 pages), which will be of a purely educational nature.

Results - Discussion

The results obtained during the laboratory research with the application of the respective methodology are presented in detail and distinctly. At the same time, the corresponding processing of the results, the scientific explanation and the discussion on them, as well as their correlation, if this is possible, with previous scientific studies. The aim is to highlight the new elements of the dissertation and its innovation in relation to existing knowledge. This section is also the most essential part of the dissertation, where the student presents all of his / her work, and its success is judged. Emphasis should be placed on the knowledge gained by the student about the methodology followed, the scientific analysis of the results and the ability to be able to manage a similar or different research problem in the future.

Conclusions

The main conclusions of the dissertation are presented, as they emerged from the evaluation of the experimental results (1-2 pages). An assessment must also be made of whether the objectives of the dissertation have been achieved.

Suggestions

It is the last section of the dissertation, where the student presents, based on the research experience he / she has gained from his / her immersion in the respective scientific subject, new ideas and suggests ways for the continuation or development of the scientific study.

Bibliography

The bibliography is presented which includes scientific articles, doctoral dissertations, books and any other book that has been used and referenced in the dissertation, usually in alphabetical order or numbered, according to some standard procedure (e.g. Oxford).

7. CONTENT OF COURSES (THEORETICAL AND LABORATORY/PRACTICE)

Department of General and Inorganic Chemistry

Y01 General and Inorganic Chemistry I

Compulsory course, 1st semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: 4 h/week ECTS: 10

Course Content (Syllabus)

Matter and energy, mass and weight. Units, measurement and equations. Distinguish elements, compounds, mixtures. Atomic and molecular mass. Calculate a percentage composition from formula. Empirical and molecular formulae. Balance chemical equations. Mole, molarity, normality, Avogadro's number. Characteristic properties of solids, liquids and gases. Endothermic and exothermic reactions. Structure of the nuclear atom and isotopes. Atomic structure, electronic shells and subshells, and orbitals. Energy level diagram for the hydrogen atom, and spectrum of atomic hydrogen. Quantum numbers for the hydrogen atom, and for other elements. Interpret orbitals in terms of probability s, p, and d electrons. Aufbau principle, Pauli principle and Hund's rules to build up electron configurations of the elements of the Periodic Table. Periodicity from configuration across and down the Table, and explain trends in radii, ionization enthalpies, electron affinities and electronegativities. IUPAC Nomenclature of Inorganic Compounds. Classification of Inorganic Compounds. Ionic and covalent bonding. Metallic bonding and relate to metallic properties. Hybridization of an atom in a given molecule. Lewis structures for simple molecules. Distinguish sigma and pi bonds. Orbital overlap of s, p, and d electrons, bond order. Molecular orbital energy-level diagram. Non-bonding and antibonding orbitals from s, p, and d combinations. Theories of resonance and p-orbital overlap. Dipoles in polar molecules. Covalent or ionic bonds. Occurrence of intermolecular interactions (van der Waals forces, and hydrogen-bonding). Inter- and intra-molecular hydrogen bonding and van der Waals (London) forces in a molecule. State the Bronsted and Lewis acid-base theory and its applications to salt hydrolysis, buffers and solubility. The theory of redox reactions.

Laboratory practice

Safety rules in Chemical laboratories. Reagent's hazards. Mass and volume measurement. Expression of solution concentration. Preparation of solutions with specific concentration. Simple methods for separation of mixtures. Decantation, filtration, centrifugation. Study of homogeneous and heterogeneous equilibrium and effect of mass and temperature on the equilibrium. Equilibriums

in aqueous solutions of electrolytes. The meaning of pH and its measurement using indicators and pH meters (Principle of pH meter operation). Estimation of the pK of a weak electrolyte. Preparation and study of the buffering ability of buffers. Estimation of the hydrolysis constant of salts in aqueous solutions. Principles and techniques of volumetric analysis. Preparation of standard solutions. Acidimetry – alkalimetry – complexometry – redox volumetric analysis. Redox reactions. Study of the reactivity series of metals and non-metals. Oxidative properties of typical oxidants in aqueous media. Voltaic cells, electrolysis, determination and application of electrolysis laws. Principles of spectroscopy. Application of electronic spectroscopy in the identification and study of inorganic compounds. Homework.

Learning Outcomes

After completing this course, students will be able to:

- connect the macroscopic observation with the corresponding processes at the molecular level.
- operate simple devices and laboratory instruments.
- perform simple experiments and present the results in a protocol work.

Y05 Inorganic Chemistry II

Compulsory course, 2nd semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

The origin of the elements. Systematic description of the Periodic Table group characteristics. Physical and chemical properties, production, chemical behavior, and common technological applications of the main group elements of the Periodic Table and their compounds: Hydrogen, Oxygen, Alkali metals, Alkaline earth metals, Boron, Aluminum, Carbon, Silicon, Nitrogen, Phosphorus, Sulfur, Halogens and Noble gases. Metals and metallurgy.

Laboratory courses/exercises

Basic laboratory techniques for the synthesis, isolation, purification and identification of inorganic compounds. Double-replacement reactions. Isolation of solid products of chemical reactions. Solid-state reactions. Single-replacement reactions. Synthesis, isolation and purity tests of alkali metal salts and boron compounds. Halogens and their oxidizing ability. Transition metals and their compounds: synthesis and isolation of copper and chromium compounds. Acid-base behavior of oxides. Allotropic forms of sulfur. Literature-based project (search the scientific literature and prepare a written report and oral presentation).

Learning Outcomes

After completing this course, the students will:

- be aware of the properties and applications of main chemical elements

- know the properties and applications of common chemical compounds
- know the general properties of group elements
- be familiar to synthesis and isolation techniques of inorganic compounds.

Y19 Inorganic Chemistry III

Compulsory course, 6th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: 4 h/week ECTS: 10

Course Content (Syllabus)

d-Block elements: atomic properties, physical properties, and oxidation states. Coordination compounds and types of ligand. Coordination number and coordination geometries. Nomenclature of coordination compounds. Structural isomerism and stereoisomerism in coordination compounds. Thermodynamic stability of coordination compounds and factors that influence their stability: formation constants, hard and soft acids and bases, chelate and macrocyclic effect, steric effects. Synthesis of coordination compounds: substitution reactions, thermal dissociation, reactions with oxidation of the metal center, reactions of the coordinating ligands, synthesis of isomeric complexes. Bond theories of coordination compounds: crystal-filed theory and ligand-field theory. Magnetic properties and UV-vis spectroscopy of coordination compounds: Orgel and Tanabe-Sugano diagrams). Kinetic stability of coordination compounds. Substitution reactions (mechanisms, substitution in octahedral and square planar complexes), isomerism reactions and redox reactions. Applications of coordination compounds.

Laboratory practice

Synthesis of Nickel(II) coordination compounds dithiocarbamate anions and phosphines as ligands: study of compounds with magnetic susceptibility measurements, electrical conductivity measurements and FTIR Spectroscopy. Synthesis of manganese (III) and nickel (II) coordination compounds with Schiff bases as ligands: study of compounds with magnetic susceptibility measurements and FTIR spectroscopy. Synthesis of cobalt(III) coordination compounds with water, ammonia and diethylamine as ligands: study of compounds with magnetic susceptibility measurements, electrical conductivity measurements and UV-vis spectroscopy (determination of the spectrochemical series of various ligands). Laboratory reports. Literature assignment.

Learning Outcomes

After completing this course, students will be able to:

• To understand the basic principles which govern the chemistry of coordination compounds.

• To interpret macroscopic characteristics and physicochemical properties of coordination compounds based on appropriate electronic structure theories.

• To plan and carry out the synthesis and physicochemical characterization of coordination compounds by means of suitable laboratory apparatus and laboratory instruments.

• To operate spectrometers and other laboratory instruments and understand the basic principles governing the respective methods.

• To handle problems on synthesis and identification of complexes.

• To present the results of laboratory studies in the form of laboratory reports.

• To present research articles using audio-visual media.

H11 Materials Chemistry

Semi-Compulsory course, 6th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Basic principles of crystallography. Types of crystalline solids. Powder and single crystal X-ray diffraction, prediction and/or determination of crystal and molecular structure. Optical properties of solids. Physical and chemical properties of materials such as semiconductive polymers, metal oxides and semiconductors. Thin films and nanostructures. Conductivity mechanisms. Ionic and electronic conductivity in imperfect crystals. Models of point defects in non-stoichiometric oxides. Examples of applications. Intermolecular interactions and the formation of supramolecular structures. Liquid crystals. Organic materials. Systems with nonlinear optical properties. Molecular wires and switches. Membranes and transport systems. Biomaterials and nanomaterials. Micelles. Applications in synthesis and catalysis.

Learning Outcomes

By the successful completeness of the course, students will:

- know about the crystal structure of solid materials
- understand basic principles and the importance of X-ray diffraction
- know the importance of dopants and their role on the electronic properties of inorganic semiconductors
- predict the electronic and ionic conductivity of metal oxides
- know the molecular structure of liquid crystals and the correlation between structure and properties
- understand the principle of important applications of liquid crystals
- know the molecular structure of intrinsically conducting polymers and the correlation between structure and properties
- understand the conduction mechanism in conducting polymers and principles of basic applications

B02 Radiochemistry and Nuclear Chemistry

Core Elective Course, 4th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Structure and properties of the atomic nuclei. Radioactivity. Radioactive decay. Radioactive equilibrium. α., β. and γ. decay-spontaneous fission. Interaction of the nuclear radiation with the matter. Detection of the nuclear radiation. Nuclear reactions. Nuclear fission. Nuclear fusion. Actinides: Production and chemical behavior. The biological effects of the nuclear radiation and radiation protection. The uranium cycle-Nuclear energy. Reactors, accelerators and their applications.

Laboratory Practice

Radioactive decay. Radioactive equilibrium. α., β. and γ. decay. Interaction of the nuclear radiation with the matter. Nuclear reactions.

Learning Outcomes

- Knowledge of the principles of Radiochemistry.
- Nuclear Chemistry Knowledge of the experimental set up of Radiochemistry
- Nuclear Chemistry Exercises in radiation measurements, decay mode and analysis of the results
- Knowledge of the principles applications of Radiochemistry-Nuclear Chemistry.

K316 Radioanalytical Chemistry and Applications of Nuclear Techniques

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Subatomic particles-structure and decay of the atomic nuclei-Radioactive series. Absorption of nuclear radiation (Absorption of charged particles, neutrons and photons). The measurement of the nuclear radiation-Detectors. Nuclear reactions-cross section, Q-value and energy balance. Nuclear safety-radiation units. Natural radioactivity. Radioactive elements in the environment. Uranium: separation techniques, determination and applications. Methods for determination of radioactive elements. Nuclear wastes treatment. Radiochemical and nuclear methods of analysis. Neutron activation analysis, x-ray fluorescence. Radioactive tracers. Radioactive dating methods. Production of radioisotopes-Radiopharmacy. Application of radioisotopes and radiations in the chemistry and biology. Application of reactors in the art and technology.

Laboratory practice

Detection and measurement of nuclear radiation, measurement statistics, dead-time determination, absorption of nuclear radiation by the matter, alpha- and gamma-ray spectroscopy, natural radioactivity, determination of uranium and thorium.

Learning Outcomes

- Knowledge of the principles of Radiochemistry- Nuclear Chemistry
- Knowledge of the experimental set up of Radiochemistry- Nuclear Chemistry
- Practice in radiation measurements and analysis of the results
- Knowledge of the principles techniques and applications of Radiochemistry-Nuclear Chemistry

K105 Didactics of Chemistry and the Role of Experimenting in Chemistry Teaching

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Introduction to the principles of teaching of physical sciences. Principles of teaching as applied in chemistry. Factors influencing the teaching of chemistry. Teaching methods. Formulation and adoption of safety rules in the school lab. Organization and classification of reagents, utensils and laboratory space. Organizing the presentation of an experiment. Objective explanation, process description, discussion of observations and results. The interaction of trainees with the teacher and each other. Analysis and evaluation of experimental test results. Assessment of the achievement of the experimental objectives in terms of the extent and type of understanding of the principles and laws governing the phenomenon studied. The demonstration experiment. Organizing and presenting to groups of students. Demonstration in microscale and in a diaphragm. Grading of difficulty, complexity and accuracy of observations for experiments aimed at students of different ages and backgrounds. Interdisciplinarity in Chemistry experiments and reference to everyday Chemistry.

Learning Outcomes

The students are expected at the end of the course to be able to:

1. Understand the main points within a chapter of any textbook they have to teach.
2. Organize these points in a form of an hour of teaching.
3. Organize the appropriate supporting material for presentation during teaching.
4. Plan a discussion with the students about the results and conclusions reached after the teaching is finished.
5. Answer any simple question put forward by students as well as ones based on student misconceptions on the topics taught.
6. Organize and setup the school lab room.

7. Organize the appropriate experiments in line with the Ministry of Education requirements but not overlooking the specific conditions occurring as well as the educational outcome of the experiments.

K109 History and Epistemology of Physical Sciences

Specialization Stream Elective Course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Science and the scientific method. How philosophy faces science. Limits and practices of epistemology. The epistemological approach on the part of philosophers and experimental researchers. Philosophical trends that have influenced or influenced science, from antiquity to modern times. The foundation of the sciences in antiquity and the historical evolution of the ideas in them in their course to modern times. The foundation of the sciences in antiquity and the historical evolution of the ideas in them in their course to modern times. Historical evolution of perceptions about the natural world. The theoretical conception - the mechanistic perception - the quantum vision of the world. Distinction of Chemistry from the backbone of natural sciences and the course of evolution of theories and perceptions in it up to modern times

Learning Outcomes

At the end of the course the students are expected to be able to:

1. Know the main philosophical movements that have been reported in history.
2. Know the relation of the main philosophical movements to science.
3. Know the main events in the evolution of science
4. Know the current scientific theories as well as the preceding ones.
5. The course through the initial proposal of an idea to the point of its acceptance as a scientific theory.
6. Know the general eras of scientific evolution and especially of chemistry evolution.
7. Know the persons related to the above achievements
8. Possess the ability to recall, manipulate and use the above knowledge in the course of teaching Chemistry to secondary school students.

K301 Bioinorganic Chemistry

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Evolution of life. Evolution and homeostasis stages. Creation of biological systems. Redox potentials and bioelements. Trace elements *in vivo*. Selective binding, cooperative and competitive activity of trace elements. The role of metal ions in biological systems. Bioinorganic chemistry and applications (coordination compounds *in vivo*, metalloenzymes). Iron metalloproteins. Metalloenzymes of manganese and the role of manganese in the oxygen evolving center of photosystem II. Copper *in vivo*. Zinc enzymes. Molybdenum *in vivo*. Elements and their compounds used as drugs. Physical methods to study metalloenzymes. Interaction of metal ions and coordination compounds with nucleic acid and other biomolecules.

Learning Outcomes

After completing this course, students will be able to:

- be aware of the role of the trace elements
- be aware of the role of the metals in life and as drugs
- know some important metalloproteins and their significance

K302 Organometallic Chemistry and Catalysis

Specialization Stream Elective Course, 8th semester

Lecture: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

General principles, characteristic properties of organometallic compounds, formation of metal-carbon bonds. Structure, reactivity and applications of different classes of organometallic compounds. Role of organometallic compounds in some reactions with applications of industrial interest, catalysis. Synthetic organic reactions catalyzed by metals. Catalytic hydrogenation and oxidation. Mo and Ru catalysts in alkene metathesis reactions. RCM, ROMP, Cross metathesis. Organometallic compounds of Cu. Organometallic compounds of Pd. Heck-reaction, Suzuki-reaction, Pauson-Khand-reaction. Stille-coupling. Other organometallic reactions.

Learning Outcomes

Upon completion of the course, students will be able to:

• understand the chemical behavior of organometallic compounds and their role in industrial catalytic processes.

• collect, evaluate, organize and present orally scientific information.

K303 Physical Methods in Inorganic Chemistry

Specialization Stream Elective Course, 8th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Basic principles of the spectroscopic techniques and other physical measurements that apply to inorganic and organometallic compounds. Selection rules in spectroscopy. Electronic absorption and emission spectroscopy. The interferometer and Fourier analysis. Mathematical background and applications. Vibration spectroscopy and analysis of normal coordinates. The magnetic behavior of inorganic systems. Elucidation of the structure of inorganic compounds through the measurement of their magnetic susceptibility. EPR and NMR spectrometries and their applications in the structural characterization of inorganic and organometallic compounds,

Learning Outcomes

After completing this course, students will be able to:

- understand the method discussed from the pattern and measurement units of a spectrum.
- understand the physical or chemical process taking place during a physical study of an inorganic system.
- define the kind of measurement that must be made in order to obtain specific information about a substance they synthesize or possess.
- understand the main and secondary observables of a physical measurement and their relation to the structure of the system studied.
- perform typical processes for smoothing, correction and optimization of the spectra line through specific algorithms.

KN304 Nanochemistry

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial : 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Nanomaterials and Nanotechnology, Inorganic Nanoparticles, Coated Inorganic Nanoparticles, Wet Synthesis Methods (Co-precipitation, Thermal Decomposition, Solvent Thermocrystalline, Microwave, Microemulsions), Isolation, Physicochemical characterization Methods, Properties of Inorganic Nanoparticles (magnetic, optical, optical, electrical), Inorganic natural microporous-mesoporous materials, zeolites and clay minerals, synthetic zeolites-clays, methods and parameters of synthesis, characterization methods, environmental (Adsorption-Ion exchange), industrial and medical applications. Synthetic inorganic nanoparticles and environmental applications (retention of radionuclides and heavy metals). Modern metal nanoparticles for technological and medical applications. Nano-radiopharmaceuticals in nuclear medicine-applications.

Learning Outcomes

After successful completion of the course, students are expected to:

1. be up to date on inorganic nanomaterials and their prospects.

2. be familiar with the methods of inorganic nanoparticle synthesis by wet chemistry.

3. be familiar with methods for characterization of inorganic nanoparticles.

4. understand how the properties of inorganic materials vary at the nanoscale.

5. be aware of applications of inorganic nanoparticles of biological interest.

6. be up to date on technological and medical applications of inorganic nanoparticles.

7. get to know natural nanomaterials, their improvement methods and applications as well as methods of their improvement and synthesis in the laboratory and specific characterization techniques.

Y11 Quantum Chemistry & Introduction to Spectroscopy

Compulsory course, 3^{d} semester

Lectures: 2 h/week Tutorial: 2 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Historical outline of the early quantum mechanics. Schrödinger equation and its application in simple systems. Quantum mechanical study of hydrogen-like and polyelectronic atoms. The spin of the electron and antisymmetric wavefunctions. Quantum chemical study of molecular structure. Molecular Orbital Theory and LCAO. Quantum chemical study of diatomic molecules and p-conjugated systems. Principles of spectroscopy. Electron and vibrational spectroscopies.

Learning Outcomes

At the end of the courses students will be able to:

- write down the Schrödinger equation for simple systems.
- describe the results of quantum chemical study of hydrogen-like and multi-electron atoms.
- setup an antisymmetric function.
- apply the LCAO method on molecular systems.
- describe the electronic structure study diatomic molecules and p-conjugated systems.
- identify the symmetry elements and find the point group of a molecule.
- describe the principles of electronic, vibrational, NMR and ESR spectroscopy.

H10 Computational Chemistry

Semi-Compulsory course, 6th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Approximate methods of quantum chemistry (Pertubation and Variation methods) of Disturbances and Change Theory). Hartree-Fock Theory. Basis sets. Study of potential energy hypersurface of

molecules. Population analysis and Natural orbitals. The practice of quantum chemical calculations. Molecular Mechanics. The tools of computational chemistry.

Learning Outcomes

At the end of the courses, students will be able to:

- apply quantum chemical and molecular mechanics calculations for geometry optimization and study of the electronic structure of a molecule.
- interpret the results of quantum chemical and molecular mechanics calculations.

H 13 Real, Virtual and Hybrid Laboratories on Principles and Laws of Chemistry in Formal and Informal Education

Semi-Compulsory course, 6th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Applications that combine the real experiment in the real laboratory, where the physical presence of the learner is required, with the virtual experiment, concerning subjects on principles and laws of chemical science, such as:

Quantum description of atom. Periodic Table - Electronic configuration, Reactions' Stoichiometry, Types of Reactions, Determination of Quantities of Educts and Products, Measurement of Physicochemical Parameters, States of Matter, Thermochemistry, Properties of Solutions (Non-Electrolytic and Electrolytic), Chemical Equilibrium, Ionic Equilibrium, Chemical Kinetics, Redox reactions, Galvanic cells, Electrolysis.

Learning Outcomes

Upon successful completion of the course, students will be able to use applications of virtual labs concerning fields of Chemistry described in the Course Content (Syllabus) and explore their parallel use with real labs.

A05 Introduction to Informatics

Core Elective Course, 2nd semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Computer Architecture and Operation. Programming elements. Use word processing software, worksheet management, and electronic presentations. Chemical design and Internet used programs.

Learning Outcomes

After completing this course, students will be able to:

- use Excel to form plots based on equations.

- adapt experimental data.
- understand Python and apply it to Chemistry problems.

K101 Molecular Modeling

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Definition of molecular modeling. Molecular graphs. Molecular engineering. Minimization of energy. Conformation analysis. Structural studies of biomolecules and polymers. Calculation and visualization of molecular properties based on *ab initio* and semi-imperial calculations. Molecular dynamics. The technique of molecular docking.

Learning Outcomes

At the end of the course students will be able to:

- apply molecular mechanics software packages for the study of molecular structure.
- study of the structure of biomolecules.

KN102 Molecular Symmetry and Group Theory

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 10

Course Content (Syllabus)

Symmetry Elements and operations. Point Groups. Group theory and molecular symmetry. Point group representations. Character tables. Applications of Symmetry and Group Theory in Quantum Chemistry and Spectroscopy.

Learning Outcomes

Upon successful completion of the course, students will have the knowledge to apply the principles of molecular symmetry and group theory to problems related to the physicochemical properties, the electronic structure, and the spectroscopy of chemical compounds.

K103 Application of Excel Sheets in Chemistry

Specialization Stream Elective Course, 8th semester

Lecture: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Introduction to Calculation Sheets (Excel). Graphs. Linear and non-linear minimum squares. Data mining, derivation and integration. Statistical analysis of data with worksheets. Creation of complex

data and application in the reproduction and study of physicochemical systems. Introduction to macros.

Learning Outcomes

Upon successful completion of the course, the student is expected to:

- be able to import and format experimental data on Microsoft Excel spreadsheets with the ability to edit and present them in graphs.
- be familiar with the application of Excel in data analysis and evaluation (price confidence intervals, error estimation, data correlation).
- implement statistical case controls.
- understand the theory of least squares and apply linear and non-linear curve adjustment (regression) to experimental data.

K104 Structuring, Presentation and Transmission of Chemical Information

Specialization Stream Elective Course, 7thsemester

Lecture: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Databases of chemical information and data. Format of molecular structure description files. Tools for building, visualization and saving 3D graphics. Graphics' file formats and editing software. Tools and techniques for writing scientific texts. Presentation tools. Structure, organization and running of a web site. Website's development tools.

Learning Outcomes

After the course, students will be able to:

- use databases of chemical data.
- build 2D and 3D chemical representations and store them in various file formats.
- author of scientific texts.
- develop presentations.
- develop simple websites.

K107 Development of Multimedia Material and e-Learning in Chemistry and Chemistry Teaching

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Principles for the use of multimedia. Video, audio, and interactive 3D molecular graphics. Multimedia and Simulation in Chemistry Teaching. Tools for development of multimedia applications and simulations. Educational Portals. Modern and asynchronous distance learning. Course management systems. Evaluation in distance learning.

Learning Outcomes

At the end of the course, students will be able to:

- create and edit Video, sound and three-dimensional graphics.
- develop multimedia packages.
- develop and edit distance education courses in course management systems.

Social Science Courses from Other Schools

KN106 Introduction to Pedagogy

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Pedagogy - Science of Education (object, basic concepts). History of pedagogical thinking and Theories of Pedagogy. Purpose and methods of pedagogical research. Educational groups and the field of Pedagogy. Pedagogy and contemporary global problems Pedagogy in the era of crisis

Learning Outcomes

The aim of the course is participants to be inducted in the history and the scientific “paradigms”, the object, the field and the research of pedagogy.

EΨ900 Psychology of Education

Specialization Stream Elective Course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Definition of educational psychology - educational psychology, school psychology and developmental psychology - educational psychology and educational practice. Heredity and of environmental factors to cognitive and social development. Cognitive development. Constructivism. Intelligence and learning. Emotional intelligence. Learning theories: Classical conditioning - implications in the educational practice. Learning by trial and error. Operant conditioning - implications in the educational practice. Insightful learning- implications in the educational practice. Social learning theory-factors that influence learning. The role of cognitive process in

learning Critical approach to learning theories. Information processing approach. Factors that influence memory. Motivation for learning. Attribution theory - internal/external attributions. The role of the family and the school to the development of motivation.

Learning Outcomes

After completing this course, the students are expected to:

- acquire knowledge concerning the development of the processes and the abilities that are involved in learning.
- acquire knowledge concerning the learning theories and the development of motivation.
- acquire knowledge concerning intrinsic and extrinsic factors that influence learning.
- be able to understand and reflect on the interaction of the above-mentioned factors.
- become familiar with methods that the educator may apply in order to enhance learning both in the cognitive and in the behavioral domain.

Department of Organic Chemistry and Biochemistry

Y15 Biochemistry I

Compulsory course, 4th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Introduction. Water (physical properties and hydrogen bonding of water, structure of liquid water, The ion product of water: The pH scale, acids and bases, The Fitness of the aqueous environment for living organisms).

Amino acids-Proteins. Acid- base properties of amino acids, the amino acids as building blocks of proteins, common amino acids, rare amino acids, non protein amino acids. The stereochemistry of amino acids and the absorption spectra. Amino acid reactions of amino groups, carboxyl groups and residue groups. Classification of proteins, Protein structure (covalent backbone and amino acid sequence, peptides, primary, secondary, tertiary, quaternary structure, higher conformation of proteins). Biological role of proteins, structural and functional proteins, protein denaturation, structure function relationship of proteins.

Enzymes. Naming and classification of enzymes, Kinetics, enzyme cofactors, coenzymes, cytochromes, inhibition of enzymic reactions, enzymic specificity, enzyme substrate complexes and covalent enzyme-substrate compounds, enzyme function regulation, isoenzymes.

Nucleic acids. Nucleic acids and primary structure. Secondary structure of nucleic acids, DNA, RNA properties in solution, the biosynthesis of nucleotides, nucleic acid catabolism. Recombinant DNA, DNA replication, transcription and repair.

Protein synthesis. The genetic code, the mechanism of protein synthesis, regulation of protein synthesis, covalent modifications, higher conformational structures of proteins and subcellular localization. Cellular defense against viral components. Recombinant DNA.

Learning Outcomes

Upon successful completion of the course, students will:

- have acquired basic knowledge about the structure and function of proteins and enzymes, hence the functioning of living organisms at the molecular level.
- gain basic knowledge of the nucleic acids (DNA, RNA), the biosynthesis of nucleic acids and their catabolism.
- have learned the genetic code that governs all living organisms, from the simplest to the most complex that is the man.

- understand the mechanism of protein synthesis and how it is regulated, covalent modifications of proteins and its formation in higher configurations.
- know the technology of recombinant DNA, which will be taught in more detail in other lessons.

Y17 Biochemistry II

Compulsory course, 5th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Metabolism. Structure of cellular membranes. Transport of water and inorganic ions across membranes. The organization of membrane transport systems – passive transport systems, active transport systems, the γ-glutamyl cycle for amino acid transport, ionophores.

The tricarboxylic acid cycle. Bioenergetics principles and the ATP cycle. The flow sheet of respiration, oxidative respiration, intracellular location of the enzymes of Krebs cycle, the reactions of Krebs cycle, anaplerotic reactions, regulation of Krebs cycle, the glyoxylate cycle, oxidation-reduction enzymes and electron transport, the respiratory chain, inhibitors of electron transport, proton exchanges during electron transport, microsomal electron transport, superoxide dismutase and catalase, electron transport in other systems.

Carbohydrates. Sugars, storage polysaccharides and cell walls. Glycoproteins and proteoglycans. Glycose metabolism. The stages of glycolysis. The phosphogluconate pathway. Metabolism of oligo- and polysaccharides, polysaccharide biosynthesis. Photosynthesis. Biosynthesis of mono- and glucose derivatives from glycose. Glycogen biosynthesis and degradation.

Lipids. The biosynthesis of lipids. Lipoproteins. Lipid metabolism. Biosynthesis of trialcylglycerols, biosynthesis of phosphoglycerides, Genetic disorders in metabolism of the complex lipids, the pathway of cholesterol biosynthesis, biosynthesis of prostaglandins.

Proteins. The biosynthesis of amino acids and some derivatives: Metabolism of inorganic nitrogen essential and non-essential amino acids. Nitrogen fixing organism, enzymic mechanism of nitrogen fixation, other steps in nitrogen cycle.

Vitamins. Vitamins and coenzymes. Water soluble and fat-soluble vitamins. Hormones, hormone receptors.

Learning Outcomes

Upon completion of lectures and laboratory exercises, students are expected to:

- understand the role of each metabolic pathway in cell function.
- describe the mechanisms for regulating metabolic pathways.
- recognize the need for scientific research in the field of biochemistry and molecular biology

K308 Clinical Biochemistry

Specialization Stream Elective Course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Sampling and maintenance of biological samples. Quality control in clinical chemistry. Analysis of proteins, amino acids and derivatives, carbohydrates, lipids and lipoproteins, enzymes. Immunological methods, automatic analyzers. Principles and methodology of molecular diagnostics. Cancer and cancer markers. Laboratory testing of endocrine, kidney, stomach and intestinal function. Acid-base balance and electrolytes. Hormones, hypertension mechanisms. Carbohydrates and diabetes. Diet. Blood clotting, clotting factors.

Learning Outcomes

Upon completion of lectures and laboratory exercises, students are expected to:

- understand the biochemical pathogeny of diseases,
- obtain knowledge on a wide-spectrum of biochemical techniques.

K309 Structural Biochemistry and Basics of Biocomputational Chemistry

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 1 h/week ECTS: 5

Course Content (Syllabus)

Structural Biochemistry. Protein structure motifs, α-structures, α / β structures, β-structures, folding and flexibility, DNA structures, helix-turn-helix, DNA recognition by eukaryotic transcription factors, transcriptional transcription factor structures, membrane protein structures, fibrous proteins, structures in the recognition of foreign molecules by the immune system, prediction, engineering and design of protein structures, elements of analysis and determination of protein structures.

Bioinformatics data. Principles of Structural Bioinformatics, Sequence Coordination, FASTA, BLAST, Multiple Sequencing, CLUSTALW, MOTIFS, Phylogenetic Trees, Prediction of Secondary Structure of Proteins and Nucleic Acids. Navigation in proteomics and protein engineering tools. Design of primers for polymerase chain reaction (PCR). Comparative design of protein structure, Analysis of microstructures.

Learning Outcomes

Knowledge acquisition regarding searching on scientific Data banks related to proteins and nucleic acids.

A deeper study, based on new technologies, of macromolecular structure (examples of relation to diseases).

Introduction to basic tools of bioinformatics.

K310 Molecular Cellular Biology and Metabolism Control

Specialization Stream Elective Course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

An overview of cells, the basic unit of life. Cells as experimental models. Prokaryotic cells, viruses, plasmids and transported genetic elements. The eukaryotic cell, structure and function of individual organelles, biological membranes and cytoskeleton. Intracellular transport and maturation of proteins. Cell cycle, cell division, differentiation and cell death. Regulation of the expression of genetic information. Cell signaling, signal transduction pathways.

Learning Outcomes

Understanding the molecular mechanisms underlying the organization and function of eukaryotic cells.

K314 Biotechnology

Specialization Stream Elective Course, 8thsemester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Growth of microorganisms. Improving strains with commercial value. Selection and isolation of strains. Site directed mutagenesis. Principles of recombinant DNA, protein engineering. Restriction nucleases, DNA sequence analysis, Nucleic acid hybridization, DNA cloning, DNA engineering, Genetic engineering, Applications of protein engineering, Fusion proteins.

Enzyme structural modification by chemical methodologies. Methods for enzyme immobilization. Enzyme binding to insoluble vectors. Intermolecular enzyme coupling. Enzyme encapsulation in liposomes or hydrophobic polymeric matrices. Properties of immobilized enzymes. Immobilization of coenzymes, polyenzymic systems and cell immobilization. Downstream processing for enzymes of industrial value. Bioreactors. Characterization of biotechnological processes. Commercial production of primary and secondary metabolites. Industrial enzymes. Utilization of cellulose-lignocellulose. Microbial recovery of metals. Biochemical electrodes.

Learning Outcomes

Upon successful completion of the course, students will be expected to:

- understand the basic principles of modern Molecular Biology techniques.
- get in touch with biotechnological applications of enzymes.

K315 Enzymology

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Nomenclature and Classification of Enzymes: Structure and role of enzymes-Criteria of enzymatic reactions – Quantitative determination of enzymes-Selection of method for detection of enzymatic activity-Sources of enzymes-Methods of extraction and purification of enzymes-Mechanisms of enzymatic reactions-Reactions of oxidoreduction-Reactions of groups transfer-Hydrolytic and non-hydrolytic reactions-Synthetic reactions-Kinetics of enzymatic reactions-Constants of Michaelis-Menten reactions-Factors affecting enzymatic reactions-Enzymatic reactions with many substrates-Active site of enzymes-Enzymes Inhibitors-Activators-Allosteric phenomenon and biological significance-Stereoselectivity of enzymes-Enzymes activity and post-translational modification of enzymes- Regulation of enzymes biosynthesis in bacteria and animal cells. Enzymes activity in non-conventional media.

Learning Outcomes

Upon successful completion of the course, the students are expected to:

- be familiar with enzyme purification techniques.
- be familiar with the mechanisms of action of enzymes as well as possible molecules that can be used to inhibit them.
- report applications of kinetics and inhibition of enzymatic reactions.
- know how they are allosterically regulated in the body with important examples

YN06 Organic Chemistry I

Compulsory Course, 2nd semester

Lectures: 4 h/week Tutorial: 2 h/week Laboratory/practice: --/week ECTS: 10

Course Content (Syllabus)

Structure and bonding in organic molecules: Coulomb forces, ionic and covalent bonds, resonance forms, atomic orbitals, molecular orbitals and covalent bonding, hybrid orbitals, structures and formulas of organic molecules. Structure and reactivity: kinetics and thermodynamics of simple chemical processes, acids and bases. Alkanes: nomenclature, properties, conformations, reactions. Cycloalkanes. Stereoisomers: optical activity, enantiomers, diastereomers, stereochemistry of organic reactions. Haloalkanes: nucleophilic substitution reactions, elimination reactions. Alcohols and ethers: nomenclature, properties, preparations, reactions. Introduction to spectroscopic methods NMR, IR, MS. Alkenes: structure, bonding, spectroscopy, preparations, reactions.

Learning Outcomes

After the implementation of this course, the students will:

- understand the basic concepts of Organic Chemistry.

- understand the physical and chemical properties of certain characteristic organic compounds classes and reaction mechanisms.

- consolidate the major spectroscopic and spectrometric methods used in the characterization of organic compounds.

YN09 Organic Chemistry II

Compulsory Course, 3rd Semester

Lectures: 4 h/week Tutorial: 2 h/week Laboratory/practice: --/week ECTS: 10

Course Content (Syllabus)

Alkynes: structure bonding, spectroscopy, preparations, reactions. Delocalized pi systems: allylic systems, conjugated dienes, Diels-Alder cycloaddition, polymerization of conjugated dienes, UV-Vis spectroscopy. Benzene and aromaticity: structure, spectroscopic characteristics, resonance energy, electrophilic aromatic substitution, benzene derivatives and polycyclic aromatic hydrocarbons.

Aldehydes and ketones: structure of the carbonyl group, spectroscopic properties, preparations, nucleophilic addition reactions. Enols, enolates ions: a-carbonyl substitution reactions. Aldol condensation reactions, conjugate addition reactions. Carboxylic acids. Derivatives of carboxylic acids. Amines: structure, spectrometry of the amino group, preparations, reactions. Chemistry of benzene substituents: benzylic oxidation and reduction chemistry of phenols, arene diazonium salts. Enolate anions and Claisen condensation. Heterocyclic Compounds: heteroatoms in cyclic organic compounds.

Learning Outcomes

After finishing the courses successfully, the students:

- will know the classes of organic compounds and the reaction's mechanism.

- will have acquired the fundamental knowledge of Organic Chemistry.

- could also extend their knowledge and experience to suggest new synthesis and to find the unknown structures of more complicated molecules.

YE12 Organic Chemistry Laboratory I

Compulsory Course, 4th semester

Lectures: --/week Tutorial: 1 h/week Laboratory/practice: 4 h/week ECTS: 5

Course Content (Syllabus)

Basic laboratory techniques. Recrystallization, extraction, drying, distillation, fractional distillation. Measurement of physical constants. Boiling with reflux. Separation of a mixture. Chromatographic methods. Steam distillation. Isolation of natural products.

Learning Outcomes

After the implementation of this course, the students will:

- understand the techniques used for the purification of organic compounds on theoretical and practical level.
- understand the techniques used for the synthesis of simple organic compounds on theoretical and practical level.

YE16 Organic Chemistry Laboratory II

Compulsory Course, 5th semester

Lectures: --/week Tutorial: 1 h/week Laboratory/practice: 4 h/week ECTS: 5

Course Content (Syllabus)

Simple syntheses of organic compounds. Synthesis of organic compounds in several stages. Use of protecting groups. Identification of organic compounds. Retrosynthetic analysis. Interconversion of functional groups. Protection of functional groups. Reactions forming C-C bond. Using spectroscopic methods (MS, IR, NMR) to determine the structure of organic compounds.

Learning Outcomes

Upon completion of the course, the students will be able to perform experiments of organic synthesis.

YN16 Organic Chemistry III

Compulsory Course, 5th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Carbohydrates, Heterocyclic compounds, Aminoacids, Peptides and Proteins, Nucleic acids, Lipids. The Organic Chemistry of Metabolic Pathways, Orbitals and Organic Chemistry: Pericyclic Reactions, Mechanisms of Organic Reactions.

Learning Outcomes

Upon completion of the course, the students will be able to:

- understand and interpret the characteristic reactions of carbonyl compounds and amines.
- recognize, describe and design the structure of biomolecules such as sugars, amino acids, lipids and DNA bases.
- determine and describe the specific activity and reactions of the biomolecules.

- understand and interpret stereochemistry in biomolecule structures.
- understand and interpret the mechanisms involved in biomolecules.
- understand and interpret the mechanisms of pericyclic reactions.
- combine information on the properties and chemical activity of biomolecules with general stereochemistry.

B04 Spectroscopy of Organic Compounds

Core Elective Course, 4thsemester

Lecture: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

The use of IR, MS, NMR, UV-vis spectroscopic methods in solving Organic Chemistry problems. Emphasis will be given to the MS spectra and NMR. NMR spectroscopy: Physical basis of the magnetic phenomenon. Pulse FT-NMR. Relaxation. Dynamic systems. NMR in solid state. Double resonance, decoupling. NMR spectra of other nuclei (other than ^{1}H and ^{13}C). NOE technique. Other newer techniques. Spectra of two dimensions. Applications in biological systems. Applications in Medicine. MS spectrometry: Fundamentals. Methods of cleavage of organic compounds. Ion analysis techniques. Modern ionization techniques. Molecular mass determination. Tandem MS. Applications of MS spectrometry in chemical analysis, environment, biology, geology, etc.

Learning Outcomes

Structure elucidation by analysis of spectroscopic data.

Prediction of spectroscopic data for known structure.

K302 Organometallic Chemistry and Catalysis

Specialization Stream Elective course, 7th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

General principles of organometallic chemistry. Characteristics properties of organometallic compounds. Formation of M-C bonds. Structure and reactivity of selected classes of organometallic compounds. The role of organometallic compounds in reactions with industry applications. Organic reactions catalyzed by metals. Catalytic hydrogenation and oxidation. Mo and Ru as catalysts in alkene metathesis. RCM, ROMP, Cross Metathesis. Organometallic compounds of Cu and Pd. Heck reaction, Suzuki reaction, Pauson-Khand reaction. Stille coupling reaction. Other organometallic reactions.

Learning Outcomes

Upon completion of the course, students will be able to:

- understand the chemical behavior of organometallic compounds and their role in industrial catalytic processes.
- collect, evaluate, organize and present orally scientific information.

K305 Organic Synthesis

Specialization Stream Elective course, 7th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Retrosynthetic analysis. Protecting groups. Oxidation. Reduction. C-C bond forming reactions. Forming C-C bonds: reactions of organometallic compounds. Forming C-C bonds: reactions of stabilized carbanions and other C-nucleophilic reagents.

Learning Outcomes

Upon successful completion of this course, students will have mastered the most basic branch of modern organic chemistry, which is Organic Synthesis. Acquiring skills in the design and synthesis of organic molecules gives the students the opportunity to deepen in Chemistry and is an important asset for their scientific and professional development.

KN306 Chemistry of Heterocyclic Compounds

Specialization Stream Elective course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Nomenclature, composition, chemical properties of small, medium and higher heterocyclic rings with one or more heteroatoms (especially O, N and S). Simple condensed heterocyclic systems. Heterocyclic compounds: synthetic methodologies and biological significance.

Learning Outcomes

Upon successful completion of the course, students will:

- gain knowledge about the most important heterocyclic rings, including various heterocyclic natural products with particular interest.
- know the general reactions of their synthesis and their properties, the mechanisms of the respective reactions as well as the special applications of various heterocyclic derivatives.
- be able to expand the acquired knowledge and experience in the study of more complex molecules.

KN307 Chemistry of Natural Products

Specialization Stream Elective course, 8th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Definition, isolation and Natural Products classification. General methods for isolating and purifying. Structure and biosynthesis of representative classes of natural products.

Learning Outcomes

Upon successful completion of the course, the students will have the ability to recognize important biosynthetic pathways for the synthesis of natural products. What is more, they will learn about important enzymes that help in the development of diversity of natural products and also the basic classes of pharmacological properties that they possess.

K313 Bioorganic Chemistry

Specialization Stream Elective Course, 8th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

The Fundamentals of Chemical Biology, The Chemical Origins of Biology, Chemistry of Biomolecules (peptides-proteins, DNA, RNA, carbohydrates, lipids). Peptide and Protein Structure. Protein Function. Glycobiology. Polyketides and Terpenes. Chemical Control of Signal Transduction.

Learning Outcomes

During this course, students are expected to:

- experience the participation of organic chemists in studies at the interface between chemistry and biology.
- gain important insights into the function of complex biological system at a molecular level.
- become familiar with the basic principles of chemical biology and drug design.
- use organic compounds as tools in studying biology.

K312 Pharmaceutical Chemistry

Specialization Stream Elective Course, 8th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Preparations, chemical properties, purity definition, pharmaceutical properties and reactivity of the main categories of organic pharmaceutical compounds. General pharmaceutical kinetics.

Learning Outcomes

The course includes basic principles of the design, synthesis, mechanism of action of inorganic, organometallic, radiopharmaceutical, organic drugs and hormones, their biochemical and biological

interaction with their molecular targets and their identification, as well as their luck, their ADME properties according to their physicochemical properties

COURSES FROM OTHER SCHOOLS

B05 General Biology

Core Elective Course, 2nd semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

The beginning of life - Chemistry of life (proteins, enzymes, DNA) - Methods in cell examination - The cell and the cell organelles - Proteinosynthesis and genetic code - From the cell to the organism (cell reproduction, mitosis, meiosis) - Tissues and organs - Mechanisms of heredity - Biotehnology in health, agriculture, cattle-raising, environment, industry.

Learning Outcomes

Upon completion of lectures and laboratory exercises, students are expected to understand the basic theories of Biology relevant to Chemistry of life.

Department of Physical, Analytical and Environmental Chemistry

Y02 Basic Principles of Analytical Chemistry

Compulsory Course, 1st semester

Lectures: 2 h/week Tutorial: 2 h/week Laboratory/practice: 6 h/week ECTS: 10

Course Content (Syllabus)

Principles, methods and applications of Analytical Chemistry. Acid-base and redox reactions. Solutions. Solubility of substances, concentration of solution and activity. The mass and charge balance equations. Reaction rate and chemical equilibrium. Distribution equilibrium. Acid base theories. Weak acids and bases. The water dissociation and the pH scale. Hydrolysis of salts. Buffer solutions. Heterogeneous chemical equilibrium. The solubility product principle. Complex and redox systems equilibrium. Laboratory practice and experimental exercises on the above principles.

Learning Outcomes

Upon completion of lectures and laboratory exercises, students are expected to know the principles, methods and applications of Analytical Chemistry including solubility of substances, solution concentration, chemical equilibrium, pH.

Y08 Quantitative Chemical Analysis

Compulsory Course, 2nd semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: 4 h/week ECTS: 10

Course Content (Syllabus)

Introduction to quantitative chemical analysis. Categories of methods for quantitative chemical analysis. Errors in chemical analysis. Systematic and random errors.

Statistical treatment of analytical data. Confidence intervals and tests of significance. Performance characteristics of analytical methods. Sampling. Instruments and labware in the laboratory of quantitative analysis. Physical and chemical processes employed in quantitative chemical analysis. Methods of sample pretreatment and dissolution. Principles of titrimetric analysis. Classic acid base, precipitation, complexometric and redox titrations. Gravimetric methods. Laboratory exercises. Selected titrimetric and gravimetric methods.

Learning Outcomes

Upon completion of lectures and laboratory exercises, students are expected to know the principles, methods (instrumentation, statistics) and applications of Quantitative Chemical Analysis.

Y18 Instrumental Chemical Analysis I

Compulsory Course, 6th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 4 h/week ECTS: 5

Course Content (Syllabus)

Introduction in instrumental chemical analysis. Spectrophotometry, spectrophotometric titration, fluorometry, nephelometry, atomic absorption spectroscopy, atomic emission spectroscopy. Electrometric techniques of chemical analysis (potentiometric titration, gravimetric and coulometric analysis, voltammetry, amperometric titration). Chromatographic techniques (TLC, GC, HPLC, SFC). Introduction in automated analysis. Flow injection analysis. Hyphenated techniques. Theoretical aspects of techniques. Principles of operation. Errors, interferences and troubleshooting. Applications of instrumental analytical techniques. Experimental.

Learning Outcomes

The students become familiar with the instrumental analytical techniques used in modern analytical laboratories. they get familiar with the principles of operation and they are also informed about the range of application in each technique, by examples of analytes and matrices involved.

H12 Metrology, Chemometrics and Quality Control

Semi-Compulsory Course, 5th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Introduction to metrology. The significance of chemical analysis. Quality. European community directives and actions. General principles of quality control and quality assurance. Quality systems. Quality control and Quality assurance. Technical and economical performance characteristics of analytical methods. Evaluation of analytical methods. Good laboratory practice. Calibration of measurements. Chemical calibrators and reference materials. Data management and reports. Control charts. Report of the results. Measurements' uncertainty. Quality manual. Reviews. Accreditation. Representative sampling. Propagation of errors. Significance tests. Calibration techniques of analytical methods. Regression analysis and reference curves. Correlation analysis. Errors. Chemometrical tools for the optimization of analytical methods. Experimental design. Multivariable analysis. Use of computer software for chemometric analysis

Learning Outcomes

Upon successful completion of the course, the students:

- acquire knowledge on chemometric methods of processing of results of analyses.
- understand the concepts for each type of error and uncertainty in measurements.

- become familiar with the principles of quality control.
- know quality assurance systems, and metrology systems.

K203 Separation Methods in Chemical Analysis

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Theoretical aspects of separation techniques. Sample preparation techniques. Pre-concentration. Solid phase extraction. Super critical fluid extraction. High Pressure Liquid Chromatography. Capillary electrophoresis. Ion chromatography. Gas chromatography. Hyphenated techniques GC-MS, LC-MS, preparative chromatography, chiral chromatography. Column switching techniques. Applications of separation techniques. Troubleshooting in HPLC. Principles, errors and interferences. Analytical method validation. Real sample analysis. Determination of caffeine, theobromine, theophylline, mefenamic acid, vitamins, paracetamol, in pharmaceuticals and biological samples, after solid phase extraction. Determination of inorganic ions by ion chromatography. Calculation of chromatographic parameters.

Learning Outcomes

Upon successful completion of the course, the students will:

- become familiar with the modern separation techniques0
- be informed upon current applications.
- become familiar with analytical method development and troubleshooting.

K204 Electroanalysis

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Conductimetric, potentiometric titrations. Coulometry, Voltammetry-amperometry. Electrochemical biosensors. Analytical applications of electrochemical techniques in biological, environmental and pharmaceutical samples as well as in food and beverages. Speciation analysis of metals applying electrochemical techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to:

- understand the basic principles of electrochemical cells.
- acquire knowledge about the theory as well as the basic principles of electrochemical techniques of analysis (conductimetry, potentiometry, pHmetry, coulometry, voltammetry, amperometry).

- apply the above mentioned techniques in chemical analysis.

K205 Analytical Instruments

Specialization Stream Elective Course, 7th semester

Lectures: 1 h/week Tutorial: 1 h/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

A) Optical systems. Introductory concepts and their link to the existing knowledge. Structural components. Use of optic elements in chemical organology. Examples.

B) Electric and electronic systems. Introductory concepts and their link to the existing knowledge. Structural components. Basic amplifier devices and circuits. Signal processing and its applicability to the measuring systems. Examples.

Learning Outcomes

Understanding principles and applications of optical systems and amplifying devices in chemical instrumentation. Acquisition of basic skills in the recognition of the instrumentation of various analytical devices.

K209 Instrumental Chemical Analysis II

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Atomic spectroscopy. Atomic Absorption spectrometry. Flame, graphite furnace and hydride generation atomizers. Inductively coupled plasma atomic emission spectrometry. Inductively coupled plasma mass spectrometry and ICPMS hyphenation with chromatography. X-ray fluorescence and absorption spectrometry. X-ray diffraction. X-rays photoelectron spectroscopy. Auger electron spectroscopy. Scanning and transmission electron microscopy. SEM-EDS. Kinetic methods of analysis. Automatic methods of chemical analysis. Automatic flow analyzers. On-line preconcentration and separation methods. Hyphenation of on-line techniques with atomic spectrometry. Laboratory practice, experimental exercises and applications of the above techniques. Mass Spectrometry: Instrumentation, analytical operation and application in Chemical Analysis and bioanalysis. Identification and quantification of analytes.

Learning Outcomes

Upon successful completion of the course, the students will have:

- knowledge of the operating principles of modern instrumental chemical analysis techniques.
- knowledge of the possibilities of instrumental analysis techniques and their limitations.
- experience in applications of these techniques in the analysis of real samples.

K210 Archaeometry and Chemistry of Archeology Materials

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Introduction to Archaeometry. Archaeological materials and technology. Stones (obsidian, quartz, precious and semi-precious stones, etc.) wood, leather, building materials, ceramics, glasses, enamels, dyes and pigments, metals and various other materials and objects. Investigation of the origin of archaeological artifacts and materials, and of their manufacturing technology and processes. Dating techniques: chemical dating, nuclear and radiochemical dating. The effects of the environment on the archaeological objects and findings, and corrosion. Introduction to conservation and restoration. Authentication tests. Laboratory exercises and application to the analysis, of stones, ceramics, glasses, metals, building materials. Data evaluation and interpretation.

Learning Outcomes

1. Introduction to the field of archaeometry, which is of particular interest to chemists in Greece.
2. Becoming familiar with archaeological materials and their properties.
3. Information on the non-destructive modern technical analysis required in ancient materials.
4. Visits to other archaeometry workshops to learn the applications of archaeometry in museums, etc.

K211 Specific Methods of Analysis

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Types and composition of samples. Sampling, sample preservation, loss of sample ingredients. Sample pretreatment techniques. Wet digestion techniques with acids and mixtures. Fusion, dry ashing, oxygen plasma ashing. Effect of microwaves and radiation. Special devices for the dissolution of solid and liquid materials. Methods for chemical analysis of water (drinking, seawater), minerals and rocks (limestone, chromite), siliceous materials (ceramics, glass, cement), metals and alloys (brass and steel). Applications of separation, spectroscopic, electrochemical and automatic techniques in chemical analysis of various materials and substrates, and laboratory exercises. REACH regulation.

Learning Outcomes

Upon successful completion of the course, the students will have:

- get familiar with specific techniques as well as separation analytical techniques.

- be informed on the use of the instruments, the applications, the advantages and the disadvantages of each technique.

K212 Bioanalytical Chemistry

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Introduction to bioanalytical chemistry. Description of different biological specimens and the problems these can introduce to the analysis. Macromolecular interactions, drug-protein interactions. Technologies for sample preparation. Utilization of enzymes in analytical chemistry (immobilized enzymes, receptors), immunoassay techniques, biosensors, electroanalytical techniques, electrophoresis (including capillary modes), micro- and nano-technologies, centrifugation, enantiomeric separations. Biological Mass Spectrometry and hyphenation. Speciation and automated analysers in bioanalysis.

Learning Outcomes

Upon successful completion of the course, the students will have:

- get familiar with Bioanalytical Chemistry with regards to different biological specimens and the problems these can introduce to the analysis.
- get familiar with various sample preparation approaches and their application to bio-samples.

H06 Environmental Pollution Control

Semi-Compulsory course, 6th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Environmental pollution control procedures. Field measurements. Principles and methods of sampling from atmosphere and various emission sources. Types of sampling devices- Analytical methods for determination of gaseous pollutants. Levels and chemical composition of airborne particulate matter. Sampling and analysis of atmospheric deposition. Principles and techniques for water sampling- Samples preatreatment methods. Analytical methods for determination of various water quality parameters (organoleptic, nutrients, heavy metals, toxic elements, toxic organic compounds). Biosensors. Urban and industrial solid wastes. Characterization of toxicity of solid wastes-Leaching tests. Evaluation of the analytical results with respect to various environmental factors. Source identification and apportionment.

Learning Outcomes

By the end of this course student will:

a) be aware with the principles of environmental monitoring.

b) know the principles of sampling methods.

c) know the methods for determination of the main pollutants.

d) assess the analytical results.

H07 Environmental Chemistry

Semi-Compulsory course, 5th or 7th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Structure and chemical composition of the atmosphere. Greenhouse effect. Depletion of stratospheric ozon. Pollution sources of the atmosphere. Ambient air quality standards. Atmospheric pollutants (emission sources, removal mechanisms, toxicity, elimination of emissions). Pollution of the atmosphere caused by traffic. Diffusion and dispersion of atmospheric pollutants. Smoke episodes - photochemical smog. Acid rain. Chemistry of natural waters. Pollution of surface and ground waters. Heavy metals. Toxic organic compounds. Fate of pollutants in waters (distribution-dispersion-chemical reactions). Limits of the quality of the water-legislation. Hygiene of drinking water. Soil pollution. Sewage-municipal and industrial waste waters. Urban solid wastes, industrial solid wastes. Principles of hazardous waste management.

Learning Outcomes

By the end of this course, the students will:

a) know the physicochemical processes occurred in the environment (atmosphere, aquatic and terrestrial).

b) be familiar with the properties, toxicity, sources and environmental fate of inorganic and organic pollutants.

c) be aware of the main environmental problems worldwide.

K207 Chemistry and Ecosystem Management

Specialization Stream Elective Course, 8th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Types and structure of ecosystems. Aquatic ecosystems. Aquatic life. Biogeochemical cycles of elements. Eutrophication. Eutrophication control strategies and models. Anthropogenic effects on ecosystem processes. Principles of ecotoxicology. Methods for measuring toxicity in the environment. Luminescent bacteria toxicity bioassays. Sediment quality criteria. Risk assessment methods. Principles for sustainable management. Systems for ecosystem management. International

and European policies and practices for Sustainable Ecosystem Management. Case studies in sustainability ecosystem management and strategy. Environmental impact assessment.

Learning Outcomes

By the end of this course, the students will be able to:

1) understand the signification and the function of ecosystems.

2) get familiar with the methodology of environmental risk assessment.

3) learn the significance and the goal of water resources management.

4) raise awareness on environmental protection.

5) learn the methodology of environmental impact assessment.

K208 Pollution Prevention and Environmental Protection

Specialization Stream Elective Course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 1 h/week ECTS: 5

Course Content (Syllabus)

Principles and measures intended to protect the environment. Treatment of municipal and industrial wastewaters. Advanced oxidation treatment techniques. Treatment of industrial gaseous effluents. Methods intended to prevent, lessen, or remove pollutants emitted from mobile sources. Characterization of the environmental hazard from solid wastes. Methods for management-disposal of municipal and industrial solid wastes. Integrated-sustainable management. Solid waste treatment methods. Life-cycle analysis. Risk assessment. Potable water treatment-disinfection. Legislative framework for environmental pollution abatement. Remediation of polluted environmental systems.

Learning Outcomes

By the end of this course, the students will be able to understand:

- the basic principles for treatment of gaseous and particulate pollutants.
- the physicochemical treatment processes for drinking water.
- sustainable development goals in the field of water.
- main management approaches for solid wastes-Characterization of toxicity-legislative framework.
- the wastewater treatment processes.
- advanced oxidation treatment techniques.

K215 Quality Assurance in Environmental Control and Management

Specialization Stream Elective Course, 8th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 1 h/week ECTS: 5

Course Content (Syllabus)

The sense of Quality in environmental pollution control and management. Introduction to Quality Systems ISO and EN. Fundamentals in quality control and quality assurance (QC/QA) of environmental measurements - Standard ISO 17025 - Accreditation of testing laboratories - Validation/verification of environmental testing - Traceability - Sampling - Uncertainty. Examples/applications. Principles and description of Environmental Management Systems. Standards ISO 14001 and EMAS. Examples/applications of environmental management. Environmental legislation - Environmental Quality Standards

Learning Outcomes

By the end of this course, the students will:

- learn about the basic Principles of Quality Control and Quality Assurance.
- understand the general requirements for the competence of testing and calibration laboratories according EN ISO/IEC 17025.
- apply Statistical Quality Control Tools.
- practice in quality control and quality assurance in Environmental Measurements.
- learn about the Environmental Management Principles and Systems, Environmental Management Systems Standards (ISO 14001, EMAS).

Y03 Applied Mathematics in Chemistry I

Compulsory Course, 1st semester

Lectures: 3 h/week Tutorial: 2 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Functions, derivatives, partial derivatives. Applications of derivatives in science. Integrals: Indefinite, Definite. Applications of integrals. Differential equations: First order, linear differential equations, differential equations with partial derivatives. Applications of differential equations in chemistry and physics.

Learning Outcomes

At the end of the courses students will be able to solve chemistry problems related to Functions, Derivatives, Integrals, Differential equations, Matrices, Determinants, Systems of linear equations, Power series and Operators

Y04 Physics I

Compulsory Course, 1st semester

Lectures: 4 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Introduction to mechanics (units, vectors, coordinate systems, particle motion, forces, inertial frame of reference, impulse, work, kinetic and potential energy, power. System of particles. Center of mass, momentum, conservation of momentum, collision. Potential Energy of diatomic molecule. Translational, rotational and vibrational energy of particles system. Mechanics of a solid body (angular momentum, rotational inertia, precession of a gyroscope). Oscillations (simple harmonic motion, damped simple harmonic motion, forced oscillations and resonance). Electricity (nature of electric charge, charge interactions, electric field, potential, capacitance, capacitors, electric dipole, dielectrics, dielectrics, polarization, electric displacement. Electric circuits, Ohm's law, Kirchhoff's laws. Magnetic field (electromagnetic induction, Lenz's law, self-inductance and mutual induction). Induced magnetism, magnetic properties of matter, magnetic susceptibility, relative magnetic permeability, diamagnetism, paramagnetism and ferromagnetism.

Learning Outcomes

By the end of this course, the students will know how to face Physics problems related to their Chemistry knowledge.

Y07 Physical Chemistry I

Compulsory Course, 2nd semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Gases (state equations of ideal and real gases, gas mixtures etc). Liquids (surface tension, viscosity, vapor pressure, dielectric constant). Solids (basics of crystal structure, allotropic forms, amorphous solids). Laws of thermodynamics. Basics of Statistical Thermodynamics. Thermochemistry. Phase equilibrium (Gibbs phase rule and phase diagrams). Chemical Equilibrium (gas phase reactions in homogeneous solutions and heterogeneous chemical reactions, effect of the pressure and temperature on the equilibrium of chemical reactions).

Laboratory practice

Experimental study of liquid surface tension, viscosity and refraction indices. Effect of Temperature on Solubility. Calorimetry.

Learning Outcomes

By the end of this course, the students will be able to:

- understand the basic principles of physical chemistry that determine the equilibrium and changes of physicochemical systems.
- carry out qualitative correlations between macroscopic phenomena and microscopic models.
- carry out simple physicochemical, thermodynamic and thermochemical calculations.

Y10 Physical Chemistry II

Compulsory Course, 3rd semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: 3 h/week ECTS: 10

Course Content (Syllabus)

Non-electrolyte solutions. Phase diagrams. Thermodynamic description of mixing. Partial molar quantities. Chemical potential of a component in a solution. Ideal and ideal dilute solution (Rault's and Henry's low). Miscible, partially miscible and non miscible liquids. Colligative properties (Boiling point elevation, freezing point depression, osmotic pressure). Liquid-solid phase diagrams. Nernst's partition law. Colloids. Electrolyte solutions. Ionic interactions. Conductivity of ionic solutions. Diffusion. Acid-base equilibrium. Strong and weak electrolytes. Heterogeneous equilibrium electrochemistry. EMF of galvanic cells and electrode potentials. Equilibrium and membrane potentials. Glass electrode. Selective interfaces and electrodes. Potentiometry – pHmetry. Electrode interfaces and structure of the double layer.

Laboratory practice: Boiling point-composition of two ideal miscible liquids. Phase diagrams of partially miscible liquids. Partition low. Conductivity of the electrolytes. pHmetry, determination of the pK of weak acids. Galvanic cells. Potentiometry.

Learning Outcomes

By the end of this course, the students will be able to understand the phase diagrams of miscible and non-miscible liquids, and the theory of electrolytic solutions.

Y13 Physical Chemistry III

Compulsory Course, 4th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: 3 h/week ECTS: 10

Course Content (Syllabus)

Kinetic theory of gases (distribution of molecular speeds, molecular collisions, transport properties). Ionic motion in electrolytic solutions (diffusion, migration). Ionic mobility and conductivity of electrolytic solutions. Kinetic properties of macromolecules and colloids. Chemical Kinetics. Simple homogeneous chemical reactions (kinetic equations of 1st, 2nd, 3rd and zero order reactions). Complicated homogeneous chemical reactions. Effect of temperature on chemical reaction rates, activated complex theory. Chemical reaction mechanisms. Catalysis. Homogeneous and heterogeneous catalytic reactions. Photochemical reactions. Spectrophotometry and polarimetry. Electrode reaction kinetics. Overpotential. Kinetic currents (Butler-Volmer and Tafel equations). Mass transfer and mixed current control. Voltammetric curves. Electrolysis (Faraday's law).

Laboratory practice

The effect of temperature and ionic strength on reaction rate. Conductometric, spectrophotometric and polarimetric monitoring of reaction kinetics.

Learning Outcomes

By the end of this course, the students will be aware of:

- mass transfer phenomena (mass, charge, momentum, heat).
- chemical kinetics.
- electrochemical kinetics.

H09 Electrochemical Reactions

Semi-Compulsory Course, 5th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Content

Electrochemical reactions and electrified interfaces. Parameters affecting the pathway of electrochemical reactions. Electron transfer kinetics. Mass transfer effects. Methods for the study of electrochemical reactions (polarography, cyclic voltammetry, rotating disc electrode, chronoamperometry). Electrochemical systems of practical interest: Electrochemical systems for energy conversion (batteries, fuel cells etc.). Electrochemical processes-electrolysis. Electrocatalysis. Electrode modification. Electrodeposition of metals and conducting polymers. Corrosion, passivation and corrosion protection of metals. Photoelectrochemical applications.

Laboratory practice

Study of the electrode/solution interphase. Polarographic and voltammetric study of reversible and irreversible electrode reactions. Study of reactions of practical interest: electrodeposition, corrosion-passivation and corrosion protection of metals.

Learning Outcomes

- Electrochemistry principles.
- Introduction to basic electrochemical techniques.
- Overview of typical electrochemical applications.

A06 Processing and Evaluation of Laboratory Data

Core Elective course, 3rd semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Content

Elements of Probability theory. Introduction to Statistics: Samples, distributions, descriptive statistics, estimations, tests of the statistical hypothesis, analysis of variance (ANOVA). Applications in presentation and analysis of experimental data: Graphical data presentation, least

squares method, confidence intervals, error estimation, data correlation. Using Excel and SPSS in data analysis and evaluation.

Learning Outcomes

Upon successful completion of the course, the student is expected to:

- be able to import and format experimental data on Microsoft Excel spreadsheets and to edit and present them in graphs.
- be familiar with Microsoft Excel and SPSS in data analysis and evaluation.
- implement statistical case tests on a sample, between two or more samples (ANOVA) and between multiple sample groups (MANOVA) to determine statistically significant differences and correlations.
- understand the least squares theory and apply linear and non-linear curve adjustment (regression) to experimental data using appropriate software (Excel, ChemStat and SPSS).

A08 Applied Mathematics in Chemistry II

Core Elective course, 2nd semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Content

Use of open-source software, Mathematica and Excel to solve applied mathematical problems in Chemistry and in the analysis, processing and presentation of laboratory experimental data.

Learning Outcomes

At the end of the courses, students will be able to use free software, Mathematica and Excel for the solution of problems of applied mathematics Chemistry and analysis, processing and presentation of laboratory experimental data.

B06 Physics II

Core Elective course, 2nd semester

Lectures: 4 h/week Tutorial: --/week Laboratory/practice: 1 h/week ECTS: 5

Content

Mechanical waves, wave motion, superposition principle and interference of waves, standing waves and resonance, beats. AC current (AC circuits, impedance and complex numbers, energy and power in AC Circuits, resonance). Geometric and wave optics. Photometry. Lenses and systems of two or more optical elements. Light waves interference, diffraction of light. Polarization of light and rotation of the polarized light. Application of polarized light and refracted light in Chemistry. Emission and absorption spectra. Assessment of bibliographic research, laboratory exercises.

Learning Outcomes

By the end of this course, the students will be aware of evolution of classic Physics to Modern Physics.

K108 ITC in the Chemical Laboratory

Specialization Stream Elective course, 8th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 1 h/week ECTS: 5

Content

Experiments controlled by computer (interface, software, protocols). Simulation experiments. Control of experiments remotely over the network.

Learning Outcomes

At the end of the courses, students will know how to interface instruments to a computer.

K110 Statistics in Thermodynamics

Specialization Stream Elective course, 8th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Content

From classical to statistical thermodynamics. Maxwell-Boltzmann statistics. Molecular partition function. Canonical ensample. Applications in the study of physicochemical systems. Statistical theories of chemical kinetics.

Learning Outcomes

By the end of this course, the students will be aware of the principles, theory and applications of Statistical Thermodynamics.

K201 Electrochemical Energy Systems and Environmental Protection

Specialization Stream Elective course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Content

Introduction to the environmental electrochemistry: alternative energy sources, environmental parameters measurement, wastewater treatment. Electrochemical production and storage of energy: fuel cells, batteries, supercapacitors, photovoltaic cells. Environmental protection: removal of heavy metals, recovery of precious metals, direct and indirect oxidation of organic pollutants.

Learning Outcomes

By the end of this course, the students will be aware of the principles, theory and applications of Electrochemistry.

K202 Modeling and Optimization of Chromatographic Separations

Specialization Stream Elective course, 8th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: 3 h/week ECTS: 5

Content

Chromatographic separation mechanisms in reverse phase liquid chromatography, ion pair chromatography and hydrophilic interaction liquid chromatography. Effect of mobile phase composition, flow rate and column temperature on substance separation. Modeling the separation of substances under stable or changing conditions. Prediction of substance retention and optimization of segregation by means of algorithms.

Laboratory practice

Experimental study of the effect of mobile phase composition, flow rate and column temperature on the retention of biologically active substances (amino acids, catecholamines, nucleosides) on reverse phase columns. Analyzing experimental data with appropriate algorithms and finding optimal separation conditions under isocratic and isothermal conditions.

Learning Outcomes

Upon successful completion of the course, the student is expected to:

- understand the chromatographic separation mechanisms, after acquiring the theoretical background on analytical techniques and physicochemical processes.
- understand how the chromatographic factors are affected (composition of the mobile phase, pH of the mobile phase, flow rate and chromatographic column temperature) in the retention of the compounds and be able to choose the appropriate chromatographic model.
- develop critical thinking on the interpretation and evaluation of chromatographic experimental data.
- to become familiar with the use of Microsoft Excel spreadsheets and appropriate algorithms (macro-commands-VBA) for adapting experimental data, predicting compound retention times and optimizing chromatographic conditions.
- follow the appropriate steps and to apply the fitting, prediction and optimization algorithms, in order to identify the optimal conditions for the separation of the chromatographic peaks of the under analysis mixture.

K206 Specific Topics in Colloid Chemistry

Specialization Stream Elective course, 7th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Content

Interfacial chemistry, thermodynamics of interfaces. Surface tension, methods for measuring surface tension. Monolayers. Surfactants. Colloidal structures in surfactant solutions, micelles, (structure, critical micellar concentration, aggregation number, solubilization, importance of micelles in industrial and biological treatments). Stability of colloidal dispersions (DLVO theory, kinetics of coagulation) electrokinetic phenomena and measurement of ζ(zeta)-potential. Application of phase diagrams in colloids. Emulsions (preparation, properties, stability, destabilization). Microemulsions, Experimental methods of studying colloids.

Laboratory practice

Preparation of hydrophobic colloids - coagulation of hydrophobic colloids using electrolytes - effect of pH - protection against coagulation. Preparation of hydrophilic colloids - determination of isoelectric point of albumin. Determination of critical micelle concentration and degree of ionization of the micelles, using conductivity measurements. Study of ternary systems - preparation of ternary diagrams. Measurement of the micelle radius using viscosity measurements. Measurement of surface and interfacial tension. Preparation of foams and study of their stability. Determination of the size of particles using the rate of their sedimentation.

Learning Outcomes

By the end of this course, the students will be aware of the principles, theory and applications of colloids and micelles.

K213 Dynamical Physicochemical Systems with Chaotic Behavior

Specialization Stream Elective course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Content

Emergence of periodic and chaotic behavior in physicochemical dynamical systems. Chemical clocks: oscillatory homogeneous and heterogeneous chemical reactions. Principles of thermodynamics for systems being far from the equilibrium and stability criteria of non-reversible changes. Linear stability analysis and bifurcation theory of non-linear dynamical systems. Characterization of the non-linear response of dynamical systems and route to chaos. Time series analysis. Fractal structures. Morphogenesis of static and dynamical chemical structures (Turing structures and chemical waves). Basics of modeling of physicochemical non-linear dynamical systems.

Laboratory practice

Oscillatory chemical reactions (i) homogeneous and non-homogeneous Belousov-Zhabotinsky reaction, (ii) electrochemical oscillators.

Learning Outcomes

With the successful completeness of the course, students will:

- know the prerequisites for the onset of non-linear dynamical behavior in physicochemical systems.
- be capable to study experimentally the temporal and spatiotemporal self-organization of chemical reactions being far from the thermodynamic equilibrium.
- describe the basic mechanism underlying else-organization in chemical, biochemical, electrochemical and population systems.
- get familiar with classical models used to describe and predict the periodic and chaotic behavior.
- understand and apply the basic principle of the linear stability analysis of non-linear 2-D dynamical systems and the basic principles of the bifurcation theory.
- recognize different routes to chaos and use methods for the analysis and characterization of chaotic time-series and strange attractors.
- understand fractal objects and how to calculate their dimension.

H13 Real, Virtual and Hybrid Laboratories of Principles and Laws of Chemistry in Formal and Informal Education

Semi-Compulsory Course, 6th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Design and application of real, virtual and hybrid chemistry workshops, dealing with the Principles and Laws of Chemistry, on issues: States of matter, Chemical Equilibrium, Chemical Kinetics, Chemical Equilibrium of Electrolytes in aqueous solutions, Redox reactions, Electrolysis, Galvanic elements. Creating mathematical models to understand phenomena related to Principles and Laws of Chemistry within an interactive learning environment. Methodology of assessment and integration of modern teaching methods in formal and informal education.

Learning Outcomes

Upon successful completion of the course, students will be able to use applications of virtual labs concerning fields of Chemistry described in the course's contents and explore their parallel use with real labs.

Department of Chemical Technology and Industrial Chemistry

H02 Macromolecular Chemistry

Semi-Compulsory Course, 6th or 8th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Introduction to macromolecular science. Nomenclature of polymers. Types and classification of polymers. Macromolecular configuration. Molecular weight distribution-average molecular weights and their determination. Solid-state properties (crystalline and amorphous behavior, thermal transitions). Polymerization mechanisms. Chain polymerization (free radical, anionic, cationic, coordination, controlled, living radical). Reaction mechanism and polymerization kinetics. Degree of polymerization and effect of temperature. Main polymers produced from chain polymerization. Step polymerization mechanism and kinetics. Main polymers produced from step polymerization. Copolymerization (kinetics and average copolymer composition). Inorganic, thermosetting, natural and liquid-crystalline polymers. Applications of polymers (medicine, etc.).

Learning Outcomes

Upon successful completion of the course, students should be able to:

- understand the meaning of macromolecules and the characteristics properties of macromolecules in relation to small molecules.
- know the repetitive chemical building block of commercial, at least, polymers.
- know the mechanisms by which polymerization reactions take place (i.e. chain, step polymerization), as well as the most important polymers of each class.
- understand the characteristics of copolymerization reactions.
- know the polymer additives.
- solve problems/exercises related to the kinetics of polymerization reactions, either free radical or step.

H03 Industrial Organic Chemistry

Semi-Compulsory Course, 5th or 7th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Industrial organic chemistry and energy. Sources of energy. Renewable energy sources (organic photovoltaics, bio-fuels). Liquid hydrocarbons-Petroleum: Composition and classification of oils.

Oil mining, refining (distillation, catalytic pyrolysis, catalytic reforming, alkylation, isomerization, carbonization) and refinery products (benzene, kerosene, Diesel, heating oil). Laboratory tests and calculation of properties of petroleum products. Bio-Diesel. Gaseous hydrocarbons-Natural Gas: Composition and properties of Natural Gas. Minong and treatment of NG. Benefits from its use. Liquefied Gas. Solid fuels-Coals: Origin and formation of coals. Chemical composition and physical properties of NG. Deposits and technological applications of coals. Processes for the exploitation of coals. Fats and oils. Carbohydrates. Basic chemical processes: Hydroformylation, sulfosis-sulfonosis, oxidation, hydrogenation and de-hydrogenation, nitrification, halogenations, alkylation, esterification. Industrial production of basic aliphatic and aromatic compounds.

Learning Outcomes

Upon successful completion of the course, the students are expected to:

- have acquired the basic knowledge, in terms of composition, properties, processing, of all conventional and renewable energy sources and mainly of liquid hydrocarbons (oil), gaseous hydrocarbons (natural gas) and solid (coal).
- understand chemical processes in the industry.
- know the properties of fats, oils and carbohydrates.
- expand the acquired knowledge and experience.

K405 Technology of Polymeric Materials

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Polymer production processes [polymerization techniques, polymerization reactors, polymerization in homogeneous (bulk, solution) and heterogeneous (suspension, emulsion) systems, polycondensation processes). Polymer classes (plastics, elastomers, fibers, coatings, glues). Polymer additives (flame retardants, plasticizers, antistatic, reinforcing and foaming agents, fillers, UV stabilizers, impact strength improvers, dyes). Polymer processing (viscoelasticity, extrusion, injection molding, blow molding, thermoforming). Polymer blends. Composite and nanocomposite polymeric materials. Biodegradable polymers. Polymer recycling.

Learning Outcomes

Upon successful completion of the course, students should:

- know the production processes of polymers on an industrial scale.
- have understood the different classes of polymeric materials, such as plastics, elastomers, fibers, coatings.
- know the additives used in polymeric materials.

- know the basic molding techniques of plastics.
- know the various fields of technological applications of polymers.

K407 Laboratory Techniques for the Synthesis and Characterization of Polymers

Specialization Stream Elective Course, 7th semester

Lectures: 1 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Synthesis of Polymers: Production of polymers by step polymerization (Nylon-6,10, polyurethane foam, Thiokol-A elastomer, Urea-formaldehyde resin). Production of polymers by chain polymerization (poly(methyl methacrylate), polystyrene, etc.). Characterization of polymers: Determination of the number average molecular weight of a linear polyether using the end-group analysis. Determination of the viscosity average molecular weight using capillary viscometers. Introduction to Differential Scanning Calorimetry, Thermogravimetric Analysis and tensile strength measurements. Identification of textile fibers. Identification of unknown polymer.

Learning Outcomes

Upon successful completion of the course, students should be able to:

- synthesize a polymer by various techniques, such as mass polymerization, solution, suspension, or emulsion.
- understand the peculiarities existing in polymer synthesis either by the step or chain polymerization mechanism.
- distinguish by simple chemical processes different types of polymers as well as different types of fibers.
- carry out laboratory measurements of properties of polymers, such as their average molecular weight, etc.

K408 Colour Chemistry and Technology

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Classification of dyes, properties of dyes, color mixing, relation between dye structure and dye properties in relation to the dyeing of natural and synthetic fibers. Theory of dyeing and printing with pigments and dyes. Digital printing, dyeing of natural and synthetic fibers, dyeing of paper and medium density fibreboards. Pigments for coating. Color measurement. Color fastness.

Laboratory exercises in dyeing, color measurement, pigment printing. Visits to relative industries.

Learning Outcomes

The students are expected to:

- learn the basic classes of textile dyes mainly classified by: i. their chemical structure ii. dyeing method.
- understand the relationship between the chemical structure of a dye and its suitability for the dyeing of a certain fiber and consequently the corresponding dyeing method.
- understand the dyeing mechanism (bond formation, forces developed between dye-fiber reactive groups.
- acquire basic knowledge of the dyeing (generally the change of a fiber-substrate's surface) technologies.
- get familiar with these technologies by means of the laboratory exercises.

K414 Chemistry, Technology and Application of Surfactants

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Surface active agents and detergents: Classification, chemical structures, preparation, properties. Detergent formulations (active and non active additives). Cosmetics, properties and preparation. Paper technology, composition, recycling, conservation. Paper specifications and dyeing methods for virgin and recycled paper.

Learning Outcomes

Students will acquire the basic knowledge of the chemistry and the applications of the surface active agents. They will become familiar with their uses in the detergent industry and the industry of cosmetic preparations. The lab practice will allow them to produce common every day use products such as soaps and cremes.

H04 Food Chemistry I

Specialization Stream Semi-Compulsory Course, 5th or 7th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Food nutrients (water, carbohydrates, proteins, lipids): Structural characteristics; Physical, chemical and techno-functional properties; Role in body functions; Usual sources; Effect of processing and storage; Effect of cooking; Applications in food industry.

Learning Outcomes

Upon successful completion of the course, students are expected to:

- be familiar with the structural characteristics of lipids, proteins and carbohydrates in foods.
- understand the role of water in the chemical and biochemical reactions that take place in food matrices.
- know the technological and biological importance of the occurrence of macro-nutrients as well as why their presence and content is determined in foods.

H05 Food Processing and Preservation

Specialization Stream Semi-Compulsory Course, 6th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Processing of raw materials in food industries, use of microorganisms and enzymes in food production, food preservation (chemical, biochemical and microbial spoilage of foods, biological safety of foods, environmental factors affecting microbial spoilage and biological safety of foods, preservation by dehydration, freezing, refrigeration, thermal processing and other physical methods, preservation with the use of food additives, salt, vinegar or sugar, preservation by smoking), packaging materials and edible packaging of foods.

Learning Outcomes

Following the successful conclusion of the classes, the students are expected to understand:

- the relationship between food quality and the various processes applied by the food industry for the exploitation of plant and livestock raw materials.
- the importance of microorganisms as factors that either makes it possible to prepare food products with acceptable quality characteristics or lead to products of low safety or quality.
- the importance of using enzymes for the preparation of foods and food constituents.
- the importance of environmental factors, such as light, oxygen, temperature and relative humidity, of composition and certain characteristics of raw materials used for their production or of packaging, in determining food deterioration or safety.
- the principles of preservation methods applied by the food industry for the preparation of products of high quality and satisfactory commercial life.

K410 Laboratory Food Testing

Specialization Stream Elective Course, 7thsemester

Lectures: 1 h/week Tutorial: --/week Laboratory/practice: 6 h/week ECTS: 5

Course Content (Syllabus)

General aspects of food examination (sampling and sample handling; method selection and application); Food examination using chemical and physicochemical methods for verification of

their composition and assessment of their authenticity, quality and nutritional value; Sensory and microbiological examination of foods.

Learning Outcomes

Following the successful conclusion of the classes, the students are expected to be able to:

- understand the principles of analytical methods applied for assessing both the nutritional value and the authenticity of foods, based on their content of primary and secondary constituents, as well as their quality by using chemical markers, biochemical markers and microbiological markers, and the principles of sensory evaluation methods.
- (a) handle instruments and equipment used in the examination of food; (b) work alone or in groups; (c) use food-related legislation in the preparation of reports based on their analytical results or in the presentation to audience of the working approach followed during the examination of a food sample in order to determine whether it meets the established standards; (d) refer to bibliographic/electronic sources to solve problems related to the examination of foods concerning their authenticity and quality.

K411 Food Quality Management

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Evolution of quality systems and relevant legislation; Compulsory and optional quality assurance and quality management systems applied to food industries; Seminars and educational visits to laboratories and industries.

Learning Outcomes

After the successful attendance of the course, the students are expected to be familiar with the evolution of quality management systems (compulsory and voluntary) in the food industry as well as the relevant legislation.

K412 Food Chemistry II

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Food micronutrients (vitamins, minerals); Food constituents that determine the sensory characteristics of edible products; Food additives.

Learning Outcomes

After the successful attendance of the course, the students are expected to:

- become familiar with the micronutrients contained in foods, the constituents that determine the sensory characteristics and the additives permitted for food use.
- have analyzed data from EFSA regarding daily requirements, bioavailability, upper permitted limits for selected vitamins, inorganic compounds and food additives in the course of tutorials.

K413 Technology and Biotechnology of Foods and Beverages

Specialization Stream Elective Course, 7th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Industrial production of foods, beverages and food components from conventional and non-conventional raw materials, Educational visits to food and beverage industrial units.

Learning Outcomes

After the successful attendance of the course the students are expected to be familiar with classical and modern technologies for the production of foods, beverages and food ingredients at industrial scale using conventional and unconventional raw materials.

Visits to food industries provides the students with the opportunity to become familiar with practical aspects of the production process

ΠΡ03 Oenology I

Specialization Stream Optional Course, 7th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

(pre-requisite: **H04 Food Chemistry I –** co-requested: **K410 Food Analysis**)

Course Content (Syllabus)

Maturation and composition of grapes; Grape harvesting and transportation to winery; Grape mechanical processing; Composition, examination and processing of must; Alcoholic and other fermentations; Composition and examination of wine; Maturation and ageing of wine; Sulfur dioxide in wine-making; Educational visits to wineries.

Learning Outcomes

After the successful attendance of the course, the students are expected to be familiar with the process of grape maturation and composition, harvest and pre-fermentation treatments, control of alcoholic fermentation, malolactic fermentation, wine chemistry and composition, wine aging as well as the use of Sulfur Dioxide in Must and Wine Treatment.

Winery visits are expected to provide the students with the opportunity to become familiar with practical aspects of the wine production process

ΠΡ04 Oenology II

Specialization Stream Optional Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

(pre-requisite: **H05 Food Processing and Preservation –** co-requested:**ΠΡ03 Oenology I**)

Course Content (Syllabus)

Economotechnical aspects and mechanical equipment in wineries; Red, white and rosé vinification; Special vinifications; Wine processing; Wine spoilage; Products and by-products from grapes and wine; Distilled beverages; Sensory analysis of wine and distilled beverages; Law and wine legislation; Educational visits to wineries.

Learning Outcomes

After the successful attendance of the course, the students are expected to be familiar with classical and special types of vinification, wine treatments, spirit production, legislation and sensory evaluation.

Visits to wineries offer the students the ability to come in contact with the producers, and become acquainted with practical aspects of production

ΠΡ05 Elements of Viticulture

Specialization Stream Optional Course, 8th semester

Lectures: 2 h/week Tutorial: --/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Current situation and perspective of viticulture in the world, the European Union and our country; Products derived from viticulture; Vine morphology and anatomy; Annual cycle of the vine; Vegetative and reproductive cycles; Vine physiology; Vine systematic taxonomy; Rootstocks and grape varieties with emphasis on wine grape varieties; Vine training systems; Winter and summer pruning; Vine propagation material; Evaluation of the natural environment; Vineyard installation; Soil cultivation, weed management, fertilization and vineyard irrigation; Grape maturation and determination of harvest date.

Learning Outcomes

After the successful attendance of the course, the students are expected to be familiar with main principles of the cultivation of Greek vineyards.

Y14 Chemical Technology

Compulsory Course, 4th semester

Lectures: 2 h/week Tutorial: 2 h/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Measurements and calculations in chemical technology, simple mass and energy balance exercise, unit systems. Fluid Flow Elements. Heat transmission elements. Water treatment, problems and solutions in the chemical industry. Wastewater treatment (urban and industrial). Brief description of the pumps. Hygiene and safety in the chemical industry. Tutorial exercises and applications

Laboratory practice

Forced air flow, ball mill crushing kinetics, flow of fluid through granular materials, heat transfer by physical transport and radiation, mass balances

Learning Outcomes

Upon successful completion of the course, the students are expected to:

- be familiar with basic measurements and calculations in chemical technology, simple mass and energy balances and unit systems.
- have a basic understanding of some elements of fluid flow and heat transfer.
- be able to solve basic exercises and applications taught previous lessons.
- be able to make the correct modifications of the respective units where necessary.
- be aware of the use of water in the chemical industry, the main problems encountered and their treatment with the appropriate treatment method.
- have basic knowledge of waste-water treatment methods (both industrial and municipal).
- be aware of some key elements of hygiene and safety in the chemical industry.

H01 Physical Processes

Semi-Compulsory Course, 5th or 7th semester

Lectures: 2 h/week Tutorial: 2 h/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Basic unit operations: study - techniques (industrial separation techniques): distillation, extraction, washing, gas absorption, drying, crystallization, fluid mixing, cooling tower, small solid particles techniques (study of the properties of small solid particles and their applications in ore beneficiation (enrichment), size reduction, precipitation, flocculation, centrifugation, filtration).

Laboratory practice

Laboratory and tutorial exercises of unit operations: Simulation of distillation column, Flotation enrichment, Filtration, Forced convection heat transfer, Air-cyclone.

Learning Outcomes

By the end of this course, the students will be aware of the principles, theory and applications of basic physical processes.

H08 Green Chemistry

Semi-Compulsory Course, 6th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Green Chemistry as a necessity. Sustainable development. Brief historical review. How can this be implemented? Principles and Applications of Green Chemistry. Principles and Applications of Green Chemical Technology - Engineering. Environmental Planning Methodologies. Tools for estimating the environmental performance of a chemical process. Criteria for the Selection of Materials and Operating Modules of a Production Process. Definition and Methodology for Life Cycle Assessment. LCA Applications. Environmental Management Systems. Industrial Ecology. Basic concepts of catalysis. Industrial catalytic processes. Renewable raw materials for the production of chemicals and fuels - energy. 1st, 2nd and 3rd generation biofuels. Alternative and green solvents.

Learning Outcomes

By the end of this course, the students will be aware of the principles, theory and applications of Green Chemistry and Technology.

A07 Management in Chemical Industry

Core Elective Course, 3th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Economy of energy. Fossil and renewable energy sources. Energy storage. Fuel cells. Energy management in chemical industry. The use of mathematical models in chemical technology. Methodology of predictions in technology. Time series analysis. Predictions with constant, linear and polynomial models. Exponential weighting techniques. Prediction of probability distribution. Chemical reactors, elements of simulation or reaction kinetics, case studies, elements of optimization of efficiency-profit, new products by blending, introduction to blending optimization.

Learning Outcomes

By the end of this course, the students will be aware of the importance of Energy in chemical industry.

B03 Chemical Processes

Core Elective Course, 4th semester

Lectures: 2 h/week Tutorial: 2 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Principles of chemical processes, types of chemical reactors, design equations, simple and multiple reactions, combination of reactors, catalytic reactions & reactors, industrial applications: catalytic cracking of heavy petroleum fractions for the production of fuels.

Learning Outcomes

By the end of this course, the students will be aware of the principles, theory and applications of chemical reactors in Technology.

K401 Technology of Inorganic Materials - Nanotechnology

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Introduction to Nanotechnology. Advanced nanomaterials and their applications. Carbon based nanostructured materials: carbon nanotubes, fullerenes, graphene oxide, graphene. Preparation and characterization methods, properties and applications. Scanning Tunneling Microscopy, Atomic Force Microscopy. Magnetic nanomaterials. Application in environmental protection, catalysis and nanomedicine: target drug delivery, magnetic tomography and regenerative medicine. Corrosion and material's protection. Thermodynamic conditions. Corrosion of Natural Materials-Mechanisms. Methods and Technical Measurements for the Control and Evaluation of the corrosion of Natural Materials and Metals.

Learning Outcomes

Upon successful completion of this course, students will have acquired basic knowledge of the structure and the properties of metals, ceramic, cement and introductory knowledge of corrosion and protection of materials, advanced nano-materials and nanotechnology, adsorbents and catalyst materials.

K402 Laboratory of Industrial Processes

Specialization Stream Elective Course, 7th semester

Lectures: - /week Tutorial: 1 h/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Laboratory practice and tutorial exercises in basic physical and chemical processes (flocculation in batch and continuous systems, flotation, thermodynamic diagrams, water cooling tower, liquid/gases adsorption, gases absorption, residence time distribution, corrosion).

Learning Outcomes

Upon completion of the course, the students are expected to:

- be accustomed to several unit operations of Chemical Industry.

- understand the basic principles and theory behind them and to observe their practical use.
- be able to handle devices and computational tools required for the above unit operations.

K403 Biotechnological Processes

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Applications of transport phenomena (fluid flow and mixing, heat transfer, mass transfer) to bio-processes. Mass and energy balances. Basic principles of kinetics in biological systems (autocatalytic, enzymatic, heterogeneous reactions, cell growth, enzyme inactivation, energy metabolism). Function and types of bioreactors (discontinuous, embolar flow and full mixing). Final (or downstream) processing. Separation - isolation - purification of biotechnologically produced products. Combined biodegradation processes. Industrial flow charts of biotechnologically produced products. Exercises and applications.

Learning Outcomes

Review and application of basic knowledge in chemical technology (previously taught), where unit operations and chemical processes are included, particularly connected to biotechnological procedures leading to industrial products.

K404 Transport Phenomena

Specialization Stream Elective Course, 8th semester

Lectures: 2 h/week Tutorial: 2 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Viscosity. Newton's Law. Shear stress. Momentum balance. Applications. Heat transfer mechanisms (conduction, forced and natural convection, radiation). Applications. Solving heat transfer problems using a computer. Mass transport mechanisms (diffusion, advection, dispersion). Macroscopic - microscopic mass balance. Interphase mass transfer.

Learning Outcomes

By the end of this course, the students will be aware of the principles, theory and applications of transport phenomena.

K406 Fundamental Principles of Environmental Technology

Specialization Stream Elective Course, 7th semester

Lectures: 3 h/week Tutorial: 1 h/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

General Principles of Good Environmental Practices (short description of ISO, LCA management systems, etc.). Principles of wastewater treatment (urban and industrial) by application of physicochemical and biological methods, with emphasis on the recovery of useful components and the reuse of treated water. Principles of treatment and disposal of solid waste (industrial - urban) with emphasis on recycling. Principles of processing industrial aerosols. Drinking water: main features and applied treatment for its production. Principles for dealing with other environmental problems (e.g. taste and odor problems). Visits to wastewater treatment plants and industrial wastewater industries and plants.

Learning Outcomes

Students with successful completion of the course are expected to:

- know the general principles and measures for environmental protection.
- know the principles of aquatic chemistry and their applications in the treatment of drinking water and waste-water.
- understand the technologies for the treatment of liquid and solid waste.
- know the basic elements of the design, manufacture and operation of waste water treatment systems.
- know the basic techniques for drinking water treatment.
- know the hierarchy of solid waste management.
- understand the recycling-re-use technologies of solid ingredients

COURSES FROM OTHER SCHOOLS

B07 Geology & Geochemistry

Core Elective Course, 3rd semester

Lectures: 2 h/week Tutorial: 1 h/week Laboratory/practice: 2 h/week ECTS: 5

Course Content (Syllabus)

Geology and Water. Earthquakes. Natural disasters. Technical Projects. Renewable energy sources. Climatic conditions. Mineral Wealth. Distribution of chemical elements in the Universe. Structure and chemical composition of the Earth. Geochemical classification of the elements. Rock geochemistry. Applications of the geochemistry. Environmental geochemistry. Legislation and Environment.

Learning Outcomes

This course focuses on the study of special topics of geology and geochemistry, such as:

- the importance of the geological phenomena and how they affect our lives.
- the natural and mineral resources and the role they play in culture, economy and development.
- the history and evolution of the Earth through the geological phenomena and fossils.

- the distribution of chemical elements in the Universe and Earth.
- the applications of geochemistry.
- the environmental geochemistry and the relevant environmental legislation.

EB932 Principles of Microbiology

Optional Course, 7th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: 3 h/week ECTS: 5

Course Content (Syllabus)

Learning Outcomes

EHO13 Elements of Economy

Elective Course, 8th semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 5

Course Content (Syllabus)

Demand Theory of Production Optimization Theory of Cost Market Structure (perfect competition, monopoly, oligopoly)

Learning Outcomes

Upon successful completion of this course, students will be able to:

- understand the behavior of the demand.
- understand the business production functioning.
- understand the functioning of the markets in the real world.

FOREIGN LANGUAGE COURSES

A01 English for Chemistry

A02 French for Chemistry

A03 German for Chemistry

A04 Italian for Chemistry

Foreign language Course, 2nd semester

Lectures: 3 h/week Tutorial: --/week Laboratory/practice: --/week ECTS: 2

Course Content (Syllabus)

Authentic texts of different genres of Chemistry on the following topics: Matter, Measurement, Describing Shapes, The periodic table, Chemical Formulas, Nomenclature, Reading chemical equations, Chemical reactions, Classifications of solids, Chemistry Laboratory Equipment, Laboratory safety, Laboratory techniques, Changes of state or phase transition, Acids, bases and salts, Solutions, Filtration, The microscope. The texts are accompanied by chemical vocabulary learning activities.

Learning Outcomes

The students are expected to:

- comprehend the basic special language and terminology of the chemical science.
- read and write chemical elements, chemical compounds and chemical equations.
- describe the equipment of the chemical laboratory.

8. BASIC DATES - WORK PROGRAMS

8.1 Basic dates of winter and spring semesters

Beginning of Winter Semester: September of the current academic year

End of Winter Semester: January of the current academic year

Beginning of Winter Semester Teaching Courses: October of the current academic year

End of Winter Semester Courses: January of the current academic year

Beginning of Spring Semester: February of the current academic year

End of Spring Semester: June of the current academic year

Beginning of Teaching Spring Semester Courses: February of the current academic year

End of Spring Semester Courses: June of the current academic year

Examination periods:

Beginning of the Winter Semester Exam: January of the current academic year

End of Winter Semester Exam: February of the current academic year

Beginning of the Spring Semester Exam: June of the current academic year

End of Spring Semester Exam: July of the current academic year

Beginning of September Exam: September of the current academic year

Examination end of September: September of the current academic year

8.2 Schedule of courses and workshops

Details for the course and exam schedule can be found at the following link:

https://www.chem.auth.gr/programma-mathimaton-ke-exetaseon/

8.3 Classrooms - Blackboard

Large Amphitheater: Old Chemistry building 1st floor (N. Alexandrou Amphitheater)

Small Amphitheater: New building, ground floor

Room A: Old Chemistry building 1st floor

Room B: Ground floor Secretariat building

Room C: Old Chemistry Building Basement

The laboratory rooms are located on the floor of each laboratory.

Many of the elective and direction courses can be held in the meeting rooms of each laboratory on the respective floor and building. In general, the curriculum that is posted each year contains the rooms and amphitheaters where the lessons can take place.

More details can be found at the link:

https://www.chem.auth.gr/programma-mathimaton-ke-exetaseon/

8.4 Exam schedule - examination periods

Details for the course and exam schedule can be found at the following link:

https://www.chem.auth.gr/programma-mathimaton-ke-exetaseon/

8.5 Academic calendar - Public holidays

The academic year begins on September 1 and ends on August 31 of the following calendar year. The educational work of each academic year is structured in two semesters of study, in the winter and in the spring, each of which includes 13 weeks of teaching and two or three weeks of examinations.

- The winter semester begins in the last week of September and ends at the beginning of the last ten days of January. The first examination period of the winter semester follows.
- The spring semester begins in mid-February and ends in late May. The first examination period of the spring semester follows.

The exact dates are set by the university senate. In exceptional cases, however, the Minister of Education, upon a proposal of the senate, regulates the beginning and the end of the two semesters outside the regular dates, in order to complete the necessary number of teaching weeks.

Each semester has two exam periods:

- The courses of the winter semester are examined during the period January - February and repeatedly during the period September.
- The courses of the spring semester are examined during the period of June and repeatedly during the period of September.

The exam periods in January-February and September last three weeks, while the June period lasts according to the law for two weeks, but all of them usually extend to a longer period.

Every semester, before the beginning of the examination period, students have the right and obligation to evaluate their courses and teachers, in order to improve the quality of their studies. More information is available on the website of the Quality Assurance Unit (MODIP-AUTH, https://qa.auth.gr) and on the website of the School / Department.

HOLIDAYS

During the months of July and August, no classes or exams are held and they are considered summer vacation months. Also on vacation include:

- **The Christmas holidays**: From December 24 to January 7.
- **Carnival holidays**: From Tyrophagou Thursday until the day after Shrove Monday.
- **The Easter holidays**: From Holy Monday to St. Thomas Sunday.

HOLIDAYS AND DAYS-OFF

- **October 26**: Feast of the patron saint of the city of Aghios Dimitrios. Liberation of Thessaloniki (National holiday).
- **October 28**: Anniversary of "OXI" in Italian fascism (National holiday).
- **November 17**: Anniversary of the Polytechnic uprising in 1973.
- **January 30**: Feast of the Three Hierarchs (Religious feast).
- **March 25**: Anniversary of the revolution of 1821 against the Turkish yoke (National holiday).
- **May 1**: May Day. - Workers' Day of Class Solidarity (Labor Day - Strike).
- **Day Of Saint Spirit**: (Mobile religious holiday).

9. BASIC PRINCIPLES OF HYGIENE AND SAFETY IN THE LABORATORIES OF THE DEPARTMENT

In the School you attend there is a "Security Committee" for the composition of which you can be informed by the Secretariat of the School. The purpose of the Committee is the safety, hygiene and protection of the premises of the School but also the safety and health of students and staff. You will be further informed by members of the Committee on general and specific issues of its responsibilities. We would, however, like to present general guidelines and point out simple rules that, regardless of your type of study, should apply. Safety and hygiene rules are presented in the first laboratory course of General Inorganic Chemistry I, of the Laboratory of Organic Chemistry I and of the Laboratory of Physical Chemistry and it is mandatory for all students of the year to attend.

SAFETY AND HEALTH ISSUES

Safety and Hygiene in the Laboratory is a key part of every laboratory course in the study Programme of the School of Chemistry. Depending on the case, different presentations are made by the laboratories of the Department but also a general presentation at the beginning of the Organic Chemistry Laboratories I. More details can be found below and on the website of the School. https://www.chem.auth.gr/

A. For your safety you should know:

- The Emergency Exits in each building.
- The locations of the First Aid Boxes and the ways in which their contents are used.
- The places where fire alarms and fire extinguishers are located.
- The places and parking lots that serve People with Disabilities (PWDs) and make sure they remain free.
- The gathering places in case of emergency

Also:

- You must not plug in power supplies if you are not sure about the safety of the circuit.
- Do not touch electrical circuits and cables with wet hands or objects.
- Do not overload the power lines (reduce the risk of fire).

- After the end of your work, turn off the electricity in the rooms and on the PCs (reduction of fire risk).
- You must not use machines / instruments without proper approval and training.
- Floors must be clean and dry to avoid accidents. In case of any liquid on the floor, inform the competent personnel to clean it.
- Any type of accident should be reported to the "Safety and Health Committee" for proper treatment and prevention of recurrence.
- You should be informed about the special "Safety Instructions in the Laboratory", if there are Laboratories in the Department you attend.

B. For your health you should know that:

- It is the duty of all of us to keep our workplaces clean.
- Smoking and eating and drinking are not allowed in classrooms, workshops and amphitheaters. Smoking is not allowed, in general, inside the University. You are also not allowed to throw cigarettes in the bins.
- After consuming food and beverages, in permitted areas, litter should be placed in appropriate bins so that the areas are kept clean and stray dogs, rodents and harmful insects are not attracted.
- If you are sick it is better to stay home for recovery. In this way you protect yourself and your classmates.
- Do not make noise and, politely, ask those who make it to reduce it (noise causes fatigue and headache).
- Work properly on the PC.

INSTRUCTIONS FOR THE CASE OF FIRE-ACCIDENT – EARTHQUAKE FIRE SAFETY AND FIRE TREATMENT INSTRUCTIONS

A. When you do NOT put out a fire yourself.

- If the fire has spread beyond its flash point.
- If you do not know the different types of fire extinguishers and you are not trained in their use.
- If you cannot extinguish the fire with its back to the emergency exit or escape.
- If the fire can prevent the only escape outlets.
- If you do not have enough equipment to put out the fire.

B. How to evacuate a burning building

- The last person to leave a room in case it means a fire alarm, should close the door behind him and not lock it. If they lock the door, it will make the work of the Fire Service difficult, that is, locating and rescuing people who have been trapped by the fire.
- Exit the escape route as specified in the action plan you will be informed about.
- NEVER use elevators as a means of escape. Go down the stairs carefully and calmly.
- Keep your head low to the ground to avoid smoke and toxic gases. If the smoke is thick, slide towards the escape outlet.
- Cover your mouth and nose with wet clothes to breathe better.
- Proceed to the exits of the building without delay and calmly.
- Do not stop to collect your personal items.
- Head to the ground floor and then to the reference area. NEVER head to the roof of a high-rise building because there is a risk that the Fire Department will not be able to rescue you.
- Go to the reference point and report to the person in charge. Do not return to the building until you have been given permission by the Fire Department or another person in charge.

C. What do you do if you are trapped in a burning building

- If you are in a burning building, do not open the doors without checking the temperature with the back of your hand while trying to escape. If the door has a high temperature, use another escape outlet.
- If there is no other escape route, close the crevices around the door with wet clothes or anything else in the area and call for "Help".
- If you are trapped, look on the phone and notify the Fire Department, giving your name, the building and the floor you are on and mentioning any danger you think the Fire Department will face when it tries to free you.
- If the room is full of smoke, try to place your head as close to the ground as possible (fresh air in case of fire is always in the lower layers of the room) and if possible ventilate (or ventilate) the space by opening a window.
- If the window is not open, do not try to break it, as you will drop the glasses on people who may be on the ground floor. Draw the attention of people by waving something that is visually visible.
- Do not lose your temper.

D. General fire safety rules

- Avoid overcharging the power supply with a power strip.
- When you have finished your work, it is correct to turn off the lights and electrical appliances.
- Do not attempt to repair defective electrical appliances unless you have the necessary qualifications.
- Report to the "Safety Committee" defective electrical appliances that come to your notice.
- Smoke in designated areas.
- Use metal or glass ashtrays.
- Do not empty ashtrays into waste baskets.
- Maintain order and cleanliness in your workplaces.
- Do not carry fuel or flammable liquids / materials

E. Use of fire extinguishers

- The category of fire that can be extinguished by the fire extinguisher is written on the surface of the fire extinguisher, together with the instructions for use.
- Dry powder or CO_2 fire extinguishers are only used by trained personnel. The same goes for the water supply system. The use of fire extinguishers by untrained personnel can cause serious injury

INSTRUCTIONS FOR PROVIDING FIRST AID IN THE EVENT OF AN ACCIDENT

- In the event of an accident, find the nearest First Aid Kit and offer first aid.
- If you cannot offer first aid, look for the right person.
- In case of a serious accident, call First Aid at 166 (EKAB).
- In case you suspect poisoning, inform EKAB, so that they receive the appropriate information from the Poison Center.

INSTRUCTIONS FOR THE EARTHQUAKE

Please be informed by the relevant brochure of the Organization for Earthquake Planning and Protection (OASP) that has been posted on the website of School of Chemistry.

More information on safety rules can be found in the Appendix of the Study Guide or on the University website.

10. POSTGRADUATE STUDIES IN THE SCHOOL OF CHEMISTRY

POSTGRADUATE PROGRAMMES OF SCHOOL OF CHEMISTRY, AUTh

- The School of Chemistry offers a Postgraduate Specialization Diploma (MDE) and a Doctoral Thesis (DD). The title is unique, but the student has the opportunity to choose between five postgraduate Programmes.
- The Programme is available for all graduates of Schools of Universities of the country and recognized cognate Institutions of abroad, as well as graduates of School of Technological Educational Institutions of related subjects.
- More information is provided in the regulation of the MPS as stated below and in the links:

Postgraduate Programme of School of Chemistry, AUTh.
https://www.chem.auth.gr/programmata-metaptychiakon/

Regulation of Doctoral Studies of School of Chemistry, AUTh (Government Gazette 1596 / 09-05-2018)
Law No 3685/2008: Institutional framework for postgraduate studies

MSc Programme "Quality Control - Chemical Analysis - Environment"

Specializations:

A. Bioanalysis - Pharmaceutical analysis

B. Product Quality Control and Assurance

C. Quality Control and Environmental Management

Government Gazette for the establishment of the MSc Programme: GG 2372/21-6-2018

Website of MSc Programme

MSc Programme "Science and Technology of Electrochemical Systems"

Specialization: Science and Technology of Electrochemical Systems

Government Gazette for the establishment of the MSc Programme: GG 2622/5-7-2018

Website of MSc Programme

MSc Programme "Molecular Design and Modeling-Chemical Education"

Specializations:

A. Molecular Design and Modeling

B. Chemical Education and Information and Communication Technologies

Government Gazette for the establishment of the MSc Programme: GG 2657/6-7-2018

Website of MSc Programme

MSc Programme "Synthetic Chemistry, Biochemistry and Applications"

Specializations:

A. Inorganic Compounds, Materials and Applications

B. Organic Composition and Applications

C. Biochemistry

Government Gazette for the establishment of the MSc Programme: GG 2622/5-7-2018/B

Website of MSc Programme

MSc Programme "Chemical Technology and Industrial Applications"

Specializations:

A. Chemical and Environmental Technology

B. Chemistry and Technology of Polymers and Nanocomposites

C. Chemistry, Technology and Control of Food and Feed

Government Gazette for the establishment of the MSc Programme: GG 2633/5-7-2018

INTERDEPARTMENTAL POSTGRADUATE PROGRAMMES

ID-MSc Programme "Teaching Chemistry, New Educational Technologies and Education for Sustainable Development"

Specializations:

A. Teaching of Chemistry

B. New Educational Technologies

C. Education for sustainable development

Government Gazette for the establishment of the MSc Programme: GG 3035/27-7-2018

Website of MSc Programme

ID-MSc Programme "Physical and Chemical Methods for Diagnosis of Deterioration of Cultural Heritage Materials"

Specializations:

Physical and Chemical Methods for Diagnosis of Damage to Cultural Heritage Materials

Government Gazette for the establishment of the MSc Programme: GG 2669/6-7-2018

Erasmus Mundus MSc "Materials Science of Archaeological Interest"

Specializations: Materials Science of Archaeological Interest

Website of MSc Programme

11. PROGRAMME OF POSTGRADUATE STUDIES & DOCTORAL STUDIES (Doctoral Studies in the School of Chemistry, AUTh)

Postgraduate studies in School of Chemistry are described on the website of the School.

GG of the Approval of the Regulation of PhD Studies

Call for PhD Studies - winter semester 2021-2022

12 POST-DOCTORAL RESEARCH IN THE SCHOOL OF CHEMISTRY, AUTH

Aristotle University of Thessaloniki, aiming at excellence and high quality recognized research by the members of the academic community, provides the opportunity to conduct postdoctoral research in its Schools.

The elaboration of Postdoctoral Research in the School of Chemistry is governed by the following relevant regulation of AUTh.

Regulation for Postdoctoral Research in AUTh

Information can also be found on the website of the School of Chemistry.

https://www.chem.auth.gr/spoudes/metadidaktoriki-erevna/

13. LIBRARY OF SCHOOL OF CHEMISTRY

- **Regulation**

The main purpose of the Library is to support the educational and research needs of the University community and to facilitate it in finding information of all contents. Non-university researchers are also served with a relevant subject. In order to effectively serve these purposes with its small staff, the Library needs the understanding and cooperation of each of its members. The operating regulation is promoted to contribute to the smooth flow of material and information.

- **Borrowing**

General rules

- The teaching staff and the special teaching fellows of the School, the pre- and postgraduate students must obtain the Library loan card from the Library.
- The loan card is renewed every year for students.
- Borrowing rights are not transferred to another person and everyone can only borrow for himself.
- Journals and reference books are not borrowed.
- Any of the books borrowed by a user can be requested back from the Library before the return date.
- Borrowers are responsible for the books they have received from the Library until the books are returned to the Library

Borrowing for undergraduate students

- Undergraduate students can only borrow the textbooks of the Closed Collection. Multiple copies can be borrowed for two (2) weeks. For single copies, see the "Special Collection Lending Rules".
- Among the supporting documents submitted to the Secretariat of the School for obtaining a degree is a certificate from the Library that the student has no pending issues with the Library.

Borrowing for postgraduate students and PhD students

- Students must show a valid loan card to be eligible to receive material from the Library.
- Students will only be able to borrow books from the Library if they have not already borrowed books for which the borrowing period has expired.

- A user cannot be charged with more than three (3) books, if he is a postgraduate student, and with more than five (5), if he is a PhD student.
- Books whose borrowing is allowed (i.e. monographs and special books) can be borrowed for two (2) weeks. Borrowing time can be extended if this book has not been requested and "kept" by another user.
- Among the supporting documents submitted to the Secretariat of the School for the acquisition of a master's or PhD Diploma is a certificate from the Library that the student has no pending issues with the Library.

Borrowing for teaching staff and the special teaching fellows

- The teaching staff and the special teaching fellows may borrow books for an academic year that can be renewed. For the best service of the readers, it is recommended to the borrowers as much as possible not to remove the books that have been borrowed from their office so that they can be returned immediately in urgent cases. In case of permanent departure, absence with a long leave, those who leave must return the books to the Library.
- A teaching staff and the special teaching fellow cannot be charged with more than twenty (20) books.
- At the end of the spring semester, the books held by the teaching staff, the special teaching fellows and students must be returned in order for the standard annual inventory of material to be made.

Borrowing special collections

There are four types of collections that have a limited borrowing time.

- Information books, rare books or journals never leave the Library.

Borrowing expiration. Return

- All books must be returned by the due date of the loan.
- If the book is not returned within one week from the expiration date of the loan, a notice is sent and after another week, the borrower loses the right to borrow books from the Library.
- The Library's lending records are renewed at the beginning of each academic year. For the renewal of the lending files of the Library, the return of all the books is required.
- Library users, who prevent the above process with a delay in returning books, lose the right to renew registration in the Library for the next year.
- Graduates who have not returned to the Library all the books that have been borrowed are subject to the sanctions provided by the School.

Book Damage or Loss

- For lost books that are no longer published, the cost of replacing them with others of a similar subject should be paid.
- For lost books that are still being published, their current price and shipping costs should be paid.
- For books that are worn and can be repaired, the cost of the repair should be paid.
- For books that have been damaged and cannot be repaired, their current price and shipping costs should be paid.

Check when leaving the library

- Books are protected by an electronic control system. They must be checked with the lending department before being removed from the Library.
- No book comes out of the Library if it is not borrowed.
- Borrowing is done only during the opening hours of the Library.

Photocopies

- To photocopy pages from books or journals, there are two photocopiers in the Library, which work with specialty cards. Users can obtain these cards from the staff of the Library. The use of the photocopier is prohibited for material that does not belong to the Library's collection.
- The Library Committee sets the cost of the cards. Users can make photocopies of the Library's books and journals with the exception of valuable and rare books that are at risk when they are photocopied continuously.
- In the case of photocopying an entire book or volume, special permission is required.
- For the photocopies of the faculty members, an arrangement is made after consultation of the management of the Library and the School.

Books

Readers have access to the online catalog with a terminal located in the Library. Finding a book is done with the help of consecutive menus, selecting the topic of interest. More information is available in the directory guide online.

Journals

The current issues of the journals are displayed alphabetically in the special exhibition. The bound volumes of the journals (arranged chronologically) are located on the ground floor of the

Library in absolute alphabetical order of title. Journals are never removed from the Library unless they are to be bound.

14. ERASMUS+ PROGRAMME

The School of Chemistry is in close collaboration with the Department of European Education Programmes within the framework of mobility Programmes for incoming and outgoing students, academics and other university staff, strengthening the dynamic participation of Aristotle University in European education networks.

ERASMUS+ PROGRAMME

Erasmus+ Programme is the EU-funding Programme for education, training, youth and sports, aiming at strengthening skills and employability as well as at the modernization of the youth and life-long educational and training systems (Higher Education, Professional Training and Qualification, Adult Education, School Education, youth activities, etc.)

Erasmus+ Programme consists of 3 Key Actions for education, training and youth:

1. Key Action 1 (KA1): Learning Mobility of Individuals (https://ww.iky.gr/el/erasmusplus-ka1)
2. Key Action 2 (KA2): Co-operation for Innovation and the Exchange of Good Practices (https://www.iky.gr/el/erasmusplus-ka2)
3. Key Action 3 (KA3): Support for Policy Reform (https://www.iky.gr/el/erasmusplus-ka3)

The State Foundation of Scholarships (IKY) is the Greek national unit of Erasmus+ Programme administration. The Programme Guide can be found in:
http://ec.europa.eu/programmes/erasmus-plus/discover/guide/
http://ec.europa.eu/programmes/erasmus-plus/documents/erasmus-plus-programme-guide_en.pdf
Useful information can also be found at the official IKY webpage:: http://www.iky.gr/erasmusplus

The Programme's main aim is student and staff mobility between the EU and other collaborating countries for studies and training. Erasmus+ Programme has become international since 2015 (**Erasmus+ International Credit Mobility Programme**), allowing for mobility from and to other countries of the world (Partner Countries). Its specific objectives are:

- Increasing the international visibility of European universities.
- Attracting third-country citizens to Europe, a high quality education center.
- Improving qualification and skills, acquiring European experience in education, research and employment.
- Promoting dialogue and understanding between people and cultures.

The School of Chemistry, within the framework the **Erasmus+** Programme, has developed bilateral collaborations (agreements) with a number of European and non–European universities, Institutions of Higher Education and Research Bodies. In more detail, student mobility is financially supported both for studies (**Erasmus+ Studies**) and practical work (**Erasmus+ Internship**), at both undergraduate and postgraduate level as well as part of the **Erasmus Mundus** postgraduate studies Programme (https://www.chem.auth.gr/spoudes/programmata-metaptychiakon/). Students as well as academic and research staff can obtain all the necessary information as well as assistance with academic and administrative matters from the School Coordinator of the Erasmus+ Programme, Associate Professor Fani Mantzouridou, fmantz@chem.auth.gr and the Department of European Education Programmes, https://eurep.auth.gr/en.

More information can be found in the following links:

https://www.chem.auth.gr/spoudes/drasi-erasmus/

https://www.auth.gr/euc

15. EUROPEAN EDUCATION PROGRAMMES

The **Department of European Education Programmes** provides administrative guidance to mobility Programme participants, strengthening the dynamic participation of Aristotle University in European education networks.

In more detail, its duties involve:

- Managing university bilateral agreements within the framework of European education Programmes for study, practical work, teaching and training mobility (Erasmus+, Erasmus Mundus etc.).
- Liaisoning with European universities for strengthening bilateral relations and dealing with all mobility aspects.
- Encouraging and supporting the participation of Aristotle University in European networks (thematic, intensive course Programmes, etc.).
- Actively supporting all University initiatives towards sustaining the European Universities' Charter (ECTS system application, Diploma Appendix awarding etc.). Aristotle University has been awarded the DS Label (2012-2015).
- Providing assistance to Greek and foreign students taking part in mobility Programmes as well as moving academics and staff.
- Regularly briefing members of the Aristotle University community for the opportunities offered by the European education Programmes.
- Advertising to foreign universities the teaching opportunities at Aristotle University.

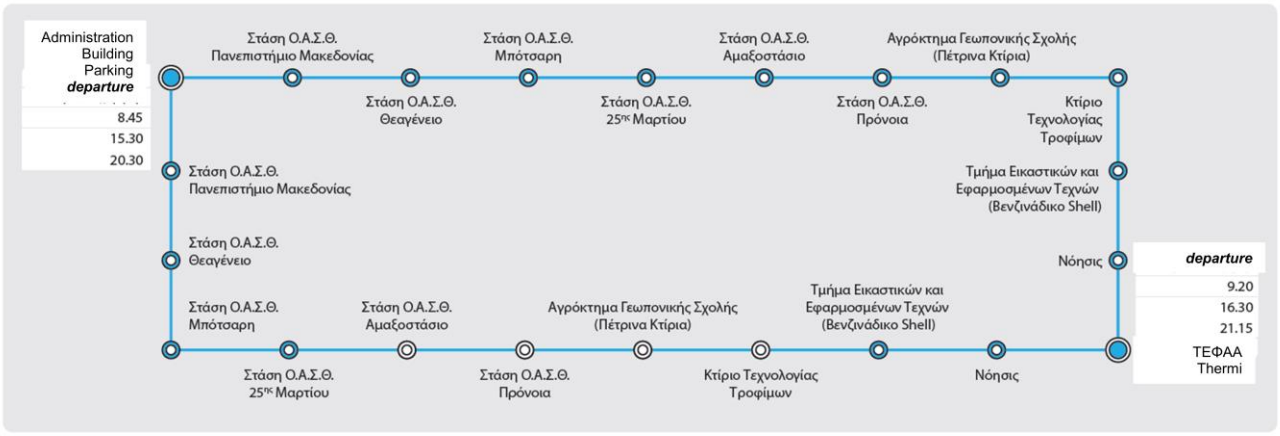
More information can be found at:

https://www.auth.gr/directorate/department/217

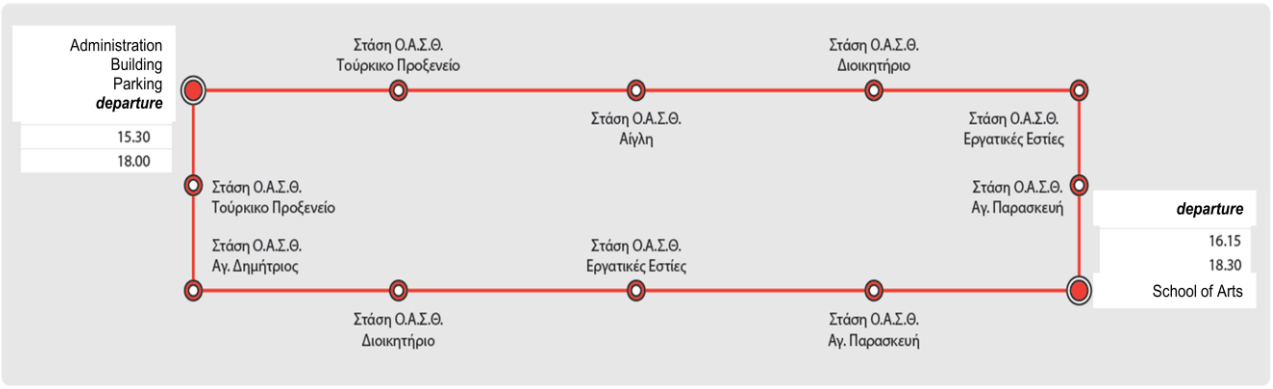
16. USEFUL INFORMATION FOR STUDENTS

16.1 Transportation

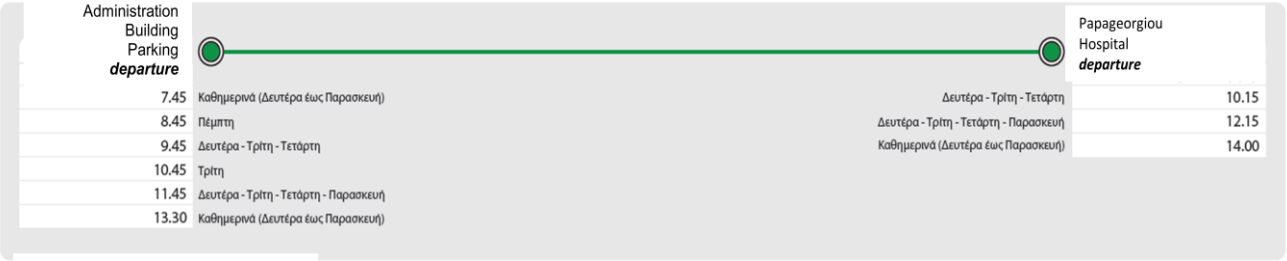
Aristotle University Bus Routes



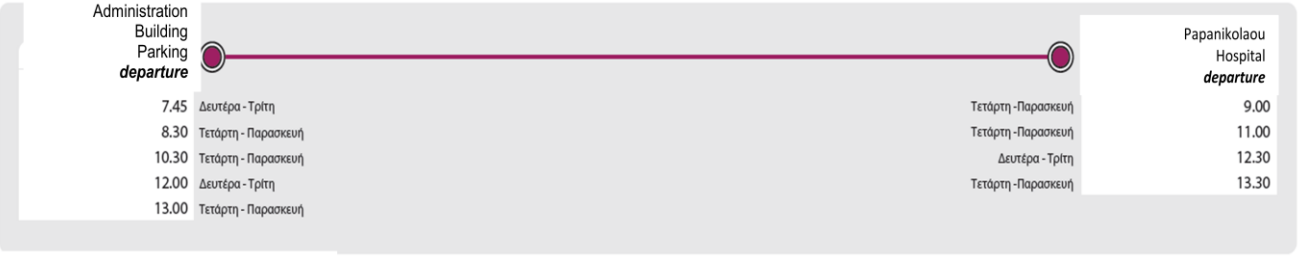
Route 1



Route 2



Route 3



Route 4

City Bus Service (Ο.Α.Σ.Θ.): https://oasth.gr/en/

16.2 Student Refectory

The Aristotle University Student Refectory is a public sector legal entity, directly associated with the University. Its premises lay at the east end of the university campus with the main entrance to September 3rd and Egnatia streets. It has one of the largest and best equipped food preparation and distribution facilities in Northern Greece, as well as a cafeteria and health office. Its main scope is providing meals and health services (including medicine) to University students.

MEALS SERVICE

Meals are provided in two large halls at the refectory premises, with a capacity of 1000 places (ground floor) and 500 places (first floor); meals for staff are provided in two small halls. Meals are also delivered to students at university locations outside the main campus.

During the summer period meals are also provided to Forestry students practicing in forests away from Thessaloniki and the Refectory also supports meals preparation in the University Summer Camp in Kalandra, Chalkidiki.

STUDENT HEALTH CARE

According to national legislation (4452/15-02-2017 (A' 17), article 31, paragraph 3): "undergraduate and postgraduate students as well as PhD students that have no health insurance, are entitled full health insurance with the national health system (Ε.Σ.Υ.), with all costs covered by the national organization of health services (Ε.Ο.Π.Υ.Υ.), in accordance with article 33 of the 4368/2016 (A' 83) legislation, simply quoting their social security number (Α.Μ.Κ.Α.).

All students requiring medical help can visit daily the Health Office based in the Student Refectory. First aid, clinical examination (without medical prescription), vaccination and advice on health issues can be provided.

There is also an Advice and Psychological Support Center (ΚΕ.ΣΥ.Ψ.Υ.) manned by psychologists where all students can get advice at no cost. There is also the possibility of psychiatric support on certain days, under appointment.

Also, not-insured students that are planning to visit EU countries can get a European Health Insurance Card (Ε.Κ.Α.Α.).

The Refectory also supports the organization of music and arts events while having at the same time its own chorus and a photography club.

Finally, at the Refectory premises, students can find the Liaison Office and the Office of Students Ombudsman.

Useful telephone numbers:

Refectory Office: +30 2310 992623

Health Care Office: +30 2310 992642

More information can be found at: https://www.auth.gr/en/units/8177

16.3 IT services

myAuth

All university electronic services are located at a single spot. One can select *"Enter"* and provide the credentials of your university personal account: a *Single Sign On* is enough. One can format one's own bookmarks as per one's preference.

You can find easily the particular service you are interested in using at the following link: https://it.auth.gr/el/dashboard

16.4 Career perspectives

Our Chemistry Graduates can seek employment both in the public and the private sector, as freelancers, in education or in the health industry. They can either work in product quality control or environmental monitoring. They can work in the State Chemistry Department or as researchers in Universities, Research Centers and Institutes, biological treatment agencies etc. A chemist can be responsible for the synthesis, production and quality control of both raw materials and final products as well as for the research for new starting materials and products with potential pharmaceutical application. To that end, they can find jobs in the chemical industry (food, drink, pesticides, medicine, plastics, textiles, cosmetics, dyes industry), in oil refineries, as wine-chemists (enologists) and in fish farms. A large number are employed as salesmen/technicians for chemicals, labware and analytical equipment. A chemist can also start his/her own analytical laboratory. Alternatively, a chemist can work as a teacher either in public or private schools as well as in a university or technical school. A chemist may spend a large part of his/her time (not only in the lab) but also at the office desk, while validating experimental results and following the relevant literature.

16.5 Studentships

In general, scholarships and prizes are awarded according to the funding body or donor's will, according to certain criteria and following a competition or some other selection process. The

number of scholarships varies each year since they depend on the organization or donor annual funds.

For example, the State Institution of Scholarships (IKY), grants scholarships to undergraduates and postgraduates based on their university entry marks and their university exam marks, respectively. For more information one can turn to IKY, 41 Ethnikis Antistaseos Ave., 14234, Nea Ionia, Attiki (tel. 210-3726300, **http://www.iky.gr**).

In general, one can find more information regarding studentships, both at the School's webpage and at: https://www.auth.gr/news

16.6 Electronic Services – People with Disabilities (AMEA)

All University electronic services can be found at a single web location, that of the Aristotle University central webpage: https://www.auth.gr/services

16.7 Electronic Services – Provisions – Health Services – Accommodation – Sports etc.

All University electronic services can be found at a single web location, that of the Aristotle University central webpage: https://www.auth.gr/services

17. DATA INDEX OF ACADEMIC STAFF (In alphabetical order)

Achilias	Dimitrios	Prof.	Lab. of Color and Polymer Chemistry and Technology	axilias@chem.auth.gr	2310997822
Akrivos	Periklis	Prof.	Lab. of Inorganic Chemistry	akrivos@chem.auth.gr	2310997706
Angaridis	Panagiotis	Assis. Prof.	Lab. of Inorganic Chemistry	panosangaridis@chem.auth.gr	2310997437
Anthemidis	Aristidis	Prof.	Lab. of Analytical Chemistry	anthemid@chem.auth.gr	2310997826
Antoniou	Kyriakos	STF	Dept. of Physical, Analytical and Environmental Chemistry	kyrantoniou@chem.auth.gr	2310997856
Avranas	Antonios	Prof.	Lab. of Physical Chemistry	avranas@chem.auth.gr	2310997686
Bikiaris	Dimitrios	Prof.	Lab. of Color and Polymer Chemistry and Technology	dbic@chem.auth.gr	2310997812
Brouma	Maria	STF	Library	brouma@chem.auth.gr	2310997837
Charistos	Nikolaos	Assis. Prof.	Dept. of General and Inorganic Chemistry	nicharis@chem.auth.gr	2310997801
Choli-Papadopoulou	Theodora	Prof.	Lab. of Biochemistry	tcholi@chem.auth.gr	2310997806
Deligianni	Eleni	Prof.	Lab. of Chemical and Environmental Technology	lenadj@chem.auth.gr	2310997808
Dendrinou-Samara	Catherine	Prof.	Lab. of Inorganic Chemistry	samkat@chem.auth.gr	2310997876
Dentsora	Urania-Evaggelia	AdP	Administrative Office	dentsoral@chem.auth.gr	2310997690
Evgenidou	Eleni	STF	Dept. of Physical, Analytical and Environmental Chemistry	evgenido@chem.auth.gr	2310997446
Fotopoulos	Apostolos	STF	Dept. of Chemical Technology and Industrial Chemistry	afotopou@chem.auth.gr	2310995290
Fylaktakidou	Konstantina	Prof.	Lab. of Organic Chemistry	kfylakta@chem.auth.gr	2310997844
Gallios	Georgios	Prof.	Lab. of Chemical and Environmental Technology	gallios@chem.auth.gr	2310997716
Gartagani	Christina	TP	Lab. of Organic Chemistry	xgarta@chem.auth.gr	2310997846
Gavriil	Dimitrios	Assis. Prof.	Lab. of Physical Chemistry	dgavriil@chem.auth.gr	2310997824
Giannakoudakis	Andreas	Prof.	Lab. of Chemical Education, and Application of ITC in Chemistry	andreasj@chem.auth.gr	2310997683

Giannakoudakis	Panagiotis	Prof.	Lab. of Chemical Education, and Application of ITC in Chemistry	panjian@chem.auth.gr	2310997724
Giannakouros	Thomas	Prof.	Lab. of Biochemistry	giannako@chem.auth.gr	2310997702
Girousi	Stella	Prof.	Lab. of Physical Chemistry	girousi@chem.auth.gr	2310997722
Hatzidimitriou	Antonios	Assoc. Prof.	Lab. of Inorganic Chemistry	hatzidim@chem.auth.gr	2310997748
Hatzidimitriou	Eufimia	Assis. Prof.	Lab. of Food Chemistry and Technology	effiehd@chem.auth.gr	2310997823
Ioannou	Konstantinos	TP	Lab. of Biochemistry	ioannou@chem.auth.gr	2310997768
Kafantari	Maria	AdP	Administrative Office	mkafantari@chem.auth.gr	2310997640
Karapantsios	Theodoros	Prof.	Lab. of Chemical and Environmental Technology	karapant@chem.auth.gr	2310997772
Karapetsa	Christina	TP	Environmental Pollution Control Lab, Dept. of General and Inorganic Chemistry	karape@chem.auth.gr	2310997747
Katsogiannis	Ioannis	Assoc. Prof.	Lab. of Chemical and Environmental Technology	katsogia@chem.auth.gr	2310997977
Kesoglou	Alexandra	AdP	Administrative Office	akesoglou@chem.auth.gr	2310997570
Kompogianni	Elissavet	AdP	Administrative Office	kompogianni@chem.auth.gr	2310 997660
Kornaraki	Sofia	AdP	Administrative Office	kornaraki@chem.auth.gr	2310997670
Kostoglou	Margaritis	Prof.	Lab. of Chemical and Environmental Technology	kostoglu@chem.auth.gr	2310997767
Koukaras	Emmanouel	Assis. Prof.	Lab. of Quantum and Computational Chemistry	koukarase@chem.auth.gr	231099
Koumbis	Alexandros	Prof.	Lab. of Organic Chemistry	akoumbis@chem.auth.gr	2310997839
Kouras	Athanasios	STF	Dept. of Physical, Analytical and Environmental Chemistry	akouras@chem.auth.gr	2310997932
Lambropoulou	Dimitroula	Assoc. Prof.	Environmental Pollution Control Lab	dlambro@chem.auth.gr	2310997687
Lazarides	Theodoros	Assis. Prof.	Lab. of Inorganic Chemistry	tlazarides@chem.auth.gr	2310997853
Lazarides	Nikolaos	Prof.	Lab. of Chemical and Environmental Technology	nlazarid@chem.auth.gr	2310997807
Lazaridou	Elpida	TP	Lab. of Food	elpidal@chem.auth.gr	2310997764

			Chemistry and Technology, Lab. of Physical Chemistry, Lab. of Color and Polymer Chemistry and Technology		
Litinas	Konstantinos	Prof.	Lab. of Organic Chemistry	klitinas@chem.auth.gr	2310997864
Lykakis	Ioannis	Assoc. Prof.	Lab. of Organic Chemistry	lykakis@chem.auth.gr	2310997871
Lykidou	Smaro	STF	Dept. of Chemical Technology and Industrial Chemistry	slykidou@chem.auth.gr	2310997769
Manoli	Evaggelia	STF	Dept. of Physical, Analytical and Environmental Chemistry	emanoli@chem.auth.gr	2310997925
Mantzouridou	Fani	Assoc. Prof.	Lab. of Food Chemistry and Technology	fmantz@chem.auth.gr	2310997774
Mpika	Vasiliki	TP	Library	vmpika@chem.auth.gr	2310997717
Nenadis	Nikolaos	Assis. Prof.	Lab. of Food Chemistry and Technology	niknen@chem.auth.gr	2310997731
Nikolaidis	Nikolaos	Assis. Prof.	Lab. of Color and Polymer Chemistry and Technology	nfnikola@chem.auth.gr	2310997594
Nikolakaki	Eleni	Assoc. Prof.	Lab. of Biochemistry	nikol@chem.auth.gr	2310997726
Noli	Fotini	Assoc. Prof.	Lab. of Inorganic Chemistry	noli@chem.auth.gr	2310997997
Ordoudi	Stergiani	STF	Dept. of Chemical Technology and Industrial Chemistry	steord@chem.auth.gr	2310997847
Pantazaki	Anastasia	Prof.	Lab. of Biochemistry	natasa@chem.auth.gr	2310997838
Papadopoulos	Nikolaos	Prof.	Lab. of Chemical Education, and Application of ITC in Chemistry	npapado@chem.auth.gr	2310997735
Papi	Rigini	STF	Dept. of Organic Chemistry and Biochemistry	rigini@chem.auth.gr	2310997878
Paraskevopoulou	Adamantini	Assoc. Prof.	Lab. of Food Chemistry and Technology	adparask@chem.auth.gr	2310997832
Peleka	Efrosini	STF	Dept. of Chemical Technology and Industrial Chemistry	peleka@chem.auth.gr	2310997836
Prohaska	Chariklia	STF	Dept. of Chemical Technology and Industrial Chemistry	prohaska@chem.auth.gr	2310997875

Psomas	Georgios	Assoc. Prof.	Lab. of Inorganic Chemistry	gepsomas@chem.auth.gr	2310997790
Samanidou	Viktoria	Prof.	Lab. of Analytical Chemistry	samanidu@chem.auth.gr	2310997698
Samara-Konstantinou	Constantini	Prof.	Environmental Pollution Control Lab	csamara@chem.auth.gr	2310997805
Sarli	Vasiliki	Assoc. Prof.	Lab. of Organic Chemistry	sarli@chem.auth.gr	2310997840
Sazou	Dimitra	Prof.	Lab. of Physical Chemistry	sazou@chem.auth.gr	2310997813
Sigalas	Michael	Prof.	Lab. of Quantum and Computational Chemistry	sigalas@chem.auth.gr	2310997815
Sotiropoulos	Sotirios	Prof.	Lab. of Analytical Chemistry	eczss@chem.auth.gr	2310997742
Spathis	Panagiotis	Prof.	Lab. of Chemical and Environmental Technology	spathis@chem.auth.gr	2310997835
Stathakis	Christos	Assis. Prof.	Lab. of Organic Chemistry	cstathakis@chem.auth.gr	2310997842
Stavrakaki	Lydia	AdP	Administrative Office	orfeas@chem.auth.gr	2310997680
Stergiopolous	Thomas	Assis. Prof.	Lab. of Physical Chemistry	stergt@chem.auth.gr	2310997752
Theodoridis	Georgios	Prof.	Lab. of Analytical Chemistry	gtheodor@chem.auth.gr	2310997718
Triantafyllidis	Konstantinos	Prof.	Lab. of Chemical and Environmental Technology	ktrianta@chem.auth.gr	2310997730
Tsiplakidis	Dimitrios	Assoc. Prof.	Lab. of Physical Chemistry	dtsiplak@chem.auth.gr	2310997766
Tsogkas	Georgios	Assis. Prof.	Lab. of Analytical Chemistry	gtsogkas@chem.auth.gr	2310997723
Tzanavaras	Paraskevas	Assis. Prof.	Lab. of Analytical Chemistry	ptzanava@chem.auth.gr	2310997804
Vasiliadou	Saoula	TP	Lab. of Inorganic Chemistry	svasi@chem.auth.gr	2310997809
Voutsa	Dimitra	Prof.	Environmental Pollution Control Lab	dvoutsa@chem.auth.gr	2310997858
Zachariadis	Georgios	Prof.	Lab. of Analytical Chemistry	zacharia@chem.auth.gr	2310997707
Zarife	Fotini	TP	Lab. of Biochemistry	zarife@chem.auth.gr	2310997697
Zarzani	Lydia	AdP	Administrative Office	lzarzani@chem.auth.gr	2310997660
Zografos	Alexandros	Assoc. Prof.	Lab. of Organic Chemistry	alzograf@chem.auth.gr	2310997870
Zotou	Anastasia-Stella	Prof.	Lab. of Analytical Chemistry	azotou@chem.auth.gr	2310997746
Zouboulis	Anastasios	Prof.	Lab. of Chemical and Environmental Technology	zoubouli@chem.auth.gr	2310997794
Zougrou	Fotini	TP	Lab. of Analytical	fzougrou@chem.auth.gr	2310997866

AdP : Administrative Personnel

Assis. Prof. : Assistant Professor

Assoc. Prof. : Associate Professor

Dept: Department

Lab. : Laboratory

Prof. : Professor

STF (ΕΔΙΠ): Special Teaching Fellow

ΤΡ (ΕΤΕΠ): Technical Personnel/Special Technical Personnel