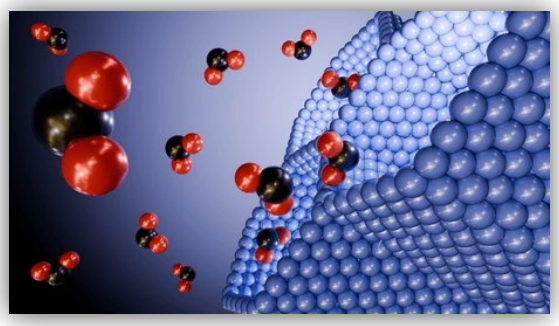
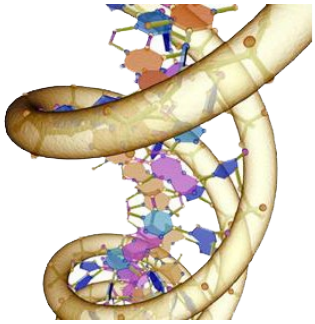
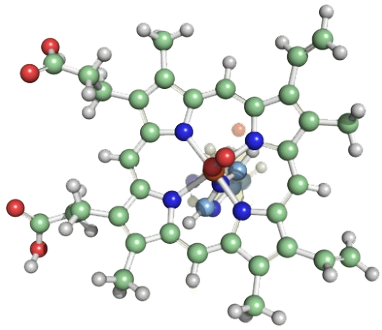


Department of Chemistry

Curriculum

2024-2025





Patras, Greece


Table of Contents

I. GENERAL INFORMATION-
STRUCTURE OF THE DEPARTMENT

I.1 The Department – An Overview

The Department of Chemistry was founded in 1966 and is one of the first established Departments of the University of Patras. The educational and research activities of the Department are centered in three separate buildings (North, South and the New Chemistry Buildings), where research and undergraduate training laboratories, one computational center and a library are located.

The Faculty of the Department consists of 32 Academic Staff members, and 9 members of Special Teaching and Technical Personnel. About 700-750 undergraduate and over 200 Postgraduate students are currently enrolled.

The Department collaborates with many European Universities under the Erasmus Student and Academic Staff Exchange Program, at both undergraduate and Postgraduate levels (https://www.upatras.gr/en/erasmus). Moreover, the majority of the faculty members participate in joint research projects with scientists from other Academic and Research Institutions and industries in Greece and abroad.

The Department is organized into the following three Divisions, each consisting of specialised laboratories with extensive research facilities and instruments:

- ***Division of Organic Chemistry, Biochemistry and Natural Products.***
- ***Division of Physical, Inorganic and Nuclear Chemistry.***
- ***Division of Applied, Analytical and Environmental Chemistry.***

I.2 Undergraduate Studies

The Department of Chemistry provides students with a full educational program covering a wide range of scientific areas and skills associated with chemistry (including Inorganic, Organic, Physical, Structural, and Analytical Chemistry), Catalysis, Biochemistry, Biotechnology, Materials, Polymer, Food and Environmental Science. The awarded diploma qualifies Department graduates with significant skills to begin a career in public or private sectors, such as the chemical industry, a wide range of analytical laboratories, as well as research and educational institutions.

I.3 Postgraduate Studies

Postgraduate studies enable Department students to pursue academic careers or careers in the private sector. The Postgraduate Program has two main directions:

I.3.1 Master of Science (MSc) specialisations

The Postgraduate program of the Department has been reformed and leads to MSc degrees in two directions. Furthermore, the Department of Chemistry has also taken over the administrative support of an Inter-Departmental MSc and an Inter-Institutional MSc Courses, while participating in Inter-Departmental MSc Courses. Specifically, MSc Courses in the Department are available in the following specifications:

1. ***Chemistry and Technology of Materials with Applications to Industry, Energy and Environment.***
2. ***Analytical Chemistry and Nanotechnology.***

I.3.2 Doctorate (PhD) Programs

The Postgraduate Studies Program (PhD) covers all the research areas and activities of the Department of Chemistry. The PhD Program enrols graduates from all Departments of the Schools of Sciences and Polytechnic Institutes of Greece or corresponding Institutions abroad, such as Departments of Chemistry, Biology, Geology, Physics and Agriculture, Medicine, Pharmacology and Chemical Engineering.

I.3.3 Other MSc Programs

- **Interdepartmental MSc Program** ***"Applied Biochemistry: Clinical Chemistry, Biotechnology, Evaluation of Pharmaceutical Products".***
  Participants: Department of Chemistry, and National Center of Scientific Research "Demokritos" (Athens).

- **Interdepartmental MSc Program** ***"Medicinal Chemistry and Chemical Biology".***
  Participants: Departments of Chemistry and Medicine (University of Patras).

- **Interdepartmental MSc Studies** ***"Science and Technology of Polymers and Composite Materials".***
  Participants: Departments of Chemistry, Chemical Engineering, Materials Science, Mechanical and Aeronautical Engineering and Physics (University of Patras).

- **Interdepartmental MSc Program** ***"Environment Sciences".***
  Participants: Departments of Biology, Geology, Mathematics, Physics, materials Science and Chemistry of the University of Patras participate in the program.

- **Inter-Institutional MSc Programme** ***"Inorganic Biological Chemistry".***
  Participants: Departments of Chemistry of the Universities of Patras, Ioannina, Thessaloniki, Athens, Crete and Cyprus.

I.4 Collaborating Countries & Institutions

Country	University/Institution
Belgium	Antwerp, Department of Chemistry
	K. Leuven, Zoological Institute
	Louvain, Unite de Catalyse et Chimie des Materiaux Divises
Canada	New Brunswick, Department of Chemistry
	Brock University, Department of Chemistry
France	Strasbourg, Louis Pasteur
	Angers, Laboratoire de Proprietes Optiques des Materiaux et Applications
	Blaise-Pascal, Department of Chemical and Biochemical Engineering, LGCB
	Marseille, Provence-CNRS
	Pierre et Marie Curie, Laboratoire de Physico-chimie Macromoleculaire
	Pau et des Pays de 1'Adour, Laboratoire de Chimie Structurale
Germany	Hannover, Department of Natural Sciences, Institute of Food Chemistry
Italy	Bologna, Department of Chemistry
	Calabria, Department of Chemistry
	Ferrara, Department of Chemistry
	Florence, Departments of Chemistry and Pharmacy and Magnetic ResonanceCenter
	Modena and Reggio Emilia, Department of Agricultural Sciences
	Rome, Department of Biochemistry (La Sapienza)
	Varese, School of Medicine
Japan	Tokyo, Agriculture and Technology, Laboratory of Organic Geochemistry
Norway	Bergen, Department of Chemistry
Poland	Poznań, Adam Mickiewicz, Institute of Physics, Nonlinear Optics Division
Spain	Barcelona, Department of Inorganic Chemistry
	Consejo, Superior de Investigaciones Cientifıcas, Catalysis & Petrochemistry (CSIC)
The Netherlands	Leiden, Department of Chemistry
Turkey	Mersin, Department of Environmental Engineering
United Kingdom	Cardiff, Department of Chemistry
	Imperial College London, Department of Chemical Engineering and Chemical Technology
	London, Birkbeck College
	Manchester, School of Chemical Engineering and Analytical Science & Satake Centre for Grain Process Engineering
	Newcastle, Civil Engineering and Geosciences
	Ulster, School of Biomedical Sciences
	Reading, Department of Food Biosciences
USA	Oklahoma, Civil Engineering and Environmental Science
	Pensylvania School of Medicine
Australia	Melbourne, Burnet Research Institute
Bulgaria	Sofia, Catalysis, Bulgarian Academy of Sciences
Germany	Mainz, Max-Planck, Institut für Polymerforschung
	Braunschweig, TU Braunschweig, Institut für Physikalische und Theoretische Chemie
Hungary	Budapest, Isotope and Surface Chemistry, Chemical Research Centre, HAS
India	Thiruvananthapuram, National Institute for Interdisciplinary Science & Technology, Biotechnology Division (NIIST)
Slovenia	Ljubljana, National Institute of Chemistry
Sweden	Stockholm, Karolinska Institute
	Uppsala, Ludwing Institutte for Cancer Research
	Stockholm, Kungliga Tekniska Högskolan

II. UNDERGRADUATE STUDIES PROGRAM

II.1 General Information

Each academic year is divided into two semesters. The first (Autumn) semester begins around October 1 and ends around January 31. Classes for the second (Spring) semester start around February 16 and end around June 10. The exact dates are announced at the beginning of each academic year in the departmental website: www.chem.upatras.gr. In order to graduate, that is to obtain the Diploma (Greek: "*Ptychio*") in Chemistry, the completion of 8 semesters (4 years) is formally required. During each semester, a student must follow 4-6 courses with a total of 23-30 contact hours per week.

II.1.1 Courses

A course may consist of lectures only, lectures and seminars, or combination of lectures, seminars and practical exercise (laboratory). The courses offered in the Department of Chemistry are grouped within the two semesters (Autumn and Spring). The way these courses appear in the Course Table, indicate the optimum sequence of courses (model study plan) that a student should follow.

The Curriculum consists of Compulsory, Semi-Optional, and Optional (chemistry or non-chemistry) courses that can be chosen by the students according to their special interests. These courses are presented in the Course Table as Optional or Semi-Optional Courses. The minimum and maximum number of courses each student should opt for is also indicated therein. These Optional and Semi-Optional courses are then treated as Compulsory ones in relation to attendance and exams matters. There are no specific quotas of students that must attend these courses. However, in some cases, a course may be suspended, when less than three students have selected it. Students are then advised to apply for a different course. The estimated number of students usually participating in optional courses is around 10-20 students. This number may also be higher. These courses provide some sort of specialization that is considered important for the job market and are related to the Chemistry of Foods & Beverages, Oenology, Environmental Chemistry, Polymer Chemistry, Analytical Chemistry, Organic and Inorganic Chemistry and Clinical Chemistry. Lectures and seminars can be followed by students at will, whereas attendance of laboratories is mandatory.

II.1.2 Exams/Assessment

There is no formal assessment throughout the semester for most courses. In some cases, lecturers offer midterm evaluation-type exams within the semester with the grades obtained considered in the estimation of the final mark. Moreover, the students are constantly examined, during the laboratory training, usually orally, on the theory and practice of each experiment they are about to perform. Finally, they must present a written report of their results after the end of each experiment. All these are considered in the estimation of the final mark, together with the marks of the final written examination, associated with each laboratory.

Courses are normally offered in the Greek language. Lecturers teach the related material based on Greek textbooks. Greek students study from these textbooks, which are offered free by the Greek Government. These textbooks are usually translations of the corresponding, most broadly used, English textbooks. Thus, the content and the level of these Greek textbooks are similar to the

corresponding English ones. So, a corresponding English textbook is indicated from the Lecturer to an ERASMUS student whose native language is not Greek and his/her Greek is not good enough to be able to study from a Greek textbook or follow lectures and seminars. These textbooks can be borrowed from the Departmental or Institutional (Central) Library.

A course is considered successfully passed, when the student has acquired at least the grade 5 out of 10 in the associated exams. A course that includes laboratory training requires a passing grade for both. Exams are conducted at the end of each semester (3 weeks duration), while repeat exams (4 weeks duration) take place in September. However, students who have failed in these exams, or have not participated in some, can be freely re-examined in the following exam periods.

II.1.3 Undergraduate Diploma Thesis

During the final year (Semesters 7 and 8), students must carry out a short research project, assigned in Greek as "*Experimental Diploma Thesis*", under the supervision of a member of the Academic staff, in addition to the courses they have to follow. At the end this project, they are expected to provide a Diploma Thesis (a written report of their results including a literature review on the field) and give an oral presentation. A grade is then assigned to the student by the supervisor involved, reflecting the overall performance of the student. This grade should be at least 5 out of 10 for a successfully completed undergraduate diploma project. A part or the whole of this project can also be conducted in another research laboratory in the same or another University. A student is considered to have completed his/her studies in our Department, only when he/she has passed all the exams associated with all courses and has trained successfully in the associated laboratories described in the Curriculum.

The Experimental Diploma Thesis corresponds to 24 ECTS Credits and may be replaced (in special cases, and after approval by the Department of Chemistry) by an extended literature review ("*Bibliographic Diploma Thesis*") on a chemical topic (in the form of a review article, including an oral public presentation). 8 ECTS Credits are assigned to such a theoretical thesis. The remaining 16 ECTS credits will be then substituted by additional *Semi-Optional* (1×5=5 ECTS Credits) *or Optional Chemical Courses* (2×4=8 ECTS Credits).

II.1.4 Greek Credits

The number of Greek credits assigned to each course is dictated by a regulation of the Greek Law for Higher Education (No. 1268/82) which states that 1 Greek credit corresponds to 1 hour lecture per week per semester, whereas for the rest of educational work (e.g., seminars and labs) 1 credit corresponds to 1-3 hours per week per semester. Through its General Assembly, each Department defines the number of credits assigned to this other educational work. In our Department, 1 credit corresponds to 1 hour per seminar per week per semester and 2 hours lab work per week per semester. 24 Greek credits are assigned to the Experimental Undergraduate Diploma Project. According to this definition, ca. 20 Greek credits are associated with each semester. The credits collected by the students during their study period in the Greek Universities, and their corresponding grades, are considered for the calculation of their final mark. A new factor, called "weighing" factor, has been introduced by law for the aforementioned calculation. According to this factor, courses associated with 1-2 Greek credits have a factor of 1.0, courses associated with 3-4 Greek credits have a factor of 1.5 and courses with more than 4 credits take the highest possible factor of 2.0. The final graduating grade is calculated based on the grades of all courses and the associated weighing factors.

II.1.5 ECTS Credits

Moreover, considering the regulation for the higher education system as it was briefly described

above, the basic requirement of the ECTS system (European Course Credit Transfer System) for 30 credits for each semester was met in our Department. These credits were then allocated to each course of a semester taking into consideration the contact hours for each course and the other work-load the mean student is expected to consume in other activities (private studying, preparation of reports, participation in exams, etc.) so that he/she will complete successfully each course. The credits were assigned to courses as multiples of 5 throughout the curriculum (according to the ECTNA recommendations for the "*Eurobachelor*"), that is 5 or 10 depending on whether they include laboratory work or not. In the revised curriculum, which started operating since academic year 2015-16 and is currently in its second year of implementation, this is however valid only for the *Core Courses* (Inorganic Chemistry, Organic Chemistry, Analytical Chemistry and Physical Chemistry as well as Biological Chemistry, Chemical Technology and Food Chemistry), the *Semi-Optional Courses* and the courses supporting them (Mathematics, Physics, Biology and Chemistry and Informatics). For the freely *Optional Chemistry Courses*, 4 ECTS credits are assigned, and 3 ECTS credits are assigned to the freely *Optional Non-Chemistry Courses*.

II.1.6 ERASMUS students

An ERASMUS student, who has studied for at least one year in our Institution, can be considered as legitimate to obtain the *Diploma in Chemistry* (*Ptychion*) offered by our Department for undergraduate studies. The ERASMUS Committee of our Department will consider the studies records of students abroad and their performance at our Department. Courses successfully completed abroad will then be correlated to those of the University of Patras. If there is no need for additional courses, this committee will propose to the General Assembly of the Department to award the Diploma (*Ptychion*) to that particular student. Otherwise, the student will have to attend and successfully pass all those courses, which are required to complete our Curriculum.

Following graduation, it is possible for a student to follow graduate studies leading to a *Postgraduate Diploma of Specialization* (PDS, equivalent to MSc Diploma) and subsequently to a *Doctorate Diploma* (DD that is a PhD Diploma). The PDS involves 1.5 years of studies. The candidate follows during the first year ca. 4-8 courses in total (2-4 courses each semester) and has to pass the exams associated with these courses. Exams take place at the end of each semester (1 week duration). The minimum passing grade is 5 out of 10. Repeat exams for both semesters take place in September (2 weeks duration). In addition, the student must prepare and deliver two oral presentations (at the end of each semester or the end of second semester), related to the specialization courses. During their third semester, students carry out a short, novel, research project and present their results written and orally. There are currently three Postgraduate Programs available in the Department and four other Interdepartmental Postgraduate Programs in which our Department participates.

II.2 Types of Courses and Associated ECTS Credits

II.2.1 Core Courses (Compulsory)

COURSE	ECTS CREDITS
Inorganic Chemistry	30
Organic Chemistry	35
Physical Chemistry	25
Analytical Chemistry	30
Biochemistry	15
Principles of Chemical Technology	10
Physics for Chemists	5
Mathematics for Chemists	5
Chemistry and Informatics	5
General Biology	5
Food Chemistry	5
Total number of ECTS credits	***170***

II.2.2 Semi-Optional Courses *

COURSE	ECTS CREDITS
Materials Chemistry and Technology (Polymers, Nanomaterials, Colloids, Catalysts)	5
Environmental Chemistry	5
Structural Chemistry	5
Physical Processes of Chemical Technology	5
Chemical Processes of Chemical Technology	5
Principles and Applications of Nuclear Chemistry	5
Total number of ECTS credits	***25 (out of 35)***

* *The remaining courses (corresponding to 10 ECTS courses), which were not selected as Semi-Optional Courses, can be selected as Optional Chemistry Courses.*

II.2.3 Experimental Diploma Thesis *

COURSE	ECTS CREDITS
Experimental Diploma Thesis	24

* *The Experimental Diploma Thesis may be replaced by an extended literature review ("Bibliographic Diploma Thesis") on a chemical topic (in the form of a literature review article). 8 ECTS Credits are assigned to such a theoretical thesis. The remaining 16 ECTS credits will be then substituted by additional Semi-Optional (2×5=10 ECTS Credits) or Optional Chemical Courses (5×4=20 ECTS Credits).*

*II.2.4 Optional Chemistry Courses**

COURSE	ECTS CREDITS
Modern Spectroscopy methods (NMR, MS) - Molecular Modelling	4
Physical Chemistry-4	4
Food Chemistry and Technology – Oenology I	8
Chemistry of Organometallic Compounds and Mechanisms of Inorganic Reactiosn	4
Quality Control in Analytical Chemistry	4
Biochemistry-3 (Gene Expression and Regulation-Gene Engineering)	4
Clinical Chemistry	4
Catalysis and Green Chemistry	4
Enzymology	4
Microbiology	4
Practical Training	4
Food Biochemistry	4
Pharmaceutical Chemistry	4
Biotechnology	4
Polymer Science	4
Chemical Industries (Inorganic and Organic)	4
Food Chemistry and Technology – Oenology II	4
Bioinorganic Chemistry	4
Computational Chemistry, Theoretical Spectroscopy and Molecular Design	4
* ***2-3 courses to be selected (at Semester 7 or 8) with a total number of ECTS credits***	***8-12***

*II.2.5 Optional Non-Chemistry Courses **

COURSE	ECTS CREDITS
Didactics of Natural Sciences	3
Introduction to Economics for Engineers and Scientists	3
Business Administration and Organization for Engineers and Young Scientists	3
English Chemical Terminology	3
Main European Languages (one from: French, Spanish, German, Italian)	3
Viticulture	3
* ***2 courses to be selected at Semester 8 with a total number of ECTS credits***	**6**

III. PROGRAM PLAN

III.1 Undergraduate Studies

The four numerals, following each course code number, indicate lecture hours, tutorial hours, laboratory hours and number of ECTS credits, respectively. During the fourth year of studies, the students must carry out a short research project (VII and VIII semesters) and finally submit a Diploma Thesis. 24 ECTS credit units are assigned to this research work (*Experimental Diploma Thesis*), which is performed under the supervision of a faculty member. In special cases, the Experimental Diploma Thesis may be replaced by an extended literature review on a topic related to chemistry (in the form of a review article). 8 ECTS Credits are assigned to this theoretical thesis. The remaining 16 ECTS credits will then be replaced by Semi-Optional or Optional Chemistry Courses.

III.2 Department of Chemistry Curriculum – Applied in 2016-2017

Note: All courses are assigned 7-digit codes (2 letters-3 numbers), according to the classification code G-LSUD [Greece-Long Studies, University (at least three years) finishing with an academic Degree]. From the three number digits, the first shows the corresponding Semester that the course is being taught and the other two show the subject area and the serial number of the particular course within the specific subject area, as follows:

01-09: Organic Chemistry
10-19: Biochemistry (Biological Chemistry)
20-29: Inorganic Chemistry
30-39: Physical Chemistry
40-49: Nuclear-Radiation Chemistry
50-59: Analytical Chemistry
60-60: Structural Chemistry
70-79: Materials Chemistry, Polymers, Food Chemistry
80-89: Chemical Technology, Industrial Chemistry
90-99: Catalysis, Environmental Chemistry.

The prefix **CHE** stands for "Department of Chemistry"
The prefixes **XA, XO, XE** indicate the corresponding Division of the Department of Chemistry, i.e.:
XA: Division of Physical, Inorganic and Nuclear-Radiation Chemistry
XO: Division of Organic Chemistry, Biochemistry and Natural Products
XE: Division of Applied, Analytical and Environmental Chemistry
BI stands for "Biology"
EX stands for "Experimental thesis"
XΠ stands for "Practical training"

For example, CHE_XA 127 stands for "*Introduction to Inorganic Chemistry*", which is taught by the staff of Division XA in Semester 1 and belongs to the subject area "*20-29: Inorganic Chemistry*".

In a similar manner, non-Chemistry Courses are assigned codes as follows:

01-09: Mathematics
10-19: Physics
20-29: Biology (e.g. 21=General Biology, 22=Microbiology, 23=Viticulture)
30-39: Economics (e.g. 31=Economics, 32=Business Administration)
40-49: Humanities (e.g. 41=Didactics of Natural Sciences, 42=English Chemical Terminology, etc.)

MA: Mathematics
PH: Physics
BI: Biology
AN: Humanities
OI: Economics

For example, AN 844 stands for "*German*", which is taught in Semester 8 and belongs to the subject area "*40-49: Humanities*".

The courses are only taught in the corresponding semesters (winter or spring) according to the following Curriculum.

1st Semester (I)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
MA 103	Mathematics for Chemists	3	1	0	4
PH 111	Physics for Chemists	4	0	0	5
XA 128	General Chemistry	2	2	2	6
XO 102	Structure and Reactivity in Organic Chemistry	3	1	0	5
XA 131	Chemistry and Informatics	2	0	2	5
BI 121	General Biology	3	1	0	5
Total (26 CH)		**17**	**5**	**4**	**30**

2nd Semester (II)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
MA 204	Statistical analysis for experimental data	3	0	0	3
XA 229	Inorganic Chemistry-1 (Chemistry of the Representative Elements)	3	1	3	7
XA 232	Physical Chemistry-1	3	1	0	5
XE 251	Analytical Chemistry-1	3	1	4	10
XO 202	Organic Chemistry of Functional Groups-I	3	1	0	5
Total (26 CH)		**15**	**4**	**7**	**30**

3rd Semester (III)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
XE 356	Analytical Chemistry-2	2	0	5	5
XA 323 Θ	Inorganic Chemistry-2 (Chemistry of First-Row Transition Metals and Coordination Complexes)	3	1	0	6
XA 323 E	Experimental Inorganic Chemistry	0	1	3	4
XA 339	Physical Chemistry-2	3	1	0	5
XE 353	Instrumental Chemical Analysis-1	3	1	0	5
XO 303	Organic Chemistry of Functional Groups-II	3	1	0	5
Total (27 CH)		**14**	**5**	**8**	**30**

4th Semester (IV)

Course		Contact Hours (CH)			ECTS credits
Code	**Title**	**Lectures (LC)**	**Seminars (SE)**	**Laboratory (LB)**	
XO 404	Spectroscopy of Organic Compounds – Experimental Organic Chemistry-1	2	1	3	5
XO 405	Chemistry of Heterocyclic Compounds and Biomolecules	3	1	0	5
XE 454 Θ	Instrumental Chemical Analysis-2	3	1	0	6
XE 454 E	Lab of Instrumental Chemical Analysis	0	1	3	4
XA 434 Θ	Physical Chemistry-3	3	1	0	5
XA 434 E	Experimental Physical Chemistry-1	0	1	3	5
Total (26 CH)		**11**	**6**	**9**	**30**

5th Semester (V)

Course		Contact Hours (CH)			ECTS credits
Code	**Title**	**Lectures (LC)**	**Seminars (SE)**	**Laboratory (LB)**	
XO 506 Θ	Synthetic Organic Chemistry	3	1	0	5
XO 506 E	Experimental Organic Chemistry-2	0	1	4	5
XA 538 E	Experimental Physical Chemistry-2	0	1	3	5
XO 512	Biochemistry-1	3	1	0	5
XA 527	Inorganic Chemistry-3 (Chemistry of 2nd and 3rd Row Metals and of Lanthanides)	3	1	0	5
XE 581	Principles of Chemical Technology	3	0	0	5
Total (24 CH)		**12**	**5**	**7**	**30**

6th Semester (VI)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
XO 612 Θ	Biochemistry-2	3	1	0	5
XO 612 E	Experimental Biochemistry	0	1	4	5
XE 681 E	Laboratory Training in Chemical Technology	0	1	4	5
XE 682	Food Chemistry	2	1	2	5
	Semi-Optional Course-1*	3 or 2	1	1 or 2	5
	Semi-Optional Course-2*	3 or 2	1	1 or 2	5
Total (27-31 CH)		**9 or 11**	**6**	**12 or 14**	**30**

** Selection of 2 Semi-Optional Course from "Table 1. Optional Courses for 6th Semester".*

Table 1. Semi-Optional Courses for 6th Semester

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
XE 671	Chemistry and Technology of Materials (Polymers, Nanomaterials, Colloids, Catalysts)	2	1	2	5
XE 691	Environmental Chemistry	2	1	2	5
XE 661	Structural Chemistry	3	1	1	5

7th Semester (VII)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
*	Semi-Optional Course-3	3 or 2	1	1 or 2	5
*	Semi-Optional Course-4	3 or 2	1	1 or 2	5
#,§	Optional Chemistry Course-1	2	1	0	4
#,§	Optional Chemistry Course-2	2	1	0	4
EX 704	Experimental Diploma Thesis-1 ** (literature review and initiation of experimental work)	0	0	8	6
EX 705	Experimental Diploma Thesis-2 ** (continuation of experimental work)	0	0	8	6
Total (- CH)		-	-	-	30

* *Selection of 2 Semi-Optional Courses from "Table 2: Optional Courses for 7th Semester".*

§ *Selection of 2 Optional Chemistry Courses from "Table 2: Optional Courses for 7th Semester" (or 5 when selected a Bibliographic Diploma Thesis is selected*).

Instead of 2 Optional Chemistry Courses of 4 ECTS credits each, 1 Optional Chemistry Course of 8 ECTS credits may be selected.

** *The research project in the frame of the experimental Diploma Thesis is usually conducted in one of the research laboratories of the Department of Chemistry. It can also be carried out in part or totally in another cooperating Department or Research Institute or in the Industry or other bodies that employ chemists (e.g. Hospitals, the General State Laboratory, etc.). The Experimental Diploma Thesis is always supervised by a member of the Academic staff of the Department of Chemistry who is responsible for assigning the final mark to the thesis (one combined mark for the courses EX704 and EX705).*

For Erasmus students, the Experimental Diploma Thesis may take place entirely in one semester (total 21 ECTS credits). It can be replaced by a Bibliographic Diploma Thesis (extended literature review), which corresponds to 8 ECTS credits. Additionally, the students must select 1 Semi-Optional Course (1×5=5 ECTS Credits) and 2 Optional Chemistry Courses (2×4=8 ECTS Credits).

7th Semester (VII) (if a Bibliographic Diploma Thesis is selected in 8th Semester)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
*	Semi-Optional Course-6	3 or 2	1	1 or 2	5
*	Semi-Optional Course-7	3 or 2	1	1 or 2	5
#,§	Optional Chemistry Course-1	2	1	0	4
#,§	Optional Chemistry Course-2	2	1	0	4
#,§	Optional Chemistry Course-3	2	1	0	4
#,§	Optional Chemistry Course-4	2	1	0	4
#,§	Optional Chemistry Course-5	2	1	0	4
Total (- CH)		-	-	-	30

* *Selection of 2 out of 3 Semi-Optional Courses from "Table 2. Optional Courses for 7th Semester" below.*

^ *Selection of 5 out of 11 Optional Chemistry Courses courses from "Table 2. Optional Courses for 7th Semester Table 2" below, in the special cases that a Bibliographic Diploma Thesis will be selected in 8th Semester.*

Instead of 2 chemical semi-optional courses each with 4 ECTS Credits, 1 chemical semi-optional course with 8 ECTS Credits may be selected.

Table 2. Optional Courses for 7th Semester

Course		Contact hours (CH)			ECTS credits
Code	**Title**	**LC**	**SE**	**LB**	
Semi-Optional Courses					
XE 783	Physical Processes of Chemical Technology	2	1	2	5
XE 784	Chemical Processes of Chemical Technology	2	1	2	5
XA 742	Principles and Applications of Nuclear Chemistry	3	1	1	5
Optional Chemistry Courses					
XO 707	Modern Spectroscopy Methods (NMR, MS) - Molecular Modelling	2	1	0	4
XA 738	Physical Chemistry-4	2	1	0	4
XE 785	Food Chemistry and Technology – Oenology-I	4	0	4	8
XA 726	Chemistry of Organometallic Compounds and Mechanisms of Inorganic Reactions	3	0	0	4
XE 756	Quality Control in Analytical Chemistry	2	1	0	4
XO 713	Biochemistry-3 (Gene Expression and Regulation-Gene Engineering)	2	1	0	4
XO 714	Clinical Chemistry	2	0	2	4
XE 792	Catalysis and Green Chemistry	3	0	0	4
XO 715	Enzymology	3	0	0	4
BI 722	Microbiology	2	0	2	4
ΧΠ 786	Practical Training *				4

** Practical Training can be selected either in the 7th or the 8th Semester.*

8th Semester (VIII)

Course		Contact hours (CH)			ECTS credits
Code	Title	LC	SE	LB	
*	Optional Chemistry Course-3	3 or 2	0 or 1	0 or 2	4
*	Optional Chemistry Course-4	3 or 2	0 or 1	0 or 2	4
*	Optional Chemistry Course-5	3 or 2	0 or 1	0 or 2	4
#	Optional non-Chemistry Course-1	2	0	0	3
#	Optional non-Chemistry Course-2	2	0	0	3
EX 804	Experimental Diploma Thesis-3 ** (continuation and completion of experimental work)	0	0	10	9
EX 805	Experimental Diploma Thesis-4 ** (writing-up of thesis and public presentation of the results)	0	0	4	3
Total (- CH)		**-**	**-**	**-**	**30**

** Selection of 3 Optional Chemistry Courses from "Table 3: Optional Courses for 8th Semester".*

 # Selection of 2 Optional non-Chemistry Courses from "Table 3: Optional Courses for 8th Semester".

*** The research project in the frame of the Experimental Diploma Thesis is usually conducted in one of the research laboratories of the Department of Chemistry. It can also be carried out in part or totally in another cooperating Department or Research Institute or in the Industry or other bodies that employ chemists (e.g. Hospitals, the General State Laboratory, etc.). The Experimental Diploma Thesis is always supervised by a member of the Academic staff of the Department of Chemistry who is responsible for assigning the final mark to the thesis (one combined mark for the courses EX804 and EX805).*

8th Semester (VIII) (if a Bibliographic Diploma Thesis is selected in 8th Semester)

Course		Contact hours (CH)			ECTS credits
Code	Title	LC	SE	LB	
*	Optional Chemistry Course-3	3 or 2	0 or 1	0 or 2	4
*	Optional Chemistry Course-4	3 or 2	0 or 1	0 or 2	4
*	Optional Chemistry Course-5	3 or 2	0 or 1	0 or 2	4
*	Optional Chemistry Course-6	3 or 2	0 or 1	0 or 2	4
#	Optional non-Chemistry Course-1	2	0	0	3
#	Optional non-Chemistry Course-2	2	0	0	3
ΒΠΕ	Bibliographic Diploma Thesis @	0	0	10	8
Total (- CH)		**-**	**-**	**-**	**30**

** Selection of 4 out of 9 Optional Chemistry Courses from "Table 3: Optional Courses for 8th Semester" below.*

^ Selection of 2 out of 9 Optional non-Chemistry Courses from "Table 3: Optional Courses for 8th Semester" below.

@ Bibliographic Diploma Thesis: In special cases, and after aprovement by the Department of Chemistry, the students may select an extended literature review in the 8th Semester, which corresponds to 8 ECTS credits. In that case, they must additionally select: a) in the 7th semester, 2 Semi-Optional Courses (10 ECTS Credits) and 5 Optional Chemistry Courses (totally 20 ECTS credits), b) in the 8th semester, apart from the theoretical thesis (8 ECTS), 4 Optional Chemistry Courses (totally 16 ECTS) and 2 Non-Chemistry Optional Courses (totally 6 ECTS). The selection of the Bibliographic Diploma Thesis is not subject to the limitation of 120 ECTS Credits.

Table 3. Optional Courses for 8th Semester

Course					ECTS credits
Code	Title	Contact hours (CH)			
		LC	SE	LB	
Optional Chemistry Courses					
XO 816	Food Biochemistry	3	0	0	4
XO 809	Pharmaceutical Chemistry	3	0	0	4
XO 817	Biotechnology	2	0	2	4
XE 885	Polymer Science	2	1	0	4
XE 886	Chemical Industries (Inorganic and Organic)	3	0	0	4
XE 887	Food Chemistry and Technology – Oenology II	3	0	0	4
XA 827	Bioinorganic Chemistry	3	0	0	4
XA 839	Computational Chemistry, Theoretical Spectroscopy and Molecular Design	2	1	1	4
XII 786	Practical Training *				4
Optional non-Chemistry Courses					
AN 841	Didactics of Natural Sciences	2	0	0	3
OI 831	Introduction to Economics for Engineers and Scientists	3	0	0	3
OI 832	Business Administration and Organization for Engineers and Young Scientists	3	0	0	3
AN 842	English Chemical Terminology	2	0	0	3
BI 823	Viticulture	2	0	0	3
	Main European Languages (one from):				
AN 843	French	2	0	0	3
AN 844	German	2	0	0	3
AN 845	Italian	2	0	0	3
AN 846	Spanish	2	0	0	3

** Practical Training can be selected either in the 7th or the 8th semester.*

IV. DESCRIPTION OF UNDERGRADUATE COURSES

1st Semester (I)

Mathematics for Chemists

1. GENERAL

SCHOOL	NATURAL SCIENCES		
DEPARTMENT	CHEMISTRY		
LEVEL OF COURSE	UNDERGRADUATE		
COURSE CODE	**MA 103**	**SEMESTER**	**1st**
COURSE TITLE	MATHEMATICS FOR CHEMISTS		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		3	**4**
Seminars		1	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Foundation course		
PREREQUISITE COURSES:	Typically, there are not prerequisite course. However, the students should already have a satisfactory knowledge of functions, derivatives and integrals.		
TEACHING AND ASSESSMENT LANGUAGE:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
THE COURSE IS OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBPAGE (URL)	https://eclass.upatras.gr/courses/CHEM2042/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

To give to the student in Chemistry the knowledge of advanced applied mathematics that he/she needs in his/her science in the areas of differential and integral calculus of one variable and of several variables, of linear algebra, differential equations. This knowledge is necessary and is used in many subsequent specialization courses in chemistry. In addition, by solving chemistry problems requiring knowledge of mathematics, students comprehend the usefulness of mathematics as a tool for solving problems of their science.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
	Showing social, professional and ethical responsibility and sensitivity to

Working independently	*gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

At the end of the course the student will have developed the following skills/ competences:

1. To be able to efficiently use the differential and integral calculus, linear algebra and differential equations in the subsequent courses in his/her studies in chemistry as well as in related problems of chemical.
2. To be able to mathematically formulate and solve problems of chemistry which make use of the above mathematical areas.

3. COURSE CONTENT

1. Differential calculus of functions of a single variable
2. Integral calculus of functions of a single variable
3. Matrices and systems of linear equations, eigenvalues, eigenvectors
4. Differential calculus of functions of several variables
5. Integral calculus of functions of several variables
6. Introduction to differential equations
7. Introduction to complex numbers

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD

Face-to-face, Distance learning, etc.

1. Teaching (4 hours/week): lectures using the blackboard concerning the theory, exercises and applications.
2. Solution of exercises (by hand) individually by each student.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students

Teaching of a computer algebra software in the computing center (optionally)

TEACHING ORGANIZATION

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Activity	*Semester workload*
Lectures (4 conduct hours per week x 13 weeks)	52
Final examination (Theory and Lab)	3
Hours for private study of the student and preparation of home-works	45
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 (total student workload)***

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

Final written examination.
Greek grading scale: 1 to 10. Minimum passing grade: 5.

5. RECOMMENDED LITERATURE

1. Markellos, V. V., "Applied Mathematics". Gotsis K & SIA E.E. Editions, Patras, 2013 (in Greek).
2. Moisiadis X., "Mathematics". Editions, A. and P. Christodoulidi O.E., Thessaloniki, 2010 (in Greek).
3. Finney, R. L., Weir, M. D. and Giordano, F. R., "Thomas' Calculus", Vol. I. University Editions of Crete, 2009.
4. Papadakis, K. E., "Applied Mathematics & *Mathematica*". Tziolas Editions, Thessaloniki, 2015 (in Greek).
5. Notes of lecturers in Greek.

Physics for Chemists

1. GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	CHEMISTRY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**PH 111**	**SEMESTER**	**1st**	
COURSE TITLE	PHYSICS FOR CHEMISTS			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures			4	**5**
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background			
PREREQUISITE COURSES:	There are no prerequisite courses. The required knowledge of Advance Mathematics (Vectors-Derivatives-Integrals) will be developed during the courses in the case where they have not been covered (temporally) by the corresponding course of Mathematics that is taught also in the first semester.			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)				

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Understand the fundamental principles of Physics.
2. Apply these principles in the fields of Chemistry.

Comprehend the operation of optical and electric/electronic instruments that he uses.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

Production of new research ideas

At the end of the course the student will have further developed the following skills/competences:

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to Physics.
2. Ability to safely handle appliances and instruments of measurement/ diagnosis.
3. Ability to adopt and apply methodology for the solution of unfamiliar problems.
4. Ability to interact with others on inter or multidisciplinary problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Production of new research ideas

Promotion of free, creative and inductive thinking

Respect to natural environment

3. COURSE CONTENT

OPTICS: Nature of light and laws of Geometric Optics. Image Formation. Interference of light waves. Diffraction and Polarization.

ELECTRICITY AND MAGNETISM: Electric Fields. Gauss's Law. Electric Potential. Capacitance and Dielectrics. Current and Resistance. Direct Current Circuits. Magnetic Fields. Sources of the magnetic field. Faraday's Law. Alternative Current Circuits. Electromagnetic Waves.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD
Face-to-face, Distance learning, etc.

Lectures and seminars face to face.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students

Lectures using transparencies, PowerPoint presentations and multimedia.

TEACHING ORGANIZATION
The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Activity	***Semester workload***
Lectures (4 contact hours per week x 13 weeks)	52
Seminars (1 contact hour per week x 13weeks) - solving of representative problems	13
Final examination (3 contact hours)	3
Hours of private study of the student for the preparation of the Final Examination	57
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

Final written examination.

Greek grading scale: 1 to 10. Minimum passing grade: 5.

All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. R.A. Serway, "Physics for Scientists and Engineers", 3rd edition, Vol. II: Electricity and Magnetism, Vol. III: Thermodymics-Waves-Optics, Translation: L. Resvanis, Bookshop G. Korfiati, 1990.

2. H.D. Young, "University Physics", Vol. II: Electromagnetism-Optics-Modern Physics, Translation: E. Anastasakis, S.D.P. Vlassopoulos, E. Dris, et all, Papazisis Publications, 1994.
3. D. Halliday, R. Resnick, K.S. Krane, "Physics", Vol.: II, Translation: G. Pneumatikos, G. Peponidis, Scientific & Technological Publications Pneumatikos G.A., 2009.

General Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 128**	**SEMESTER**	**1st**
COURSE TITLE	General Chemistry		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		2	**6**
Tutorials		2	
Laboratories		2	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (General Chemistry) and Skills Development (Experimental Chemistry)		
PREREQUISITE COURSES:	There are no prerequisite courses.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2089/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Use the law of conservation of mass, the significant figures in calculation, convert from one temperature scale to another, and calculate the density of a substance.
2. Write nuclide symbols, determine atomic weights from isotopic masses and fractional abundances, write the ionic formula of given ions, write the name and formula of anions of acids, and balance simple equations.
3. Calculate the formula weight from a formula, calculate the mass of an atom or molecule, convert moles of substance to grams and vice versa, calculate the percentage composition from the formula, calculate the mass of an element in a given mass of compound, determine the empirical formula from percentage composition, relate quantities in a chemical equation and find the limiting reactant.
4. Formulate net ionic equations, classify acids and bases as strong or weak, assign oxidation numbers, balance simple oxidation – reduction reactions, calculate and use molarity.

5. Relate wavelength and frequency of light, calculate the energy o a photon, determine the wavelength or frequency of a hydrogen atom, apply the de Broglie equation, and use the rules for the equation numbers.
6. Apply the Pauli exclusion principle, determine the configuration of an atom using the building-up principle or the period and group numbers, apply the Hund's rule.
7. Use Lewis symbols to represent ionic bond formation and write electron configurations of ions, compare ionic radii and obtain relative bond polarities, write Lewis formulas using formal charges, relate bond order and bond length, estimate ΔH from bond energies.
8. Predict molecular geometries, relate dipole moment and molecular geometry, apply valence bond theory, describe molecular orbital configurations.
9. Identify acid and base species according to the Brønsted-Lowry and Lewis concepts, decide whether reactants or products are favoured in an acid-base reaction, calculate concentrations of H3O+ and OH– in solutions of a strong acid or base.
10. Write the IUPAC name given the structural formula of a coordination compound and vice versa, decide whether isomers are possible, describe the bonding in a complex ion, predict the relative wavelengths of absorption of complex ions.
11. Understand and explain the kinetics of a chemical reaction, predict and assess the kinetic mechanism, and calculate the reaction rate.
12. Explain basic principles of electrochemistry. Understand and use the electrochemical cells.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*Others*
Production of new research ideas	

At the end of the course the student will have further developed the following skills/competences:

1. Ability to solve cumulative-skills theoretical and practical problems. These problems require two or more operational skills earnt in the present or in previous chapters.
2. Skills enabling the student to solve simple and complex stoichiometry problems.
3. Ability to apply the key relations between position of the elements in the periodic table, their electron configuration and their physical and chemical properties.
4. The "heart" of the course is the chemical bond and the student should be able to determine the type of bonding in each substance and to describe the formation of bonds in various substances.
5. Ability to explain some important properties of compounds, as solubility, melting point, boiling point, vapor pressure and so on.
6. Ability to address chemical problems in a spherical manner, handling the chemistry knowledge as a whole and combing theories and principles from different sub-fields of chemistry to solve generic problems.

Generally, by the end of this course the student will have further developed the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Group work

Excercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

Respect to natural environment

Work design and management

3. COURSE CONTENT

1. Chemistry and Measurements

Law of conservation of mass. Matter: Physical state and chemical constitution (solids, liquids and gases. Elements, compounds and mixtures). Measurements and significant figures. SI units. Derived units. Units and dimensional analysis.

2. Atoms, Molecules and Ions

Atomic theory of matter. The structure of the atom. Nuclear structure–Isotopes. Atomic weights. Periodic table of the elements. Chemical formulas–Molecular and ionic substances. Organic compounds. Naming simple compounds. Writing chemical equations. Balancing chemical equations.

3. Calculations with Chemical Formulas and Equations

Molecular weight and formula weight. The mole concept. Mass percentages from the formula. Elemental analysis: Percentages of carbon, hydrogen and oxygen. Determining formulas. Molar interpretation of a chemical equation. Amounts of substances in a chemical reaction. Limiting reactant: Theoretical and percentage yields.

4. Chemical Reactions: Introduction

Ionic theory of solutions. Molecular and ionic equations. Precipitation reactions. Acid–base reactions. Oxidation–reduction reactions. Balancing simple oxidation–reduction reactions. Molar concentration. Diluting solutions. Gravimetric analysis. Volumetric analysis.

5.Quantum Theory of the Atom

The wave nature of light. Quantum effects and photons. The Bohr theory of the hydrogen atom. Quantum mechanics. Quantum numbers and atomic orbitals.

6. Electron Configurations and Periodicity

Electron spin and the Pauli exclusion principle. Building-up principle and the periodic table. Writing electron configurations using the periodic table. Orbital diagrams of atoms–Hund's rule. Mendeleev's predictions from the periodic table. Periodic properties (atomic radii, ionization energies, electron affinities). Periodicity in the main-group elements.

7. Ionic and Covalent Bond

Describing ionic bonds. Electron configuration of ions. Ionic radii. Describing covalent bonds. Polar covalent bonds. Electronegativity. Writing Lewis electron-dot formulas. Delocalized bonding–Resonance. Exceptions to the octet rule. Formal charge and Lewis formulas. Bond length and bond order. Bond energy. Intermolecular forces (dipole-dipole forces, London forces, van der Waals forces and the properties of liquids, hydrogen bonding.

8. Acids and Bases

Properties of water. Brønsted acids and bases. Energetic effects during the dissociation of acids in aqueous solutions. Effectiveness of oxoacids. Amphoteric oxides and hydroxides.

9. Molecular Geometry and Chemical Bonding Theory

The VSEPR model. Dipole moment and molecular geometry. Valence bond theory. Description of multiple bonding. Principles of molecular orbital theory. Electron configurations of diatomic molecules of the second-period elements. Molecular orbitals and delocalized bonding.

10. Chemical Kinetics

Reaction rates. Mechanisms of chemical reactions. Laws of chemical kinetics.

11. Electrochemistry

Redox potentials. Oxidation and reduction reactions. Electrochemical cells. Principles and laws of electrochemistry.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, tutorials and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. powerpoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Laboratory report and written or oral test during each of the laboratory exercises (the 20% of the grade of each exercise is added in the final grade only if the student has secured the minimum passing grade of 5, and only if the student has secured at least the grade of 4 in the final exam). 2. Optionally, elaboration of an exercise and a 10-minute oral presentation in groups of two students (the 20% of the grade of each exercise is added in the final grade only if the student has secured the minimum passing grade of 5, and only if the student has secured at least the grade of 4 in the final exam). Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5 All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	*Semester workload*
Lectures (2 contact hours per week x 13 weeks)	26
4 Laboratory Exercises (3 conduct hours per 3 weeks)	12
Seminars/Tutorials (2 conduct hours per week x 10 weeks) - solving of representative problems, techniques and theory associated to each laboratory experiment	20
Hours for private study of the student and preparation of homeworks, and preparation and reports for the Laboratory	19
Final examination (3 conduct hours)	3
Hours of Private Study of the Student for the preparation of the Final Examination	45
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

5. RECOMMENDED LITERATURE

1. N. Klouras, "Modern General Chemistry", 1η Edition, Greek Language Translation of D.D. Ebbing και S.D. Gammon "General Chemistry", 10th Edition 2013
2. D.D. Ebbing and S. D. Gammon, "General Chemistry", 9th Edition, Houghton Mifflin Company, 2009.
3. R.H. Petrucci, W.S. Hawood, G.E Herring and J. Madura, "General Chemistry: Principles and Modern Applications", 9th Edition, Prentice Hall, 2006.
4. R. Chang, "General Chemistry: The Essential Concepts", McGraw-Hill Science Engineering, 2007.
5. T.E. Brown, E.H. LeMay and B.E. Bursten, "Chemistry: The Central Science", 10th Edition, Prentice Hall, 2006.
6. J. McMurry, R.C. Fay and L. McCarty, "Chemistry", 4th Edition, Prentice Hall, 2003.

7. S.S. Zumdahl, "Chemistry", 7th Edition, Houghton Mifflin College Div., 2007.

Structure and Reactivity in Organic Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 102**	**SEMESTER**	**1st**
COURSE TITLE	STRUCTURE AND REACTIVITY IN ORGANIC CHEMISTRY		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		3	**5**
Tutorials		1	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science : Organic Chemistry		
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. Essentially, the students should possess adequate level of knowledge in Chemistry at the expected University Entry Level		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.upatras.gr/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

Structure of Organic Compounds

Describe the bond type involved in organic compounds including conjugated systems and understand their role in determining structure geometry, electron distribution and reactivity. Draw resonance forms using curled arrows and understand the dominant one.

Nomenclature of homologous series and stereochemistry

Know how to convert structures to names and vice versa using the IUPAC system or empirical methods as appropriate.

organic compounds. Know how to assign substituent priorities at a stereogenic center and determine *R/S* configurations.

Identify and name isomeric compounds including E/Z isomers in unsaturated systems and meso compounds. Draw resonance strucrue 2D and 3D representations of structures. Understand the concept of steric crowding, dihedral angle, barrier to rotation, axial and equatorial substitution in ring systems and the way these influence the energetics and stability of conformers.

Acidity and basicity
Understands the influence of various atoms and functional groups on the acidity and basicity of organic compounds.
Understands inductive and resonance effects and how they affect the availability of a lone pair of electrons and the acidity of a proton. Understands and manages the concept of pKa in the context of both acidity and basicity.

Nucleophilic substitution and Elimination reactions
Identify and assess the electrophilic and nucleophilic capacity of various atoms in a given structure as well as relative leaving group abilities. Predict whether a nucleophilic substitution reaction will follow the SN1 or SN2 mechanism and predict possible products including their stereochemistry. The same for E1/E2 reactions. Assess how these, their rate of formation and S/E ratio will vary with reaction conditions and reactants' stereochemistry. Use product stereochemistry to deduce possible reaction mechanisms and write them using curled arrows to designate them.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of essential facts, concepts, theories and applications which are related to Organic Chemistry.
2. Ability to apply this knowledge and understanding to problem solving of advanced Organic Chemistry topics
3. Ability to adopt and apply first-principles approaches to problem solving of advanced Organic Chemistry topics.
4. Study skills needed for continuing professional and academic development.
5. Ability to interact with others in chemical or interdisciplinary problem solving and brainstorms

Generally, by the end of this course the student will, furthermore, have develop the ability to:
Search, identify, analyse and combine facts, patterns and information
Adapt to new situations
Decision making
Work independently
Teamworking
Apply critique and self-assessment
Develop free and creativity thinking and deductive thought processing
Consider impact of chemistry to the natural environment
Work design and time management

3. COURSE CONTENT

1. Organic Chemistry and Organic compounds
- The Discipline
- Sources, properties and impact of organic compounds in Life Sciences and the Industry

2. Nomenclature of homologous series
- Homologous series and functional groups
- IUPAC convention for naming organic compounds
- Nomenclature priorities in multifunctional compounds
- Nomenclature of aromatic compounds

- Empirical names of common organic chemicals and their derivatives

3. Types of Bonds in Organic Compounds

- Ionic and covalent bonds
- The rule of outer octet
- Electronegativity of atoms
- Polar covalent bonds, Dipole moment, Inductive effect
- Electron repulsion and shape of molecules
- Lewis and Kekulé structures
- Resonance forms and conjugated systems,
- Drawing electron movement using curled arrows
- Atomic orbitals and hybridization
- Types of Bonds
- Bond angles, lengths and strengths
- Molecular orbitals
- Induced dipole, van der Waals and hydrogen bonds

4. Stereochemistry

- Structural Isomers, Stereochemistry, Chirality
- E/Z alkenes, syn/anti ring substitution
- R/S designations of and enantiomers optical activity and enantiomeric excess
- Drawing 2D and 3D stereochemistry,
- Conformations in chains, Rotamers, gauche and eclipsed conformations, steric interactions, Newman Projections
- Conformations in chains and rings, ring inversion, ring strain,

5. Reactivity in Organic Chemistry

- Thermodynamics and kinetics of chemical reactions
- Chemical equilibrium
- Transition state, Rate Determining Step, Activation Energy
- Acids and Bases in Organic Chemistry – pKa's of common functional groups
- Nucleophiles and Electrophiles / Concept of Hard and Soft
- Types of solvents
- Types of Selectivity in Organic reactions

6. Nucleophilic substitution and Elimination Reactions

- Nucleophilic substitutions at saturated carbon atoms
- Leaving group ability - S_N2 και S_N1 αντιδράσει
- Elimination reactions E2 και E1
- Factors in reactants and reaction conditions that influence reaction course and product stereochemistry

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, seminars and face to face tutorials.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course. Use of molecular models
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Tutorials (1 conduct hour per week x 13 weeks) - solving of representative problems	13
Final examination (3 contact hours)	3
Student private study and preparation of tutorials and examination	70

	Total number of hours for the Course (25 hours of work-load per ECTS credit)	*125 (total student workload)*
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optional home-assignments (maximum of three) in groups of 4. Provided a grade of 4/10 is achieved in each, the mean mark of home-works contributes 20% to the final mark. 2. Written examination after the end of the semester = final grade (G_{SOC}), unless home assignments are to be considered (see above) Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.	

5. RECOMMENDED LITERATURE

1. Carey F. A., Giuliano R. M., Allison N. T. και Bane S. L. «Organic Chemistry», 11th Edition, McGraw Hill «Οργανική Χημεία», 11η έκδοση, Απόδοση στα Ελληνικά: Α. Τρογκάνης, Γ. Ρασσιάς, Α. Τσοτίνης. Εκδόσεις ΚΡΙΤΙΚΗ, 2020. Κωδικός στον Εύδοξο 94645265
2. J. Clayden, N. Greeves, S. Warren, "Organic Chemistry", 2nd Edition, 2012, Oxford University Press
3. «Οργανική Χημεία», 2η έκδοση, Τόμοι Ι,ΙΙ. Απόδοση στα Ελληνικά: Γ. Κόκοτος κ.ά., Εκδόσεις Utopia, 2017.
4. Klein D. "Organic Chemistry", 3nd Edition, 2017, Wiley, "Οργανική Χημεία", Τόμος Ι, Απόδοση στα Ελληνικά: Γ. Κόκοτος κ.ά., Εκδόσεις Utopia, 2015.
5. D.E. Levy, "Arrow pushing in Organic Chemistry: an easy approach to understanding reaction mechanisms", Wiley-Interscience, 2011.

Chemistry and Informatics

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	XA 131	**SEMESTER**	**1st**
COURSE TITLE	CHEMISTRY AND INFORMATICS		
INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		2	5
Laboratory work		2	
COURSE TYPE general background, special background, specialised general knowledge, skills development	General background and Skills development.		
PREREQUISITE COURSES:	Typically, there are not prerequisite courses.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2432/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire

with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

Basic skills in Computational Mathematics, Basic methodology of solving scientific problems. The knowledge and skills that will be acquired fall into the area of Information Technology and the handling of Electronic Computers.

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

Computer operation for advanced scientific applications and internet use for scientific application in chemistry.

3. COURSE CONTENT

A. Computer architecture. Using computers, basic knowledge of the Internet. Search, retrieval, and processing information on the Internet. Data bases. Computer programming with emphasis on solving problems relevant to Chemistry, Mathematics and Physics.

B. Introduction to Programming (QB64 or Python).

C. Computations: Roots of equations. Numerical integration. Lagrange interpolation. Solution of ordinary differential equations. Systems of differential equations.

D. Text processing. Basic software: WinWord, Excel/Office, PowerPoint. Introduction to QtiPlot, polynomial fitting, and graphical data processing.

E. Mandatory preparation of a full scientific paper (Project) on a given topic of chemical interest, involving the retrieval of information and scientific data from the internet. A molecule/molecular structure is chosen. The student is required to present, through individual work, a concise overview of the significance and applications of the molecule, historical information on its contribution to Chemistry, its physical and chemical properties, toxicity, and synthesis methods.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The major part of the lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download. Laboratory for Computer Programming with emphasis on problems related to the application of Mathematics to Physics and Chemistry. Draw information and scientific data from the Internet.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	*Semester workload*
Lectures (2 contact hours per week x 13 weeks)	26
Laboratory Exercises (2 contact hours per week). Weekly training on the content of the course through applications using PC.	26

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	Project preparation	40
	Final examination (1 contact hour)	1
	Hours of Private Study of the Student for the preparation of the Final Examination	32
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written examination (50% of the final grade). Final laboratory examination (30% of the final grade). Evaluation of the project (20% of the final grade). Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.	

5. RECOMMENDED LITERATURE

1. E. Steiner, "*The Chemistry Maths Books*", Oxford, 1996.
2. P. Norton, "*Introduction to Computers*", 6th edition, Tziolas Publications, 2018.
3. Christian Hill, "*Python for Chemists*", Gotsi Publications, 2025.
4. Ioannis Th. Famelis, "*Computational Mathematics*", Kritiki Publications, 2021.
5. Related Scientific Journals.

General Biology

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**BI 121**	**SEMESTER**	**1st**
COURSE TITLE	GENERAL BIOLOGY		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**	
Lectures	3	**5**	
Tutorials	1		
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Biochemistry)		
PREREQUISITE COURSES:	Typically, there are not prerequisite course.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2109/		

2. LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.*

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Recognize the basic biological functions of the cell and the molecular mechanisms underlie these functions.
2. Recognize the types of animal tissues and their embryonic origin.
3. Recognize the basic principles of the organization and functions of animal organs.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to cell biology, to the organization and functions of animal tissues and organs.
2. Ability to apply such knowledge and understanding to expand his/her education to more complex issues of general biology as to the solution of biological problems of an unfamiliar nature.
3. Study skills needed for continuing professional development.
4. Ability to interact with others on inter or multidisciplinary problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

3. COURSE CONTENT

1. Principles of cellular organization. Viruses, nucleoprotein complexes, eukaryotic – prokaryotic cell, origin of the cell.
2. Principles of molecular organization Chemical bonds, biomolecules, macromolecules, organizarion of cellular structures and organelles.
3. Plasma membrane. Functions of membranes, molecular composition and organization, dynamic nature of membranes, transport through membranes.
4. Nucleus – Organization of chromosomes. Structure and organization of nucleus, morphological and functional characteristics of chromosomes.
5. Replication of DNA. Expression and regulation of genetic information. Replication of DNA. Principles of expression and regulation of the gene, transcription, structure and maturation of RNA, genetic code, translation.
6. Cytoplasmic network of membranes. Endoplasmic reticulum, Golgi, synthesis and maturation of proteins, transportation and secretion of proteins, internalization of cells, structures and macromolecules, lysosomes and cellular degradation.

7. Nucleus, organization of chromosomes and traffic of molecules between nucleus and cytoplasm.
8. Cytoskeleton – cellular motility. Organization of cytoskeleton, microtubules, microfibrils, intermediate fibrils, motility of the cells and organelles.
9. Cell walls, extracellular matrix and cell interactions.
10. Cell signalling. Signalling molecules, receptors and transduction pathways.
11. Cell growth – cellular division. Mitosis, cellular division, meiosis.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHODS *Face-to-face, Distance learning, etc.*	Lectures, self-tests of students and problem-solving seminars.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally, two mid-term examinations with the final examination grade to be the mean mark. It is mandatory to obtain pass grade (≥5) in each examination. 2. Written examination after the end of the semester. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 9 weeks) - solving of representative problems	9
Mid-term examinations (2 mid-term examinations x 2 contact hours each)	4
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for mid-term or/and final examination	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

5. RECOMMENDED LITERATURE

1. G.M. Cooper and R.E. Hausman. "The cell: a molecular approach" Seventh Edition 2016.
2. V. Marmaras and M. Labropoulou-Marmara, “Cell Biology: a molecular approach”, 4th Edition, Typorama Edition, 2000.
3. B. Lewin, “Genes VIII”, Volume I and II, (Greek edition), 8th Edition, Translation: G. Stamatogiannopoulos, Academic Editions I. Basdra, 2004.

Statistical analysis for experimental data

1. GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	CHEMISTRY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**MA 204**	**SEMESTER**	**2nd**	
COURSE TITLE	STATISTICAL ANALYSIS FOR EXPERIMENTAL DATA			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures			3	**3**
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Foundation course			
PREREQUISITE COURSES:	Mathematics for Chemists			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek.			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO			
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2042/			

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course is the basic introductory course in Probability and Statistics.
The main purpose of the course is to familiarize students with the basic theory and laws of probability and the widely used functions and parameters of description of probability distributions. In addition, the course aims to present methods of data analysis using graphical tools and descriptive statistical measures.
Moreover, the course also aims to familiarize the students with the use of appropriate statistics for conducting hypothesis testing and construct confidence intervals for population parameters.
Finally, simple linear regression is introduced.

Upon successful completion of the course the student will be able to:

1. analyze data using descriptive statistics tools.
2. use appropriate sampling measures to calculate confidence intervals for the mean, the variance, and proportions.
3. using the hypothesis testing and confidence interval procedures for decision making.
4. use simple linear regression

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking*

Working independently

Team work

Search for, analysis and synthesis of data and information, with the use of the necessary

3. COURSE CONTENT

1. The importance of probability and statistics on Chemistry

Objects of probability and statistics, the role of probability in statistics, examples of application in chemistry.

2. Probability theory, random variables and distribution characteristics

Sample space and events, axiomatic foundation, basic notions of combinatorial theory, conditional probability, probability, probability density and distribution functions, mean, moments of higher order, covariance and correlation.

3. Normal distribution

4. Descriptive statistics

Arithmetic measures, graphical methods of exploratory data analysis.

5. Sampling distributions and estimation

Central limit theorem, the t, chi-square and F distributions, confidence intervals for means, variances and proportions with one and two samples.

6. Tests of hypotheses

Errors, characteristic curve and power of a test of hypotheses, tests for means, variances and proportions with one and two samples, tests of significance, relationship between hypothesis tests and confidence intervals.

7. Simple linear regression

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	1. Teaching: lectures using the blackboard and slides concerning the theory, exercises and applications in chemistry. 2. Solution of extra exercises for better understanding
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Teaching using slides and thus projector Moreover, the slides of the lectures are stored in the platform eclass
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation,*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Final examination (Theory and Lab) (3 contact hours)	3
Hours for private study of the student and preparation of home-work	33
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***

laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

5. RECOMMENDED LITERATURE

1. I. A. Koutrouvelis, "Applied probability and statistics", 2nd Edition, Gotsis Editions, Patras 2015. (in greek)
2. D.C. Montgomery and G.C. Runger, "Applied statistics and probability for engineers", Tziolas Editions, 2017. (in greek)
3. G. Zioutas, "Probability and statistics for engineers", "sofia" editions A.E.E.E., 2019. (in greek)

Inorganic Chemistry-1 (Chemistry of the Representative Elements)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 229**	**SEMESTER**	**2nd**
COURSE TITLE	INORGANIC CHEMISTRY 1 (CHEMISTRY OF REPRESENTATIVE ELEMENTS)		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	Lectures	3	**7**
	Tutorials	1	
	Laboratory work	3	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Inorganic Chemistry) and Skills Development (Experimental Inorganic Chemistry)		
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess: (a) knowledge provided through the previously taught theoretical courses ''Introduction to Inorganic Chemistry'', and (b) laboratory skills obtained through the previously attended laboratory-related course "Introduction to Inorganic Chemistry".		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2073/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to appreciate the fact that:

There are some ninety-two naturally occurring elements as well as a handful of man-made radioactive elements. When in combination, these elements constitute all of our food, shelter, energy sources and everything we manufacture and use in our lives. This course provides a foundation for the understanding of the varying chemistries of the elements of the Periodic Table, with emphasis on inorganic materials. The course includes the descriptive chemistry of many of the most common elements and their compounds, integrating such topics as symmetry and structure, bonding models, reactions and the synthesis and characterization of inorganic compounds. An understanding of the behaviour of elements and their compounds is central to chemistry and borders the Earth and Life Sciences, as well as Engineering.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. To develop expertise relevant to the professional practice of chemistry.
2. To develop an understanding of the range and chemistry of elements in the periodic table and their compounds.
3. To establish an appreciation of the role of inorganic chemistry in the chemical sciences.
4. To develop an understanding of the role of the chemist in measurement and problem solving in inorganic chemistry.
5. To provide an understanding of chemical methods employed for problem solving involving inorganic systems.
6. To provide experience in some scientific methods employed in inorganic chemistry.
7. To develop skills in procedures and instrumental methods applied in analytical and synthetic tasks of inorganic chemistry.
8. To develop skills in the scientific method of planning, developing, conducting, reviewing and reporting experiments.
9. To develop some understanding of the professional and safety responsibilities residing in working with inorganic systems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Group work

Exercise of criticism and self-criticism *Promotion of free, creative and inductive thinking* *Respect to natural environment* *Work design and management*

3. COURSE CONTENT

1. The elements.
2. The chemical compounds.
3. The isolation of elements.
4. The life cycle of compounds.
5. How we can systematically study the elements and their compounds.
6. Introduction to the chemical, biochemical and biological properties of metals, non-metals and semi-metals.
7. Chemistry of hydrogen and its compounds.
8. Chemistry of oxygen and its compounds.
9. On water.
10. The atmosphere.
11. General aspects of the chemistry of the 1st group elements.
12. General aspects of the chemistry of the 2nd group elements.
13. General aspects of the chemistry of the 13th group elements.
14. General aspects of the chemistry of the 14th group elements.
15. General aspects of the chemistry of the 15th group elements.
16. General aspects of the chemistry of the 16th group elements.
17. General aspects of the chemistry of the 17th group elements.
18. General aspects of the chemistry of the 18th group elements.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems	13
Laboratory experiments (3 contact hours per week x 13 weeks)	39
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of home-works (5 per semester), for Inorganic Chemistry-1, and reports, for the Laboratory, and preparation for the Laboratory (study of techniques and theory)	39

	Hours of Private Study of the Student for the preparation of the Final Examination	117
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***250 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Oral examination during the seminars on problems given as homework in the lectures. The mark of the seminars is added to the final mark only when the student secures the minimum mark of 5 in the final written examination. 2. Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English. *EXPERIMENTAL INORGANIC CHEMISTRY-1 (EOC-2)* 1. Written tests of 15 minutes duration at the beginning of each new laboratory period (experiment). The mean mark from these tests consists the 50% of the final grade (G_{EOC-2}). 2. Reports following completion of each laboratory experiment. The mean mark of the consists the other 50% of the final grade (G_{EOC-2}). Minimum passing grade: 5. Final Course Grade (FCG) FCG = (G_{SOC} + G_{EOC-2}) / 2

5. RECOMMENDED LITERATURE

1. P. Ioannou, "Chemistry of the Elements of the s and p groups", Volume I, Filomatheia Editions, 2006.
2. P. Karagiannidis, "Topics in Inorganic Chemistry: The chemical elements and their compounds", 4th Edition, Ziti Editions, 2009.

Physical Chemistry-1

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 232**	**SEMESTER**	**2nd**
COURSE TITLE			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**5**
Tutorials	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Basic Physical Chemistry).
PREREQUISITE COURSES:	Typically, there are not prerequisite course, but the students should possess, at least, basic knowledge of Mathematics
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.

IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/CHEM2242

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Understands the transport phenomena
2. Describes an ideal gas model and by that to deduct and describe its fundamental properties (energy states and state functions).
3. Expands the ideal gas model to the real gases.
4. Understands and apply the first, the second and the third law of thermodynamics.
5. Defines the fundamental energy functions that come from the first law of thermodynamics and from that to be able answers the following questions:
   a) How a system can be defined
   b) Which is the work that a chemical reaction produces
   c) Which are the changes in the state functions of the system that happen in a chemical reaction
6. Defines the fundamental energy functions that come from the second law of thermodynamics and from that to be able answers the following questions:
   a) Which are the changes in the state functions of the system that happen in a chemical reaction
   b) When a chemical reaction is spontaneous
   c) How a heat engine works
7. Construct a graph of energy function and explains them
8. Analyses the changes of state in physical transformations
9. Describes the systems response of equilibria in physical transformations

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Chemical Thermodynamics and Changes of State.
2. Uses this knowledge for describing with mathematical models various physical and chemical systems.
3. Uses this knowledge for solving problems related to mass transfer and chemical reactions procedures.
4. Abilities in studding and understanding various concepts in Fields of Science (Natural Sciences, and Medical Sciences) as well as in Industry.
5. Ability to apply this knowledge in experiments which involved in physicochemical systems.

3. COURSE CONTENT

1. The properties of gases, the compression factor, Virial coefficients, the van der Waals equation, the real gases–the perfect gases, equation of state, the kinetic theory of gases, $pV=nRT$, mean speed of molecules in a gas, the Maxwell-Boltzmann distribution of speeds, the collision frequency, the mean free path, collisions with walls and surfaces, Graham's law of effusion, Transport properties– theoretical determination of the diffusion coefficient of the Fick's law, thermal conduction and viscosity, Poiseuille's equation.
2. The First Law of Thermodynamics, open–closed–isolated system, work–heat–energy of the system, internal energy of a system, intensive–extensive properties, the first thermal engine of James Watt, reversible changes– p-V diagrams, adiabatic changes, definition of C_p, C_V, step functions–inexact differentials, state functions-exact differentials, gas internal pressure π_T, expansion coefficient α, isothermal compressibility κ_T, The Joule-Thomson effect and the coefficient $t\mu_T$,C_p-$C_V=\alpha(p+\pi_T)V$, isothermal expansion of a perfect gas, adiabatic reversible expansion, heat capacity ratio $\gamma=C_p/C_V$.
3. The Second Law of Thermodynamics, Entropy, the change in entropy for isothermal reversible expansion of a perfect gas, spontaneous and non-spontaneous changes, The Zeroth Law of Thermodynamics, The Third Law of Thermodynamics, thermodynamic engineering, heat pumps, Carnot cycle in p-V plot, the Clausius inequality and the definition of the Enthalpy, Gibbs and Helmholtz energy, functions, combining the First and Second Laws: the Maxwell relations, derivation of the $\pi_T = T(\partial p/\partial T)_V - p$, derivation of the Gibbs-Helmholtz equations: $[\partial(G/T)/\partial(1/T)]_p=H$ and $[\partial(A/T)/\partial(1/T)]_V=U$, chemical potential of real and perfect gases, fugacity.
4. Thermodynamics supplementary: derivation of the $\Delta S=nR\ln(V_f/V_i)+C_V\ln(T_f/T_i)$, mathematical definition of a reversible change, Carnot cycle in S-T plot, efficient of a heat engine, the third law of thermo-dynamics and the impossibility of reaching absolute zero of temperature, analysis of the Joule-Thomson effect, $\mu=[V(\alpha T-1)/C_p]$, Linde refrigerator and liquefied air.
5. Physical transformations, melting, boiling, sublimation, μ-T plot, the temperature and pressure dependence of chemical potential, Clapeyron equation μ-T and p-T phase diagram, the solid-liquid boundary, the liquid-vapour boundary, the solid-vapour boundary, partial molar quantities, the Gibbs-Duhem equation, the Gibbs energy of two ideal-gases mixing, Francois Rault's and Henry's laws, colligative properties, the elevation of boiling point, the depression of freezing point, Osmosis, liquid-vapour equilibrium, the distillation of mixtures, Azeotropes, J.W. Gibbs' phase rule.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures and tutorials in the amphitheatre. Face to face teaching by the active participation of students with questions and exemplary solution of problems related to the theory.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in teaching.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Tutorials (1 contact hour per week x 13 weeks) - solving of representative problems	13
Final examination (3 contact hours for Physical Chemistry 1)	3
Hours for private study of the student	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Two (2) optional written progress during the Semester 2. Final written examination Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. P.W. Atkins, "Physical Chemistry", Volume I, Translation: S. Anastasiadis, G.N. Papatheodorou, S. Farados, G. Fitas, Creta University Press, 2005.
2. N.Th. Rakintzis, "Physical Chemistry", 3rd Edition, Papasotiriou Edition, 1994.
3. E. Dallas, "Physical Chemistry", Publications of University of Patras.

Analytical Chemistry-1

1. GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	CHEMISTRY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**XE 251**	**SEMESTER**	**2nd**	
COURSE TITLE	ANALYTICAL CHEMISTRY-1			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures			3	**10**
Tutorials			1	
Laboratory work			4	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Analytical Chemistry).			
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. The students should have at least knowledge of the basic concepts of Chemistry.			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	http://www.chem.upatras.gr			

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*

- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Define basic concepts such as solutions and their characteristics, expressions of the concentration of solutions (molarity, wt. %, etc), precipitates and related terms (precipitation, coagulation, digestion and peptization of colloids, contamination, occlusion and mechanical entrapment, etc) and other concepts of analytical chemistry.
2. Describe and compare the advantages of the various methods of Chemical Analysis.
3. Describe modern analytical techniques that can find applications in a variety of samples (biological, environmental, food, pharmaceuticals, materials and artwork).
4. Perform equilibrium calculations for weak acid and weak base solutions.
5. Choose appropriate pH-indicators and carry out relevant calculations of pH.
6. Perform calculations for the preparation of buffer solutions.
7. Describe the importance of solubility product for the selective precipitation of compounds and the separation of ions.
8. Derive equations and perform calculations in equilibria involving sparingly soluble salts and fractional precipitation.
9. Derive equations and perform calculations in equilibria involving complex formation.
10. Derive equations to describe equilibria in oxidation-reduction systems. Galvanic cells. Electrochemical potentials. Applications of potentials in chemical analysis.
11. Extraction.
12. Chromatography.
13. Describe the methodology for a correct chemical analysis (best practice).
14. Describe fundamental laboratory techniques as well as their advantages and their limitations, e.g. solid–liquid separations methods.
15. Choose the pathways for the separation and identification of chemical substances, combining analytical methods to resolve complex problems.
16. Be able to combine and apply the knowledge acquired in other fields of Chemistry (e.g. Organic Chemistry, Biochemistry etc) in which certain notions and principles of the course in question are necessary and useful and vice-versa.
17. Describe all the safety rules to be applied in a chemical laboratory and recognize what one must not do.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will have developed the following skills/competences:

1. Find his/her way in a book of General and Analytical Chemistry to be used as a source of information (e.g. equilibrium constants).
2. Solve problems related to chemical analysis.
3. Use and convert easily the measurement units of various physical quantities and constants
4. Choose the appropriate analytical method for the separation, identification and quantitative analysis of specific substances.
5. Identify and name glassware and apparatus in a chemical laboratory.
6. Organize his/her work in the lab, select the appropriate glassware, perform calculations and prepare standard solutions, etc.

7. Be familiar with the laboratory apparatus and common techniques and their uses, e.g. filtration, centrifugation, extraction, etc.
8. Keep a laboratory notebook.
9. Be able to cooperate in a chemical lab (work in a group).
10. Work following all the standard safety rules for a chemical lab.
11. Be able to adapt to the continuously evolving Analytical Laboratory.

3. COURSE CONTENT

1. Importance of Analytical Chemistry for Science and everyday life.
2. Methods of chemical analysis.
3. Solutions (water as a solvent, expressions of concentration and conversion between units, principle of mass/matter conservation, principle of electrical neutrality, etc.)
4. Chemical equilibrium of weak acids and bases.
5. Hydrolysis.
6. Formation and dissolution of precipitates. Fractional and homogeneous precipitation.
7. Equilibrium in solutions of complexes.
8. Chemical equilibrium of a redox system.
9. Extraction.
10. Chromatography.
11. Exercises and solutions to problems in the above chapters.
12. Basic chemical laboratory techniques and apparatus (sampling, weighting, volume measurement, precipitation, centrifugation, filtration etc). Theory and practice in an analytical lab.

Laboratory exercises:

1. Separation and identification of cations and anions in solutions (groups I–IV).
2. Qualitative analysis of an unknown solid substance.
3. Chromatography: paper, thin layer, ion exchange.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	1. Lectures using power-point presentations. The students are asked to find information in their documents. Educational software and use of the Internet facilities for information retrieval from data bases and other sources. 2. Tutorials focused on problem solving and exercises of various types: multiple choice, right/wrong, filling the gaps, balancing chemical equations. 3. Laboratory exercises: analysis of solutions of ions or organic substances. Analysis of solid samples.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Lectures.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems	13
Laboratory exercises (4 contact hours per week x 12 weeks)	48

	Final written examination (3 contact hours)	3
	Final written examination of the lab (1 contact hour)	1
	Private study time of the student and preparation for the half-term evaluations and final examination	146
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***250 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Evaluation of the result of analysis of unknown solutions. 2. Written tests during the laboratory practice through the whole semester. Questions on the theory and problem solving of the same type with those practiced in the tutorials. In order to consider that the student has succeeded in the laboratory practice, the mean value of the marks obtained for the results of the analysis of the unknown solutions and the corresponding test must be at least 5 (pass in 0-10 scale). This consists the 50 % of the final mark. 3. Written examination at the end of the semester. The mark obtained will be the 60% of the final mark provided that it is higher than 5. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. T.P. Hadjiioannou, "Chemical equilibrium and inorganic qualitative semimicroanalysis", D. Mavrommati Edition, 1999.
2. W.R. Robinson, J.D. Odom, H.F. Holtzclaw Jr., "General Chemistry, with Qualitative Analysis", 10th Edition, Houghton Mifflin Company, 1997.
3. Group authorship of the lab, "Laboratory exercises in Analytical Chemistry, Publications of University of Patras, 2015-2016.

Organic Chemistry of Functional Groups-I

1. GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	CHEMISTRY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**XO 202**	**SEMESTER**	**2nd**	
COURSE TITLE	ORGANIC CHEMISTRY OF FUNCTIONAL GROUPS-I			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures			3	**5**
Tutorials			1	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Organic Chemistry).			
PREREQUISITE COURSES:	Typically, there are not prerequisite courses.			

	Essentially, the students should possess the knowledge provided through the previously taught theoretical course "Structure, Reactivity and Mechanisms in Organic Chemistry'' (1st semester).
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

Be familiar with the general chemistry of the following classes of organic compounds: alkanes, alkenes, alkynes, alkyl halides (halo alkanes), alcohols, phenols, ethers, epoxides, benzene and its derivatives.

Specifically:

Alkanes

Account for "strain" in small rings. Relate the difficulty of forming cyclic systems to the size of ring required. Identify and apply the typical preparation reactions and reactions of alkanes in organic synthesis.

Alkenes

Use simple orbital overlap theory to account for non-rotation about *pi* bonds, conjugation, the stability of allyl carbocations, and the features of the Diels-Alder reaction. Identify and apply the typical preparation reactions and reactions of alkenes in organic synthesis.

Alkynes

Identify and apply the typical preparation reactions and reactions of alkynes in organic synthesis.

Aromatic compounds

Explain the structure, stability and reactivity of benzene using the concept of resonance. Identify simple non-benzenoid aromatic molecules by using Hückel's rule. Distinguish between Friedel-Crafts alkylation and acylation reactions for use in organic synthesis. Use the electrophilic and nucleophilic aromatic substitution in the synthesis of aromatic derivatives.

Alkyl halides (haloalkanes and haloaromatic compounds)

Exploit the usefulness of alkyl halides in organic synthesis, especially through substitution and organometallic reagents. Account for the reduced reactivity of "non activated" halo aromatics and halo alkenes.

Alcohols and phenols, ethers and epoxides

Exploit the usefulness of alcohols and epoxides in synthesis. Account for the acidity of alcohols and phenols.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

Production of new research ideas

In addition, by the end of this course the student will have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Organic Chemistry.
2. Ability to apply this knowledge and understanding to the solution of problems related to Organic Chemistry of non-familiar nature.
3. Ability to adopt and apply methodology to the solution of non-familiar problems of Organic Chemistry.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems.
6. Ability to use the Artificial Intelligence in solving synthetic problems.

In general, by the end of this course the student will have developed the following general abilities (from the list above):

Searching, analysing and synthesising facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Group work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

Respect to natural environment

Work design and management

3. COURSE CONTENT

Alkanes
Sources, preparation and reactions.

Alkenes
Electronic structure, *cis-trans, E/Z* isomers, preparation *via* elimination reactions. Addition reactions – hydrogenation, electrophilic addition of HX, H_2O, X_2, regioselectivity and stereoselectivity of addition reactions, Markovnikov's rule, carbocation structure and stability, addition in the presence of peroxides - anti-Markovnikov. Hydroboration. Oxidation. Conjugated dienes, resonance, stability of allylic carbocations, 1,2- and 1,4- addition to dienes. Cycloaddition reactions (Diels-Alder).

Alkynes
Structure and preparation methods. Addition reactions – hydrogenation, electrophilic addition of HX, H_2O, X_2, acidity, formation of alkyne anions, coupling reactions.

Aromatic Compounds
Structure and stability of benzene, resonance, Hückel's rule, simple non-benzenoid aromatics (cyclopentadienyl, tropylium). Electrophilic aromatic substitution - halogenation, nitration, sulfonation, the Friedel- Crafts alkylation and acylation reactions. Isomerism of benzene derivatives, reactivity and orientation of reactions on substituted aromatic rings, oxidation and reduction of aromatic compounds. Side-chain halogenation.

Alkyl halides (haloalkanes and haloaromatic compounds)
Preparation from alcohols, nucleophilic substitution reactions, elimination reactions, Grignard reagents. Haloaromatics and haloalkenes.

Alcohols and phenols, ethers and epoxides
Primary, secondary and tertiary alcohols. Acidity of alcohols and phenols, hydrogen bonding. Synthesis of alcohols from alkenes and from carbonyl compounds. Reactions of alcohols - with hydrogen halides, phosphorus halides, dehydration, reaction with metals, acylation, oxidation. Synthesis and reactions of phenols - oxidation, acylation. Williamson ether synthesis, acidic cleavage, cyclic ethers and crown ethers. Synthesis and ring-opening reactions of epoxides.

Application of Artificial Intelligence (AI) in solving synthetic problems.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures face-to-face.

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of PowerPoint presentation in teaching.</td></tr>
<tr><td>TEACHING ORGANIZATION
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (3 contact hours per week x 13 weeks)
Tutorials (1 contact hour per week x 13 weeks – Analysis of problem solving strategy and solution of representative problems)</td><td>52</td></tr>
<tr><td>Final examination (3 contact hours)</td><td>3</td></tr>
<tr><td>Hours for private study of the student</td><td>70</td></tr>
<tr><td>Total number of hours for the Course (25 hours of work-load per ECTS credit)</td><td>125 (total student workload)</td></tr>
</table>
</td></tr>
<tr><td>STUDENT ASSESSMENT
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written examination.
Greek grading scale: 1 to 10. Minimum passing grade: 5.
All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.</td></tr>
</table>

5. RECOMMENDED LITERATURE

1. Marc Loudon, Jim Parise, "*Organic Chemistryt*", 7th edition, Published by Macmillan Learning, 2021.
2. L. G. Wade, "*Organic Chemistry*", 9th edition, Published by Pearson, 2020 & 2017.
3. J. McMurry, "*Organic Chemistry*", 1st Greek-9th American Edition, University of Crete Press, 2017.
4. T. Mavromoustakos, T Tselios, K. Papakonstantinou, "*Basic Principles of Organic Chemistry*", in Greek language, Published S. Athanasopoulos & Co 2014.

Analytical Chemistry-2

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 356**	**SEMESTER**	**3rd**
COURSE TITLE	ANALYTICAL CHEMISTRY-2		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**	
Lectures	2	**5**	
Laboratory work	5		
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Analytical Chemistry).		
PREREQUISITE COURSES:	The students should have a basic knowledge of General Chemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The course can be, however, taught in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)			

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student should:

1. Acknowledge the capabilities of the various quantitative analytical chemistry techniques and have the ability to compare them.
2. Have an understanding of modern analytical techniques applied widely in a variety of samples (e.g. biological samples, environmental samples, foodstuff, drugs, materials, artworks).
3. Present flexibility in combining analytical techniques to solve complex problems.
4. Have the ability to combine and exploit the knowledge gained also in other fields of Chemistry in which concepts of the current course are extensively used (e.g. Organic Chemistry, Biochemistry, etc.).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*

Working in an interdisciplinary environment
Production of new research ideas

By the end of this course the student will have further developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications related to Analytical Chemistry.
2. Ability to apply this knowledge and understanding to the solution of Analytical Chemistry problems of non-familiar nature.
3. Ability to adopt and apply methodology to the solution of non-familiar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems.
6. To work in a chemical lab following the safety rules.

Generally, by the end of this course the student will, furthermore, have developed the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3. COURSE CONTENT

- Classification of quantitative chemical analysis methods.
- Sampling, sample treatment, measurement techniques, instruments and chemical reagents.
- Statistical treatment of analytical data (accuracy, precision etc), errors in chemical analysis, significant figures, methods for reporting analytical data.
- Classification of gravimetric methods. Precipitation (homogeneous precipitation, crystal growth, colloids, impurities, digestion, errors in gravimetric analysis).
- Classification of titrimetric methods, standard solutions, indicators.
- Acid/base equilibria and titrations, complexometric titrations, precipitation titrations, reduction/oxidation titrations, acid-base titrations in non-aqueous solvents, errors in titrimetric analysis.
- Buffer solutions, titration curves for strong/weak acids and bases, mass balance and charge balance equations, errors.
- Evaluation and comparison of gravimetric and titrimetric analytical methods.
- Solving problems in the above chapters.

Laboratory exercises

- Introduction to the Laboratory of Analytical Chemistry-2 (instruments, chemical reagents, preparation of solutions, safety rules etc.)
- Determination of sodium carbonate (neutralization titration)
- Determination of calcium and total hardness of water with EDTA (complexometric titration).
- Determination of iron^{II} with potassium permanganate (redox titration)
- Determination of copper^{II} with iodide (iodometry)
- Determination of ascorbic acid with iodine (iodimetry)
- Determination of nicotine in tobacco (non-aqueous acid-base titration)
- Determination of nickel with dimethylglyoximate (gravimetric analysis)

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. Use of the Internet for the exploitation of scientific sites and the extraction of information from databases on Analytical Chemistry issues. Communication with the students is established either through email or through the webpage of the Chemistry Department.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (2 contact hours per week x 13 weeks)	26
Half-term evaluations (2, the first in the middle and the second one at the end of the semester, 1 contact hour each)	2
Laboratory work (5 contact hour per week x 12 weeks)	60
Final written examination (2 contact hours)	2
Hours for private study of the student and preparation for the half-term evaluations and/or the final examination.	35
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 hours (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally, half-term written examinations: one at the middle and the other one at the end of the semester. The final grade is the average of the two half-term examinations. The student should secure at least the grade 6 (0-10 scale) in the first half-term in order to participate in the second one. This score represents the 60% of the final grade of the course. 2. Written examination after the end of the semester (unless the student successfully participated in the half-term exams). Minimum passing grade: 5. This score represents the 60% of the final grade of the course. 3. Grade of laboratory work: This score is the 40% of the final grade of the course (minimum passing grade: 5). All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. D.C. Harris, "Quantitative Chemical Analysis", W.H. Freeman & Company, 2007.
2. G.D. Christian, P.K. Dasgupta, K.A. Schug, "Analytical Chemistry", J. Wiley & Sons, 2013.
3. D.A. Skoog, D.M. West, F.J. Holler, "Analytical Chemistry, An Introduction", Saunders College Publishing, 1992.
4. "Vogel's Textbook of Quantitative Chemical Analysis", Revised by G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, Longman Scientific & Technical, 1989.
5. T.P. Hadjiioannou, A.K. Kalokerinos, M. Timotheou-Potamia, "Quantitative Analysis", Athens, 2017.
6. V. Nastopoulos, C. Papadopoulou, "Quantitative Analysis Laboratory Notes", University of Patras Publication Centre, 2017.

Inorganic Chemistry-2 (Chemistry of First-Row Transition Metals and Coordination Complexes)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ΧΑ 323 Θ**	**SEMESTER**	**3rd**
COURSE TITLE	INORGANIC CHEMISTRY-2 (CHEMISTRY OF FIRST ROW TRANSITION METALS AND COORDINATION COMPLEXES)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**6**
Tutorials	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Inorganic Chemistry of Transition Metals-Coordination Chemistry) and Skills Development (Synthetic Inorganic Chemistry).
PREREQUISITE COURSES:	Typically, there are no prerequisite courses. It is recommended that the students should have passed the previous courses "Introduction to Inorganic Chemistry" and "Inorganic Chemistry 1".
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2129/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Recognize d-block elements and write their ground-state electronic configurations.
2. Discuss the oxidation states of d-block elements.
3. Explain the variation of radii, ionization energies and other physical properties of d-block elements both horizontally and vertically within the Periodic Table.
4. Describe occurrence, metallurgy, chemical properties and uses of representative first row d-block metals.
5. Know the basic features of coordination chemistry (definition of the coordination complex, terminology, ligands, coordination numbers, stereochemistry, colours, magnetic properties, stability, isomerism, and applications of the metal complexes).
6. Discuss and analyze the bonding in coordination complexes (valence-bond theory, crystal field theory, molecular orbital theory).
7. Know the basic principles of kinetics and mechanisms in inorganic reactions.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Respect for difference and multiculturalism

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking*

At the end of the course the student will have further developed the following skills/competences:

1. Ability to demonstrate knowledge and understanding of concepts and principles related to the chemistry of the d-block elements.
2. Ability to demonstrate knowledge and understanding of concepts and principles related to coordination chemistry.
3. Ability to apply such knowledge and in-depth understanding to solve exercises of unfamiliar nature.
4. Ability to interact with others on interdisciplinary problems.

3. COURSE CONTENT

1. The first-row d-block metals

a) Definitions.
b) Occurrence, metallurgy and uses.
c) Electronic configurations of atoms and ions.
d) Physical properties.
e) The reactivity of the metals.
f) Characteristic properties (colour of their compounds, paramagnetism, complex formation).

2. Descriptive chemistry of titanium, iron and copper

For each metal:

a) Occurrence, extraction and uses.
b) Physical properties.
c) Reactions.

3. Basic coordination chemistry

a) Historical background.
b) The coordination complex: Definitions and the Werner era.
c) Ligands (monodentate, bidentate, polydentate, terminal, bridging).
d) Coordination numbers and geometries.
e) Nomenclature
f) Isomerism in d-block metal complexes (ionization isomers, hydration isomers, coordination isomers, linkage isomers, polymerization isomers, geometrical isomers, optical isomers).
g) Applications of coordination complexes in technology, biology and medicine.
h) Stability constants of coordination complexes.

4. Bonding in d-block metal complexes

a) Valence Bond Theory (hybridization schemes, applying VBT).
b) Crystal Field Theory (the octahedral crystal field, crystal field stabilization energy, high- and low-spin octahedral complexes, the tetrahedral crystal field, the square planar crystal field, spectrochemical series of ligands, colours of metal complexes).
c) Molecular Orbital Theory (octahedral complexes, complexes with no metal-ligand π bonding, complexes with metal-ligand π bonding).

5. Reactivity, kinetics and mechanisms of inorganic reactions

a) Preparation of metal complexes.
b) Reactivity.
c) Kinetic stability - inert and labile complexes.
d) The effect of CFSE on the reactivity of coordination complexes.
e) Associative and dissociative mechanisms of inorganic reactions.

f) Kinetics of substitution reactions in coordination complexes.

g) Trans-effect.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, tutorials face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. powerpoint) in teaching. Use of ICTs in the seminars providing information on the theory and the methodology for multi-step and complicated problems.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks)-solving of representative problems	9
Progress exams (2 progress exams, in the middle and end of the semester, 2 hours duration each)	4
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of home-works, progress exams, and final exam	95
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***150 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1) Optionally, two progress exams (with the opportunity to pass the course), one in week 7 and the other in week after the end of the semester, i.e., week 14. To participate in the second progress exam, the student must secure the minimum grade of 5 in the first progress exam. 2) Final written exam, final grade, unless the student has participated in the progress exam, so the aforementioned conditions will be applied. Minimum passing grade: 5 3) The final examination of the course will be in the Greek language. For the Erasmus students the examination will be carried out in the English language. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. N. Klouras, "Transition Metals and Coordination Compounds", Traulos Publishing Company, 2019.
2. D. Kessissoglou, P. Akrivos, "Chemistry of Coordination Compounds - Theory, Exercises and Experiments", Ziti Publishing Company, 2013.
3. N. D. Hatziliadis, "Introduction to Inorganic and General Chemistry", 2nd Edition, Athens, 2014.

Experimental Inorganic Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 323 E**	**SEMESTER**	**3rd**
COURSE TITLE	EXPERIMENTAL INORGANIC CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Tutorials	1	**4**
Laboratory work	3	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development
PREREQUISITE COURSES:	Typically, there are no prerequisite courses. It is recommended that the students should have passed the previous courses "Introduction to Inorganic Chemistry" and "Inorganic Chemistry 1".
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2062/ https://eclass.upatras.gr/courses/CHEM2061/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Prepare, purify, crystallize and characterize coordination complexes of first-row d-block metal ions.
2. Study, recognize, explain and characterize coordination compounds using IR and UV/Vis spectroscopies.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

At the end of the course the student will have further developed the following skills/competences:

1. Ability to demonstrate knowledge and understanding of concepts and principles related to the chemistry of the d-block elements.

2. Ability to demonstrate knowledge and understanding of concepts and principles related to coordination chemistry.
3. Ability to apply such knowledge and in-depth understanding to solve exercises of unfamiliar nature.
4. Ability to interact with others on interdisciplinary problems.
5. Skills enabling the student to synthesize and study coordination complexes in the laboratory (hands-on training).

3. COURSE CONTENT

1. Synthesis, purification and crystallization of d-block metal compounds and complexes, such as:

a) double nickel(II)/ammonium/sulfate salt,

b) potassium dichromate,

c) potassium/chromium(III) alum,

d) hexaamminonickel(II) chloride and bromide,

e) bis(dimethylglyoximato) nickel(II),

f) catena-tetra(μ-thiocyanato) cobalt(II) mercury(II),

g) catena-tetrakis(aspirinato)dicopper(II),

h) copper(I) chloride,

i) bis(aquo)tetrakis (acetato) dichromium(II),

j) octahedral cobalt(III) ammino complexes, etc.

2. Characterization of the above-mentioned compounds by means of conductivity measurements, room-temperature magnetochemistry, IR and UV/VIS/ligand field spectroscopies.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. powerpoint) in teaching. Use of ICTs in the seminars providing information on the theory and practice of the laboratory experiments and the methodology for multi-step syntheses.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Seminars (1 conduct hour per week × 6 weeks)-solving of representative problems	6
Laboratory work (3 conduct hours per week × 13 weeks)	39
Final examination on the material covered in the laboratory and the seminars/tutorials (3 conduct hours)	3
Hours for private study of the student and preparation of home-works and final exam	52
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. N. Klouras, "Transition Metals and Coordination Compounds", Traulos Publishing Company, 2019.
2. D. Kessissoglou, P. Akrivos, "Chemistry of Coordination Compounds - Theory, Exercises and Experiments", Ziti Publishing Company, 2013.
3. N. D. Hatziliadis, "Introduction to Inorganic and General Chemistry", 2nd Edition, Athens, 2014.

Physical Chemistry-2

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 339**	**SEMESTER**	**3rd**
COURSE TITLE	PHYSICAL CHEMISTRY-2		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		3	**5**
Tutorials		1	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Physical Chemistry).		
PREREQUISITE COURSES:	There are no prerequisite courses.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, the course can be taught in English if foreign students are enrolled.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2015/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of the course the student will be able to have basic knowledge for the interpretation of spectroscopic observations and measurements.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

At the end of this course the student will further develop the following skills:

Using advanced specialized software in applications in Chemistry: Spectroscopy, Molecular Modelling in Organic and Inorganic Chemistry. Search, analysis, and synthesis of data and information, using the necessary technologies.

3. COURSE CONTENT

- Historical introduction. The discovery of the electron by J.J. Thomson. Black body radiation and classical physics. Planck's Law. The electronic spectrum of the hydrogen atom. Rydberg's equation. Quantization of the angular momentum and Bohr's model of the hydrogen atom. De Broglie's theory, wave properties of matter. Heisenberg's Uncertainty Principle.
- The wave equation. The vibrating spring. Solving the wave equation by variable separation. General solution of the wave equation.
- Schrödinger's equation and some simple problems. Solving Schrödinger's equation: an eigenvalue problem. Observables and linear operators in Quantum Mechanics. A particle in a potential well: energy quantization. Uncertainty principle for a particle in a potential well.
- General principles of quantum Mechanics. The state of a system. Linear operators in Quantum Mechanics. Time-dependence of the wavefunction. Quantum mechanical operators, commutation and the uncertainty principle.
- The harmonic oscillator. Schrödinger's equation and energy levels. Infrared spectra of diatomic molecules. Asymptotic solution of Schrödinger's equation.
- Three-dimensional problems. Particle-in-a-box. Separable hamiltonian operators and the corresponding wavefuctions. Schrödinger's equation for the hydrogen atom. Symmetry of s orbitals. Schrödinger's equation for the helium atom.
- Approximative methods. Perturbation theory. The variational principle.
- Atoms. Atomic unit's system. Studying the helium atom. Hartree-Fock equations and the self-consistent field method. Antisymmetric wavefunctions. Hartree-Fock calculations and comparison with experimental data.
- Introduction to Molecular Symmetry.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures and Tutorials face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Lectures. Tutorials. Problems are solved in an exemplary way. The course includes practical exercises through the application of specialized software for the study of basic characteristics of atoms and molecules.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Tutorials (1 contact hour per week x 13 weeks) - solving of representative problems	13
Final written examination (3 contact hours)	3
Private study time of the student and preparation for final examination	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. P. Atkins, J. De Paula, J. Keeler, "*Physical Chemistry*", University of Crete Press, 2020.
2. P. Atkins, R. Friedman, "*Molecular Quantum Mechanics*", Papazisis Publications, 2023.
3. K. Kolasinski, "Physical Chemistry", Kritiki Publications, 2020.
4. J. N. Murrell, S. F. Kettle, J. M. Tedder, "The Chemical Bond", University of Crete Press, 2nd Edition, 2018.
5. A. McQuarrie, "*Quantum Chemistry*", University Science Books, 1983.
6. C. J. Cramer, "*Computational Chemistry: theories and models*", Wiley, 2004.
7. Related Scientific Journals.

Instrumental Chemical Analysis-1

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE (BACHELOR of SCIENCE)		
COURSE CODE	**XE 353**	SEMESTER	**3rd**
COURSE TITLE	INSTRUMENTAL CHEMICAL ANALYSIS-1		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		3	**5**
Tutorials		1	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Analytical Chemistry)		
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students have basic knowledge of Physics, Organic chemistry, Qualitative analysis and Quantitative analysis.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The course can be, however, taught in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chem.upatras.gr, http://eclass.upatras.gr		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student will know:

Electroanalytical Techniques

1. *Potentiometry.* Indicator electrodes. Development of electrical potentials. Development of membrane potentials. Reference electrodes. The liquid junction potential. Electrodes selective to molecules. Principle and architecture of potentiometric gas sensors. Principle and architecture of biocatalytic membrane electrodes. Quantitative analysis by potentiometry. Direct potentiometric methods. Calibration methods. Errors in potentiometry. Potentiometric titrations.
2. *Coulometry.* Principle of coulometric titrations. Advantages of coulometric titrations. Various types of coulometric titrations: Acid-base titrations; precipitation titrations; complex-formation titrations; oxidation reduction titrations. Electrochemical cells for coulometry. Problems.
3. *Voltammetry.* Principles of voltammetric sensors.
4. Atomic absorption and atomic fluorescence spectroscopy: Atomization techniques, instrumentation for atomic absorption, interferences, analytical techniques in atomic absorption spectroscopy, atomic fluorescence spectroscopy.
5. Atomic emission spectroscopy: Atomic emission spectroscopy based on plasma sources.
6. Atomic mass spectrometry: mass spectrometry (general), inductively coupled plasma/mass spectrometry.
7. X-Ray atomic spectroscopy.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

At the end of the course the student will have further developed the following skills/competences:

1. Ability to apply knowledge and understanding to the solution of qualitative and quantitative problems of an unfamiliar nature.
2. Ability to adopt and apply methodology to the solution of unfamiliar problems.
3. Study skills needed for continuing professional development.
4. Ability to interact with others on inter or multidisciplinary problems.
5. Propose membrane composition for potentiometric determination of various ions or molecules.
6. Predict interferences in potentiometric determinations.
7. Selection of a reference electrode.
8. Ability to develop potentiometric determinations including calibration and calculations.
9. Development of coulometric titrations.

3. COURSE CONTENT

1. *Electroanalytical Techniques*:

Potentiometry. Indicator electrodes. Development of electrical potentials. Development of membrane potentials. Reference electrodes. The liquid junction potential. Electrodes selective to molecules. Principle and architecture of potentiometric gas sensors. Principle and architecture of biocatalytic membrane electrodes. Quantitative analysis by potentiometry. Direct potentiometric methods. Calibration methods. Errors in potentiometry. Potentiometric titrations.

Coulometry. Principle of coulometric titrations. Advantages of coulometric titrations. Various types of coulometric titrations: Acid-base titrations; precipitation titrations; complex-formation titrations; oxidation reduction titrations. Electrochemical cells for coulometry. Problems.

Voltammetry. Principles of voltammetric sensors.

2. *Atomic Spectroscopy*

Atomic absorption and atomic fluorescence spectroscopy: Atomization techniques, instrumentation for atomic absorption, interferences, analytical techniques in atomic absorption spectroscopy, atomic fluorescence spectroscopy.

Atomic emission spectroscopy: Atomic emission spectroscopy based on plasma sources.

Atomic mass spectrometry: mass spectrometry (general), inductively coupled plasma/mass spectrometry.

X-Ray atomic spectroscopy: Principle and instrumentation.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (powerpoint) in Lectures. Course lectures and exemplary solved problems for every chapter. Communication with the students via e-mail or the e-class electronic platform: http://eclass.upatras.gr. Personal Codes are given to the students with their registration at the department. Seminars. Problems are solved in an exemplary way summarizing before the theory behind each problem.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems	13
Final written examination (3 contact hours)	3
Private study time of the student and preparation for the final examination	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 hours (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. D.A. Skoog, F.J. Holler, T.A. Nieman, "Principles of Instrumental Analysis ", 6th Edition, Thomson Brooks Cole Publications, 2007.
2. Th. Hatjiioannou and M.A. Kouppari, "Instrumental Analysis, Mavrommatis Publications, 2003.
3. D. C. Harris, "Quantitative Chemical Analysis", 8th Ed., W. H. Freeman and Company Publications, 2010.

Organic Chemistry of Functional Groups-II

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 303**	**SEMESTER**	**3rd**
COURSE TITLE	ORGANIC CHEMISTRY OF FUNCTIONAL GROUPS-II		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**5**
Tutorials	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Organic Chemistry)
PREREQUISITE COURSES:	There are no prerequisite courses. Essentially, the students should possess the knowledge provided through the courses: "Structure and Reactivity in Organic Chemistry'' (1st semester) and "Organic Chemistry of Functional Groups-I" (2nd semester).
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

Be familiar with the general chemistry of the following classes of organic compounds: Aldehydes, ketones, Carboxylic acids and their derivatives, Amines and other nitrogen containing compounds (e.g. nitro compounds).

Specifically:

Aldehydes –ketones, Carboxylic acids and derivatives:

1. Present the most important methods for the preparation of carbonyl compounds and reactions involving inter-conversion of carbonyl groups. Present the most important reactions with the participation of carbonyl group.
2. Evaluate chemical methods and propose/apply methods for the synthesis and inter-conversion of carbonyl compounds and their conversion to other organic compounds.
3. Present the applications and use of carbonyl compounds.

Amines and other nitrogen containing compounds

Distinguish between the behaviour of amines as nucleophiles and bases, and between nitrogen in sp3, sp2 and sp hybridization. Explain the basicity of amines, and the reduced basicity of amides. Understand the usefulness of diazonium compounds and apply them in the synthesis of substituted aromatic derivatives.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

In addition, by the end of this course the student will have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Organic Chemistry.
2. Ability to apply this knowledge and understanding to the solution of problems related to Organic Chemistry of non-familiar nature.
3. Ability to adopt and apply methodology to the solution of non-familiar problems of Organic Chemistry.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems.
6. Ability to use the Artificial Intelligence in solving synthetic problems.

In general, by the end of this course the student will have developed the following general abilities:

Searching, analysing and synthesing facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Group work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

Respect to natural environment

Work design and management

3. COURSE CONTENT

Aldehydes –ketones, Carboxylic acids and derivatives:

1. A preview of Carbonyl Compounds
2. Aldehydes and Ketones: Nucleophilic Addition Reactions
3. Carboxylic Acids and Nitriles
4. Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions
5. Carbonyl Alpha-Substitution Reactions
6. Carbonyl Condensation Reactions

Amines and other nitrogen functions

Primary, secondary and tertiary amines, amine basicity, synthesis of amines by substitution and reduction reactions, reactions of amines - alkylation, Hofmann exhaustive methylation, acylation, preparation of diazonium compounds - and their use in synthesis; nitro compounds.

Application of Artificial Intelligence (AI) in solving synthetic problems.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of PowerPoint presentation in teaching. Use of eclass platform (eclass.upatras.gr)

TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	***Activity***	***Semester workload***
	Lectures (3 contact hours per week × 13 weeks) Tutorials (1 contact hour per week × 13 weeks – Analysis of problem solving strategy and solution of representative problems)	52
	Final examination (3 contact hours)	3
	Hours for private study of the student	70
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.	

5. RECOMMENDED LITERATURE

1. Marc Loudon, Jim Parise, "*Organic Chemistry*", 7th edition, Published by Macmillan Learning, 2021.
2. L. G. Wade, "*Organic Chemistry*", 9th edition, Published by Pearson, 2020 & 2017.
3. J. McMurry, "*Organic Chemistry*", 1st Greek-9th American Edition, University of Crete Press, 2017.
4. T. Mavromoustakos, T Tselios, K. Papakonstantinou, "*Basic Principles of Organic Chemistry*", in Greek language, Published S. Athanasopoulos & Co 2014.

Spectroscopy of Organic Compounds – Experimental Organic Chemistry-1

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 404**	**SEMESTER**	**4th**
COURSE TITLE	SPECTROSCOPY OF ORGANIC COMPOUNDS - EXPERIMENTAL ORGANIC CHEMISTRY-1		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	**5**
Tutorials	1	
Laboratory work	3	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Spectroscopy of Organic Compounds) and Skills Development (Experimental Organic Chemistry-1)
PREREQUISITE COURSES:	**Spectroscopy of Organic Compounds:** Typically, there are not prerequisite course. Essentially, the students should possess knowledge of Organic Chemistry and basic knowledge of General Chemistry and Physics. **Experimental Organic Chemistry-1:** Typically, there are not prerequisite course. The students should possess knowledge of Organic Chemistry obtained through the previously attended courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

SPECTROSCOPY OF ORGANIC COMPOUNDS

Use (IR), ^{13}C και ^{1}H nuclear magnetic resonance (NMR), separately or in combination with each other, or with additional information from ultraviolet (UV)/Visible (vis) spectroscopy, mass spectrometry (MS), analytical data or descriptive chemistry, to identify structural features or complete structures of 'unknown' molecules. Determine a molecular formula either from the accurate mass of a molecular ion or from the isotope peak intensities. Calculate a 'double bond equivalent' from a molecular formula and propose possible structural characteristics thereof.

EXPERIMENTAL ORGANIC CHEMISTRY-1

Organize and execute syntheses of relatively simple organic molecules. More specifically, to:

1. Collect all the necessary information (compounds physical properties and hazards, literature information etc.) and then organize an organic synthesis/preparation.
2. Explain the role of the various reagents.
3. Assembly the various apparatuses required in a synthesis and carry out successfully both the synthetic part and the separation and purification of the product(s) part of a synthesis. For this purpose, the student should have been acquainted with the theory and practice of techniques such as extraction, filtration, refluxing, distillation, recrystallization, etc.
4. Use spectroscopic methods (UV-Vis, IR, NMR and MS) for identifying the product(s).
5. Processing and present the results of the syntheses he/she carried out, such as yields, mechanisms, improvement of synthetic routes, etc.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Spectroscopy of Organic Compounds.
2. Ability to prepare and carry-out the synthesis and characterization of simple organic molecules.
3. Ability to apply this knowledge to the solution of non-familiar problems.
4. Ability to apply this knowledge to the solution of new compounds.
5. Study skills needed for continuing professional development.
6. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and processing of data and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and management

3. COURSE CONTENT

SPECTROSCOPY OF ORGANIC COMPOUNDS

1. Matter and Electromagnetic Irradiation.
2. UV-Vis Spectroscopy (theory– applications)
3. IR and Raman Spectroscopy (theory– applications)
4. MS Spectrometry: a) Description of the principle and the various ionization techniques (Electron Impact, Chemical Ionization, MALDI, ES, etc. b) Generally about molecular fragmentation in mass spectrometry and Fragmentation pathways of the various categories of compounds c) Examples – Applications.

5. Nuclear Magnetic Resonance (NMR) spectroscopy, chemical equivalence, the δ scale, chemical shift. ^{1}H NMR spectra, integration, spin-spin coupling, the n+1 rule. ^{13}C NMR Spectroscopy, multiplicity in off-resonance spectra.
6. Combinatorial use of the above spectroscopic/spectrometric techniques for the identification of 'unknown' organic compounds.

EXPERIMENTAL ORGANIC CHEMISTRY-1

1. Introductory concepts of the Organic Chemistry Laboratory and description of techniques.
2. Preparation of tert-butyl chloride.
3. Preparation of acetanilide.
4. Preparation of cyclohexanone oxime.
5. Canizzarro reaction.
6. Nitration of Acetanilide.
7. Thin Layer Chromatography (separation of aminoacids).
8. Microscale reactions (Synthesis of Benzoine).

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, Tutorials and Laboratory work face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. Use of Artificial Intelligence (AI) in teaching. Tutorials with exemplary analysis of problem solving in Spectroscopy. Tutorials where the experimental steps are thoroughly analysed and combined with theory.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (2 contact hours per week × 13 weeks)	26
Tutorial (1 contact hour per week × 13 weeks – Analysis of the laboratory experiments and combination with theory)	13
Laboratory work (3 contact hours per week x 13 weeks)	39
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of home-works and preparation for the seminars and Laboratory	44
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**SPECTROSCOPY OF ORGANIC COMPOUNDS:** Written examination (50% of the final grade). **EXPERIMENTAL ORGANIC CHEMISTRY-1:** 1. Written tests of 15 minutes duration at the beginning of each new laboratory period (experiment). The mean mark from these tests consists the 25% of the final grade. 2. Reports following completion of each laboratory experiment. The mean mark from these tests consists the 25% of the final grade. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. L.D. Field, S. Sternhell, J.R. Kalman, H.L. Li, A.M. Magill, "*Organic Structure from Spectra*", 1st Greek Edition-5th American Edition, Utopia Publishing, 2017.
2. Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, "*Introduction to Spectroscopy*", 1st Greek Edition, Broken Hill Publishers Ltd, 2020.
3. L. G. Wade, W. Simek, "*Organic Chemistry*", 9th Edition, Translation to Greek: D. Komiotis et al, Tziolas Publications, 2018.
4. J. McMurry, "*Organic Chemistry*", 1st Greek-9th American Edition, University of Crete Press, 2017.
5. D. Papaioannou, G. Stavropoulos, T. Tsegenidis, "*Spectroscopy of Organic Compounds*", in Greek language only, University of Patras Publications Centre, Patras, 2005.

Notes of lecturers in Greek.

Chemistry of Heterocyclic Compounds and Biomolecules

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 405**	**SEMESTER**	**4th**
COURSE TITLE	CHEMISTRY OF HETEROCYCLIC COMPOUNDS AND BIOMOLECULES		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		3	**5**
Tutorials		1	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Organic Chemistry)		
PREREQUISITE COURSES:	There are no prerequisite courses. However, it is recommended that students should have at least a basic knowledge of General Chemistry and Organic Chemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Instruction may be given in English in case foreign students attended the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2056/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

CARBOHYDRATES AND NUCLEIC ACIDS

- Draw the Fischer projection of glucose and the chair conformation of the anomers of glucose from memory.

- Recognize the structures of other anomers and epimers of glucose, drawn as either Fischer projections or chair structures, by noticing the differences from the glucose structure..
- Name monosaccharides and disaccharides, and draw their structures from their names.
- Predict which carbohydrates mutarotate, which reduce Tollens reagent, and which undergo epimerization and isomerization under basic conditions.
- Predict the products of the following reactions of carbohydrates: bromine in water, nitric acid, $NaBH_4$ or H_2/Ni, alcohols / H^+, CH_3I and Ag_2O, NaOH and dimethyl sulphate, acetic anhydride and pyridine, phenylhydrazine, Ruff degradation, Kiliani-Fischer synthesis.
- Use the information gained from these reactions to determine the structure of an unknown carbohydrate.
- Use the information gained from methylation and from periodic acid cleavage to determine the ring size.
- Draw the common types of glycosidic linkages and recognize these linkages in disaccharides and polysaccharides.
- Recognize the structures of DNA and RNA and draw the structures of a ribonucleotide and a deoxyribonucleotide.

AMINO ACIDS, PEPTIDES, AND PROTEINS

- Name amino acids and peptides and draw the structures from their names.
- Use perspective drawings and Fischer projections to show the stereochemistry of D- and L- amino acids.
- Explain which amino acids are acidic, which are basic, and which are neutral. Use the isoelectric point to predict whether a given amino acid will be positively charged, negatively charged, or neutral at a given pH.
- Show how one of the following syntheses might be used to make a given amino acid: reductive amination, HVZ followed by ammonia, Gabriel—malonic ester synthesis, Strecker synthesis
- Predict products of the following reactions of amino acids: esterification, acylation, reaction with ninhydrin.
- Use information from terminal residue analysis und partial hydrolysis to determine the Structure of an unknown peptide.
- Show how solution-phase peptide synthesis or solid-phase peptide synthesis would be used to make a given peptide. Use appropriate protecting groups to prevent unwanted couplings.

LIPIDS

- Classify lipids both into the large classifications (such simple lipids, complex lipids, phospholipids etc.) and into the more specific classifications (such waxes, triglycerides, cephalins, lecithins, steroids, prostaglandins, terpenes, etc.)
- Predict the physical properties of fats and oils from their structures.
- Identify the isoprene units in terpenes and classify terpenes according to the number of carbon atoms.
- Predict the products of reactions of lipids with standard reagents. In particular, consider the reactions of the ester and olefinic groups or glycerides and the carboxyl groups of fatty acids.
- Explain how soaps and detergents work, with particular attention to their similarities and differences.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, have develop the following skills (general abilities):

1. Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and application which are related to Organic Chemistry and especially to the chemistry of heterocyclic

compounds and biomolecules.

2. Ability to apply this knowledge and understanding to problem-solving in wider Organic Chemistry issues.
3. Ability to expand and apply methodology to the solution of more complex problems.
4. Study skills needed for continuing academic and professional development.
5. Ability to interact with others in chemistry or interdisciplinary problems.

Generally, by the end of this course the students should develop the following general skills:

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new knowledge and combination of various concepts of chemistry

Decision making

Autonomous (Independent) work

Opportunity to assess the course and self-assessment

Promotion of free, creative and inductive thinking

3. COURSE CONTENT

CARBOHYDRATES AND NUCLEIC ACIDS

- Introduction
- Classification of Carbohydrates
- Monosaccharides
- D-L Sugars, Diastereomers, Epimers
- Cyclic Structures of Monosaccharides
- Anomers of Monosaccharides; Mutarotation
- Reactions of Monosaccharides: Side Reactions in Base, Reduction of Monosaccharides, Oxidation of Monosaccharides; Reducing Sugars, Formation of Glycosides, Ether and Ester Formation, Reactions with Phenylhydrazine, Chain Shortening: The Ruff Degradation, Chain Lengthening: The Kiliani-Fischer Synthesis
- Fischer's Proof of the Configuration of Glucose
- Determination of Ring Size; Periodic Acid Cleavage of Sugars
- Disaccharides
- Polysaccharides
- Nucleic Acids: Introduction
- Ribonucleosides and Ribonucleotides
- The Structure of Ribonucleic Acid
- Deoxyribose and the Structure of Deoxyribonucleic Acid
- Additional Functions of Nucleotides

AMINO ACIDS, PEPTIDES, AND PROTEINS

- Structure and Stereochemistry of the *a*-Amino Acids
- Acid-Base Properties of Amino Acids
- Isoelectric Points and Electrophoresis
- Synthesis of Amino Acids: reductive amination, HVZ followed by ammonia, Gabriel—malonic ester synthesis, Strecker synthesis
- Resolution of Amino Acids
- Reactions of Amino Acids: esterification, acylation, reaction with ninhydrin.
- Structure and Nomenclature of Peptides and Proteins
- Peptide Structure Determination
- Solution-Phase Peptide Synthesis
- Solid-Phase Peptide Synthesis

- Proteins

LIPIDS

- Introduction
- Waxes
- Triglycerides
- Reactions of Lipids: hydrogenation of glycerides, Saponification of Fats and Oils, transesterification; biodiesel
- Soaps and Detergents
- Phospholipids, Steroids, Prostaglandins, Terpenes

HETEROCYCLES

- Definition, Diversity and Categorisation of Heterocycles

Nomenclature

- Empirical names
- Method of Substitution
- Hantzsch-Widman system (IUPAC)
- Similarities and differences in reactivity between cyclic and aliphatic analogues

3- and 4--membered heterocycles

- Structure, stereochemistry and reactivity
- Syntheses of epoxides aziridines and β-lactams

Cyclisation reactions

- Kinetics and stereoelectronic effects in heterocyclisations
- Baldwin rules
- The Ring Closing Metathesis reaction in the synthesis of heterocycles
- 1,3 dipolar cycloadditions

5-membered aromatic heterocycles

- Structure, electronic properties
- Degree of aromaticity - aromatic *vs* diene behaviour
- Reactivity and regioselectivity in Electrophilic aromatic substitution reactions
- Reactivity and regioselectivity in Nucleophilic aromatic substitution reactions
- Acidity and Basicity of azoles
- Deprotonation of ring-carbon atoms and side chains
- Syntheses of 5-membered aromatic heterocycles

6-membered aromatic heterocycles

- Structure, electronic properties, nucleophilicity and basicity of azines
- Regioselectivity in Electrophilic aromatic substitution reactions
- Regioselectivity in Nucleophilic aromatic substitution reactions
- The Chichibabin reaction
- Reduction of pyridine rings - NAD/NADH
- Reactivity of substituents - similarities with benzene analogues
- Structure, electronic properties and reactivity of pyridine oxide
- Syntheses of pyridines, pyrazines and pyridazines

Fused aromatic heterocycles

- Nomenclature
- Structure and Reactivity of Indole, Quinoline and Isoquinoline

- Regioselectivity in Electrophilic aromatic substitution reactions
- Regioselectivity in Nucleophilic aromatic substitution reactions
- Syntheses of fused aromatic heterocycles.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Physical presence in Lectures and seminars.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Lectures. Course lectures, in the form of ppt or pdf files, are uploaded in the internet (https://eclass.upatras.gr/courses/CHEM2056/), from where the students can be freely downloaded using password. Communication with the students is established either through mail or through the webpage of the Chemistry Department.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 9 weeks) - solving of representative problems	9
Half-term evaluations (2, one in the middle and the other at the end of the semester, 2 contact hours each)	4
Final written examination (3 contact hours)	3
Private study time of the student and preparation for the half-term evaluations and final examination	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally, at least one, half-term written examinations, the first one in the chapter of Biomolecules and the second in the chapter of heterocycles (immediately after the end of the semester). It is prerequisite that the students should at least obtain the grade 4 in the first half-term examination in order to be allowed to participate in the second one. 2. Written examination at the end of the semester - final mark, unless the student passed in half-term examinations. Minimum passing grade: 5. The assessment structure described above focuses on problem solving by combining the concepts and theories taught. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. J. McMurry, "Organic Chemistry", Translation to Greek: A. Varvoglis, M. Orfanopoulos, I Smonou, et al, University of Crete Publications, 2012.
2. L. G. Wade, Jr.,"Organic Chemistry", Translation to Greek: D. Komiotis, et al, A. Tziola and Sons Publications, 2010.
3. J. Clayden, N. Greeves, S. Warren, "Organic Chemistry", Vols I and II, Translation to Greek: G. Kokotos et al, Utopia Publications, 2017.
4. Notes from the teachers

Instrumental Chemical Analysis-2

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ΧΕ 454 Θ**	**SEMESTER**	**4th**
COURSE TITLE	INSTRUMENTAL CHEMICAL ANALYSIS-2		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**6**
Tutorials	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Analytical Chemistry)
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students have basic knowledge of Physics, Organic chemistry, Qualitative analysis and Quantitative analysis.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, the course can be taught in English if foreign students enrolled.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.chem.upatras.gr, http://eclass.upatras.gr

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student will know:

1. Properties of electromagnetic radiation. Parts of optical instruments.
2. UV/Vis molecular spectroscopy: Transmittance and absorbance measu-rements. Beer's Law. Instrumentation.
3. Applications of UV/Vis molecular spectroscopy: Requirements for absorption at the UV/Vis range. Applications in qualitative and quantitative analysis. Photometric titrations.
4. Molecular luminescence spectroscopy: Theory of fluorescence and phosphorescence. Instrumentation. Applications and luminescence methods. Chemiluminescence.
5. Infrared absorption spectroscopy: Theory, instrumentation and applications.
6. Molecular mass spectrometry: mass spectra, ion sources, Instrumentation. Applications.
7. Automated methods of analysis. Principles, Instrumentation and Applications.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Adapting to new situations

Decision-making

Working independently

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Showing social, professional and ethical responsibility and sensitivity to gender issues

Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

At the end of the course the student will have further developed the following skills/competences:

1. Critical knowledge of the advantages and disadvantages of various spectroscopic and chromatographic techniques.
2. How can we choose a spectroscopic technique in order to address a particular analytical challenge in real samples?
3. Quantitative aspects of spectroscopic techniques, including calibration.
4. Effect of interferences and how to avoid them.
5. How can we choose a particular instrument (cost versus performance).
6. Advantages and disadvantages of various instruments.
7. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to chromatography.

3. COURSE CONTENT

1. Introduction to spectroscopic techniques: Properties of electromagnetic radiation. Parts of optical instruments.
2. UV/Vis molecular spectroscopy: Transmittance and absorbance measurements. Beer's Law. Instrumentation.
3. Applications of UV/Vis molecular spectroscopy: Requirements for absorption at the UV/Vis range. Applications in qualitative and quantitative analysis. Photometric titrations.
4. Molecular luminescence spectroscopy: Theory of fluorescence and phosphorescence. Instrumentation. Applications and luminescence methods. Chemiluminescence.
5. Infrared absorption spectroscopy: Theory, instrumentation and applications.
6. Atomic absorption and atomic fluorescence spectroscopy: Atomization techniques, instrumentation for atomic absorption, interferences, analytical techniques in atomic absorption spectroscopy, atomic fluorescence spectroscopy.
7. The basic chromatographic parameters: Distribution constant, Retention time, Retention factor and their physical meaning. He will be able to use these parameters to calculate from a chromatogram other also basic parameters like the Selectivity Factor and the Resolution.
8. The Plate theory and its basic assumptions and calculate from a chromatogram the Number of Theoretical Plates. The Rate Theory and van Deemter equation, with its graphical representations for Gas and Liquid Chromatography- HPLC.
9. Recognize the classes of analytes to be determined with Gas Solid and Gas Liquid Chromatography (with packed and capillary columns). Choose the appropriate column and detector for the separation and determination of certain analytes with Gas Chromatography.
10. Recognize the various types of Liquid Chromatography-HPLC (Liquid-Solid Chromatography, Liquid-Liquid Chromatography Normal and Reverse Chromatography, Ion Chromatography and Size Exclusion Chromatography). Select the appropriate column for a cterain separation and the appropriate Detector for the determination of a certain analyte. Understand the role of the solvent in HPLC.
11. Perform in a Chromatogram Qualitative and Quantitative Analysis, with simple Normalization and also based on Response Factors.
12. Molecular mass spectrometry: Mass spectra, ion sources, Instrumentation. Applications.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures and tutorials
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Lectures. Communication with the students via e-mail or the e-class electronic platform: http://eclass.upatras.gr. Personal Codes are given to the students with their registration at the department. Seminars. Problems are solved in an exemplary way summarizing before the theory behind each problem.

TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	***Activity***	***Semester workload***
	Lectures (3 contact hours per week × 13 weeks)	39
	Seminars (1 contact hour per week × 13 weeks) - solving representative problems	13
	Final written examination (3 contact hours)	3
	Private study time of the student and preparation for the half-term evaluations and final examination	70
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.	

5. RECOMMENDED LITERATURE

1. D.A. Skoog, F.J. Holler, T.A. Nieman, "Principles of Instrumental Analysis", 6th Edition, Thomson Brooks Cole Publications, 2007.
2. T.P. Hadjiioannou and M.A. Kouppari, "Instrumental Analysis", Mavrommatis Publications, 2003.
3. D.C. Harris, "Quantitative Chemical Analysis", 8th Edition, W. H. Freeman and Company Publications, 2010.

Lab of Instrumental Chemical Analysis

1. GENERAL

SCHOOL	NATURAL SCIENCES		
DEPARTMENT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE (BACHELOR of SCIENCE)		
COURSE CODE	XE 454 E	**SEMESTER OF STUDIES**	4th
COURSE TITLE	Lab of Instrumental Chemical Analysis		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Seminars		1	**4**
Laboratory work		3	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Analytical Chemistry)		
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students have basic knowledge of Physics, Organic chemistry, Qualitative analysis and Quantitative analysis.		

TEACHING AND ASSESSMENT LANGUAGE:	Greek. The course can be, however, taught in English in case foreign students attend the course.
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBPAGE (URL)	http://www.chem.upatras.gr, http://eclass.upatras.gr

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student will know:

1. Properties of electromagnetic radiation. Parts of optical instruments.
2. UV/Vis molecular spectroscopy: Transmittance and absorbance measurements. Beer's Law. Instrumentation.
3. Applications of UV/Vis molecular spectroscopy: Requirements for absorption at the UV/Vis range. Applications in qualitative and quantitative analysis. Photometric titrations.
4. Molecular luminescence spectroscopy: Theory of fluorescence and phosphorescence. Instrumentation. Applications and luminescence methods. Chemiluminescence.
5. Infrared absorption spectroscopy: Theory, instrumentation and applications.
6. Atomic absorption and atomic fluorescence spectroscopy: Atomization techniques, instrumentation for atomic absorption, interferences, analytical techniques in atomic absorption spectroscopy, atomic fluorescence spectroscopy.
7. Atomic emission spectroscopy: Atomic emission spectroscopy based on plasma sources.
8. Atomic mass spectrometry: mass spectrometry (general), inductively coupled plasma/mass spectrometry.
9. Molecular mass spectrometry: mass spectra, ion sources, Instrumentation. Applications.
10. Automated methods of analysis. Principles, Instrumentation and Applications.
11. Knowledge and skills that will be acquired fall into the area of Information Technology and the handling of Electronic Computers.

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

At the end of the course the student will have further developed the following skills/competences:

1. Critical knowledge of the advantages and disadvantages of various spectroscopic, electrochemical and chromatographic techniques.
2. How can we choose a spectroscopic technique in order to address a particular analytical challenge in real samples?
3. Quantitative aspects of spectroscopic techniques, including calibration.
4. Effect of interferences and how to avoid them.
5. How can we choose a particular instrument (cost versus performance).
6. Advantages and disadvantages of various instruments.

3. COURSE CONTENT

- Potensiometry
- Electrogravimetric analysis
- Conductimetry

- UV/Vis Spectroscopy (quantitative analysis, standard addition method)
- UV/Vis Spectroscopy (binary mixtures)
- Spectrometric determination of enzyme kinetics
- IR
- Mass spectrometry
- Fluorescence spectroscopy
- XRF
- Atomic absorbance
- Atomic emission (Flame photometry)
- Gas chromatography
- HPLC ion exchange
- HPLC reverse phase.

4. TEACHING and LEARNING METHODS - ASSESMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, tutorials and laboratory practice
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (powerpoint) in Lectures. Communication with the students via e-mail or the e-class electronic platform: http://eclass.upatras.gr. Personal Codes are given to the students with their registration at the department. Seminars. Problems are solved in an exemplary way summarizing before the theory behind each problem.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (1 conduct hour per week x 13 weeks)	13
Laboratory exercises (3 conduct hours per week x 12 weeks)	36
Final written examination (3 conduct hours)	3
Final written examination of the lab (1 conduct hour)	1
Private study time of the student and preparation for the half-term evaluations and final examination	72
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 hours (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* *Αναφέρονται ρητά προσδιορισμένα κριτήρια αξιολόγησης και εάν και που είναι προσβάσιμα από τους φοιτητές;*	Experimental data processing and written report for each laboratory exercise, 20% of the final grade. One written examination at the end of Semester, 80% of the final grade. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. D.A. Skoog, F.J. Holler, T.A. Nieman, "Principles of Instrumental Analysis", 6th Edition, Thomson Brooks Cole Publications, 2007.
2. T.P. Hadjiioannou and M.A. Kouppari, "Instrumental Analysis", Mavrommatis Publications, 2003.
3. D.C. Harris, "Quantitative Chemical Analysis", 8th Edition, W. H. Freeman and Company Publications, 2010.

Physical Chemistry-3

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ΧΑ 434 Θ**	**SEMESTER**	**4th**
COURSE TITLE	PHYSICAL CHEMISTRY-3		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**5**
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical course ''Physical Chemistry-1''
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Define the chemical equilibrium constant of a reaction and derive its relation to temperature and pressure.
2. Answer the following questions:
   a) How fast does a chemical reaction occur?
   b) What factors affect the rate of chemical reactions?
   c) What is the mechanism that follows chemical reactions?
3. Define the factors that influence the rate of enzyme reactions.
4. Define parameters such as activity, activity coefficient, mean activity coefficient of ions in solution and describe the interactions between the different species in electrolyte solutions.
5. a) Describe the electrode-electrolyte interface.
   b) Represent electrochemical cells.
   c) Predict when electrochemical reactions become spontaneous.
   d) Define the electrochemical equilibrium.
   e) Define the dependence of the ionic potential on the activities of the ions.
6. Define the rate of electrochemical reactions and describe its relationship to the potential difference of

electrodes.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course the student will further develop the following skills:

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which related to Physical Chemistry and especially of Chemical Equilibrium, Chemical Kinetics and Electrochemistry.
2. Ability to apply this knowledge and understanding to the solution of problems related to Material Science, Environment, Food Science, Biology, Pharmacy and Medicine.

3.Study skills needed for continuing professional development.

4. Ability to interact with others in chemical or of interdisciplinary problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities:

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and management

3. COURSE CONTENT

1. Chemical Equilibrium

Chemical equilibrium constants and their dependence on temperature and pressure. Representative examples of chemical equilibrium. Chemical equilibrium in biological reactions.

2. Chemical Reaction Kinetics

Kinetic equations. Define reaction order and rate constant of chemical reactions. Kinetic equations from the mechanism of the reaction. Steady state approximation. Kinetic equations for consecutive reactions. The kinetics of complex reactions.

3. Kinetic of enzyme actions

Effect of concentration, pH and temperature on the rate of enzyme action. Michaelis-Menten mechanism of enzyme action.

4. Conductivity and Ionic Equilibrium

Conductivity. Transport numbers. Conductivity and electrical mobility of ionic species. Ionic equilibrium. Buffer solutions. Indicator solutions.

5. Electrochemical cells

Electrodes and electrochemical cells. Electrochemical reactions. Thermodynamics of electrodes and electrochemical potential. Membrane potentials. Definition of *pK* of an acid or base and the pH of a solution. Potentiometric titrations.

6. Electrochemical Kinetics

Electric double layer. Rate of electrochemical reactions. Overpotential. Polarography. Corrosion.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, seminars work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. power point) in teaching.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems	13
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of technical reports for each laboratory experiment.	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally two (2) written examinations during the semester. 2. Written examination after the end of the semester. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English. Minimum passing grade for the theoretical session: 5. The final course grade is calculated as follows: Grade of the final written examination and grade of the optional written examinations..

5. RECOMMENDED LITERATURE

1. G. Karaiskakis, "*Physical Chemistry*", in Greek language only, Travlos Publications, 1998.
2. P. Atkins, J. De Paula, "*Physical Chemistry*», 8th Edition, Oxford University Press, 2006.
3. N. Katsanos "*Physical Chemistry: Basic Consideration*", 3rd Edition, in Greek language only, Papazisis Publications, 1999.
4. N. Katsanos, "*Physical Chemistry Laboratory Textbook*", Parts I & II, in Greek language only, University of Patras Publications, 2006.
5. G. Karaiskakis, N. Klouras, E. Manesi-Zoupa, "*Chemistry Laboratory Textbook*", in Greek language only, Hellenic Open University Publications, 2003.
6. R.J. Sime, "*Physical Chemistry: Methods-Techniques-Experiments*", (Saunders Golden Sunburst Series), Saunders College Publishing, 1998.

Experimental of Physical Chemistry-1

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 434 E**	**SEMESTER**	**4th**
COURSE TITLE	EXPERIMENTAL PHYSICAL CHEMISTRY-1		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Seminars		1	**5**
Laboratory Work		3	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development		
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical course ''Physical Chemistry -1''		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case international students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)			

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Define the chemical equilibrium constant of a reaction and derive its relation to temperature and pressure.
2. Answer the following questions:
   a) How fast does a chemical reaction occur?
   b) What factors affect the rate of chemical reactions?
   c) What is the mechanism that follows chemical reactions?
3. Define the factors that influence the rate of enzyme reactions.
4. Define parameters such as activity, activity coefficient, mean activity coefficient of ions in solution and describe the interactions between the different species in electrolyte solutions.
5. a) Describe the electrode-electrolyte interface.
   b) Represent electrochemical cells.
   c) Predict when electrochemical reactions become spontaneous.
   d) Define the electrochemical equilibrium.
   e) Define the dependence of the ionic potential on the activities of the ions.

6. Define the rate of electrochemical reactions and describe its relationship to the potential difference of electrodes.

7. Knowledge and skills that will be acquired fall into the area of Information Technology and the handling of Electronic Computers.

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will further develop the following skills:

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which related to Physical Chemistry and especially of Chemical Equilibrium, Chemical Kinetics and Electrochemistry.

2. Ability to apply this knowledge and understanding to the solution of problems related to Material Science, Environment, Food Science, Biology, Pharmacy and Medicine.

3. Study skills needed for continuing professional development.

4. Ability to interact with others in chemical or of interdisciplinary problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities:

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Group work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

Respect to natural environment

Work design and management

3. COURSE CONTENT

1. Guide to good lab practice and safety rules
2. Introduction to laboratory and instrumental techniques
3. Vapour pressure
4. Equilibrium between a liquid and its vapour pressure
5. Determinationofmolecularweight using the freezing point depression
6. Conductivity and ionic equilibrium
7. Chemical equilibrium and potentiometric methods
8. Thermochemistry
9. REDOX potentials
10. Shear viscosity of liquids
11. Chemical reaction kinetics
12. Inorganic electronic spectroscopy
13. Vibrational spectroscopy (infrared)
14. Specific rotation and polarimetry

4. TEACHING and LEARNING METHODS - ASSESMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Seminars and laboratory work face to face.

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Information and Communication Technologies (ICTs) (e.g. power point) in teaching.</td></tr>
<tr><td>TEACHING ORGANIZATION
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Laboratory work (3 contact hours per week x 13 weeks)</td><td>39</td></tr>
<tr><td>Seminars (1 contact hour per week x 13 weeks) - solving of representative problems</td><td>13</td></tr>
<tr><td>Final examination (3 contact hours)</td><td>3</td></tr>
<tr><td>Hours for private study of the student</td><td>70</td></tr>
<tr><td>Total number of hours for the Course (25 hours of work-load per ECTS credit)</td><td>125 hours (total student workload)</td></tr>
</table>
</td></tr>
<tr><td>STUDENT ASSESSMENT
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>The course is consisted of seminars and laboratory sessions.
1. 15-min written or oral examinations before each experimental session.
2. Written reports after the end of each experiment.

Greek grading scale: 1 to 10. Minimum passing grade for the theoretical session: 5.
All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.</td></tr>
</table>

5. RECOMMENDED LITERATURE

1. G. Karaiskakis, "*Physical Chemistry*", in Greek language only, Travlos Publications, 1998.
2. P. Atkins, J. De Paula, J. Keeler, "*Physical Chemistry*», 11th Edition, Oxford University Press, 2018.
3. D. A. McQuarrie, J.D. Simon, ''*Physical Chemistry. A Molecular Approach*''. University Science Book, 1997.
4. N. Katsanos "*Physical Chemistry: Basic Consideration*", 3rd Edition, in Greek language only, Papazisis Publications, 1999.
5. N. Katsanos, "*Experiments in Physical Chemistry*", Parts I and II, in Greek language only, University of Patras Publications, 2006.
6. G. Karaiskakis, N. Clouras, E. Manesi-Zoupa, "*Experiments in Chemistry*", in Greek language only, Open University Publications, 2003.
7. R. J. Sime, "*Physical Chemistry: Methods-Techniques-Experiments*", (Saunders Golden Sunburst Series), Saunders College Publishing, 1998.
8. D. A. McQuarrie, J.D. Simon, ''*Physical Chemistry. A Molecular Approach*''. University Science Book, 1997.

Synthetic Organic Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 506 Θ**	**SEMESTER**	**5th**
COURSE TITLE	SYNTHETIC ORGANIC CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**5**
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Organic Chemistry / Synthetic Organic Chemistry)
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess adequate level of knowledge provided through the previously taught theoretical courses "Structure and Reactivity in Organic Chemistry", "Organic Chemistry of Functional Groups-I'', "Organic Chemistry of Functional Groups-II'' and "Chemistry of Heterocyclic compounds and Biomolecules"
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Present the most important methods for the preparation/synthesis of mono- and multi-functional (with one or more functional groups) compounds, of open chain or cyclic, which include (a) interconversion of main functional groups, (b) oxidation or reduction and the associated conditions/reagents, (c) introduction and removal of protecting or activating groups, and (d) formation of new C-C and C-heteroatom bonds.
2. Present the principles of antithetic analysis, recognize possible retrons and identify the most appropriate disconnections for use in syntheses of organic compounds of medium complexity.
3. Apply antithetic analysis and suggest syntheses for organic compounds with moderate complexity.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Synthetic Organic Chemistry.
2. Ability to apply this knowledge and understanding to the solution of problems related to Synthetic Organic Chemistry of non-familiar nature.
3. Ability to adopt and apply methodology to the solution of non-familiar problems of Synthetic Organic Chemistry.
4. Ability to prepare and execute multi-step syntheses of organic molecules
5. Study skills needed for continuing professional development.
6. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Group work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

Respect to natural environment

Work design and management

3. COURSE CONTENT

1.Preparation and Interconversion of Functional Groups

Preparations and Reactions of the following main functional groups:

Alkanes, Alkenes, Alkynes, Alcohols, Alkyl halides, Ethers-Epoxides, Aldehydes-Ketones, Carboxylic acids-Anhydrides, Acyl chlorides-Esters-Amides-Nitriles, Amines and Aromatic compounds. Within this context, the concepts of protecting and activating groups and the methodologies for Reduction and Oxidation in Organic Chemistry are also presented.

2. Syntheses of functional groups with C-C bond formation

Nucleophilic carbon compounds, Electrophilic carbon compounds, Syntheses of compounds with one functional group (Alkanes, Alkenes, Alkynes, Alcohols, Aldehydes-Ketones, Carboxylic acids, Nitriles). Syntheses of compounds with two functional groups in positions 1,2-, 1,3-, 1,4-, 1,5- and 1,6-.

3. Methods for the synthesis of cyclic compounds

Types of reactions for ring formation. Factors affecting the easy of ring formation. Methods for macrocyclic compounds formation. Methods for 3-6membered carbocyclic compounds.

4. Cross coupling reactions: Heck, Suzuki, Stille, Hiyama, Negishi, Kumada, Sonagashira, Buchwald and related catalysed reactions by Cu, Pd, Ni, Ru – RC and RO Metathesis reactions. Hydrogenation.

5. Lithium-Halogen exchange, reductive alkylation of amines, use of Weinreb amides.

6. Carbene organocatalysis

7. Retrosynthetic (or Antithetic) Analysis

Introduction (Transforms or retro-reactions, Target-molecule, Synthons, Equivalent reagents or reactants, Retrons, Transform types). Non-obvious disconnections, Umpolung, Disconnections of heteroatomes and

heterocyclic rings. Disconnections of small rings. Strategy in synthesis. Applications of antithetic analysis to the synthesis of natural products.

Asymmetric Synthesis

Chemical and biological methods for asymmetric synthesis. Applications to the synthesis of natural products and drugs.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, Tutorials work face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (3 contact hours per week × 13 weeks)	39
Seminars (1 contact hour per week × 13 weeks) - solving of representative problems	13
Final examination (3 contact hours for Synthetic Organic Chemistry)	3
Hours for private study of the student and preparation of home-works (3 per semester)	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally, preparation of three in total home-works from groups of two students each. 20% of the mean mark of the home-works is added to the grade obtained in the final written examination, provided that the student has secured at least the grade 4. 2. Written examination after the end of the semester - final grade (G_{SOC}), unless the student participated in the preparation of home-works during the semester. In that case, the 20% of the mean mark of the home-works is added to the final examination mark. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

- Suggested textbooks:

1. D. Papaioannou, "*Synthetic Organic chemistry*", in Greek language only, Papazisis Publications, Athens, 2019.
2. J.R. Hanson, "*Organic Synthetic Methods*" Tutorial Chemistry Texts No. 12, Royal Society of Chemistry, 2002.
3. J.-H. Fuhrhop, G. Li, "*Organic Synthesis: Concepts and Methods*", 3rd Edition, Wiley-VCH GmbH, 2003.
4. M.B. Smith, "*Organic Synthesis*", 2nd Edition, McGraw-Hill, New York, 1994.
5. P. Wyatt, S. Warren, "*Organic Synthesis: Strategy and Control*", John Wiley & Sons, 2007.

- Relevant research journals:

1. Synthesis
2. Synlett
3. J. Org. Chem.
4. Org. Lett.
5. Eur. J. Org. Chem.
6. Tetrahedron
7. Tetrahedron Lett.

Experimental Organic Chemistry-2

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 506 E**	**SEMESTER**	**5th**
COURSE TITLE	EXPERIMENTAL ORGANIC CHEMISTRY-2		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Seminars	1	**5**
Laboratory work	4	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Skills Development (Experimental Organic Chemistry-2)
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess: (a) knowledge provided through the previously taught theoretical courses "Organic Chemistry of Functional Groups-I'', "Organic Chemistry of Functional Groups-II'' and "Spectroscopy of Organic Compounds", and (b) laboratory skills obtained through the previously attended laboratory-related course 'Experimental Organic Chemistry-1''.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

Organize and execute syntheses of relatively simple organic molecules. More specifically, to:

1. Collect all the necessary information (properties and hazards of chemical substances; synthesis literature e.t.c.) and then organize an organic synthesis/preparation.

2. Explain the role of the various reagents.
3. Construct various apparatuses required in a synthesis or the purification of a compound and carry out successfully both the synthetic part and the separation and purification of the product(s) part of a synthesis. For this purpose he will have been acquainted with the theory and practice of techniques such as extraction, filtration, refluxing, distillation, recrystallization, sublimation, vacuum distillation, distillation with the aid of water vapor, chromatography etc.
4. Use reagents, solvents and laboratory techniques friendly (benign) to the Environment (Green Chemistry).
5. Use spectroscopic methods (UV-Vis, IR, NMR and MS) for the characterization of the product(s).
6. Edit and present the results of the syntheses he/she carried out, such as yields, mechanisms, improvement of synthetic routes, etc.
7. Analyze and organize complex syntheses in simpler sequential steps.
8. Edit and calculate in multi-step syntheses the yields of each step as well as the total yields, to make useful observations and suggest possible modifications.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to prepare and carry-out the synthesis and characterization of simple organic molecules.
2. Ability to prepare and execute multi-step syntheses of organic molecules
3. Ability to apply this knowledge to the solution of non-familiar problems.
4. Ability to apply this knowledge to the solution of new compounds.
5. Study skills needed for continuing professional development.
6. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and processing of data and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and management

3. COURSE CONTENT

1. Synthesis of diazonium salts.
2. Preparation of aniline through the reduction of nitrobenzene.
3. Diels-Alders reaction using microwaves (Green Chemistry).
4. Barbier reaction (Grignard-type) in aqueous solution (Green Chemistry).
5. Multi-step preparation of benzocain from p-toluidine:
   a) Acetylation of p-toluidine to N-acetyl-p-toluidine.
   b) Oxidation of N-acetyl-p-toluidine to p-acetamidobenzoic acid with $KMnO_4$.
   c) Hydrolysis of the p-acetamidobenzoic acid to p-aminobenzoic acid (PABA) with aqueous HCl.
   d) Preparation of benzocaine (Fischer esterification of PABA with EtOH).

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD
Face-to-face, Distance learning, etc.

Tutorials and laboratory work face-to-face.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students

Use of ITCs (PowerPoint) in the seminars providing information on the theory and practice of the laboratory experiments and the methodology for multi-step syntheses.

Use of Artificial Intelligence (AI) in teaching.

TEACHING ORGANIZATION

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Activity	*Semester workload*
Tutorials (1 contact hours per week × 13 weeks)	13
Laboratory work (4 conduct hours per week x 13 weeks)	52
Preparation for the Laboratory (study of techniques and theory)	60
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT

Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

1. Written tests of 15 minutes duration at the beginning of each new laboratory period (experiment). The mean mark from these tests consists the 40% of the final grade
2. Rating the yields of the various syntheses and general performance of each student. The mean value of these results will represent the 50% of the final grade.
3. Reports of each laboratory experiment. The mean mark of the consists the other 10% of the final grade

Greek grading scale: 1 to 10. Minimum passing grade: 5.

All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

-Suggested bibliography:

1. D. L. Pavia, G. M. Lampman, G. S. Kriz, R. G. Engel, "A Microscale Approach to Organic Laboratory Techniques", Cengage Learning, 2018.
2. Argyropoulos N., Kotouli-Argyropoulou E., Litinas K., Malamidou-Xenikaki E., Maroulis A., Spyroudis S., Tsoleridis K., Chatziantoniou-Marouli K., "*Experimental Organic Chemistry: Special Part B*", Gartaganis Publications, 2010 (in greek language).
3. Vogel, A. I., Tatchell, A. R., Furniss, B. S., Hannaford, A. J., & Smith, P. W. G.,, "*Vogel's, Textbook of Practical Organic Chemistry*", 5th Edition, Pearson Education, 1996.

- Related academic sources and journals:

All scientific articles used in teaching and in laboratory work are available.

Experimental Physical Chemistry-2

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 538 E**	**SEMESTER**	**5th**
COURSE TITLE	EXPERIMENTAL PHYSICAL CHEMISTRY-2		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Seminars	1	**5**
Laboratory Work	3	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical courses ''Physical Chemistry 1'', ''Physical Chemistry 2'', and ''Physical Chemistry-3''
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case international students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Ability to observe safety rules in a chemical laboratory.
2. Ability to carry out complex scientific experiments with a view to identifying physicochemical sizes
3. Ability to collaborate effectively with others in the joint execution of experimental work.

4. Ability to record all data and observations from the experiment, to perform the mathematical calculations required to determine the sizes and corresponding errors of various physical quantities. Also, ability in drawing conclusions by commenting on the results on the basis of bibliographical data.
5. Knowledge and skills that will be acquired fall into the area of Information Technology and the handling of Electronic Computers

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will further develop the following skills:
1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which related to Physical Chemistry and especially of Chemical Equilibrium, Chemical Kinetics and Electrochemistry.
2. Ability to apply this knowledge and understanding to the solution of problems related to Material Science, Environment, Food Science, Biology, Pharmacy and Medicine.
3. Study skills needed for continuing professional development.
4. Ability to interact with others in chemical or of interdisciplinary problems.
Generally, by the end of this course the student will, furthermore, have develop the following general abilities:
Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and management

3. COURSE CONTENT

Guide to good lab practice and safety rules.
Introduction to laboratory and instrumental techniques.
Adiabatic decompression of gases (Determination of theC_V and C_P thermal capacities in the gas phase).
Distillation (Determination of molecular weight of substance insoluble in water).
Surface tension of liquids (Determination of surface tension in liquid solutions and the relevant cross section between the components of the solution).
Adsorption from solution (Study of adsorption of molecules from solution onto a solid surface, determination of the fraction of the solid surface covered by absorbed molecules).
Determination of the molecular weight of a polymer by measuring its viscosity in solutions.
Measurement of the permanent electric dipole moment of molecules in solution.
Colloids.
Conductivity (Determination of the acidity constant of a weak acid / base).
Electrochemistry and the determination of activity coefficients.
Measurement of theTafel equation
Galvanic cells
Vibrational spectroscopy (Raman)

4.TEACHING and LEARNING METHODS - ASSESMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Information and Communication Technologies (ICTs) (e.g. power point) in teaching.

Use of ICT in teaching, laboratory education, communication with students	

TEACHING ORGANIZATION

The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Activity	*Semester workload*
Laboratory work (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems	13
Final examination (3 contact hours)	3
Hours for private study of the student	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 hours (total student workload)***

STUDENT ASSESMENT

Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

The course is consisted of seminars and laboratory sessions.

1. 15-min written or oral examinations before each experimental session.
2. Written reports after the end of each experiment.

Greek grading scale: 1 to 10. Minimum passing grade for the theoretical session: 5

All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

- Suggested bibliography:

1. G. Karaiskakis, "*Physical Chemistry*", in Greek language only, Travlos Publications, 1998.
2. P. Atkins, J. De Paula, J. Keeler, "*Physical Chemistry*», 11th Edition, Oxford University Press, 2018.
3. D. A. McQuarrie, J.D. Simon, ''*Physical Chemistry. A Molecular Approach*''. University Science Book, 1997.
4. N. Katsanos "*Physical Chemistry: Basic Consideration*", 3rd Edition, in Greek language only, Papazisis Publications, 1999.
5. N. Katsanos, "Experiments in Physical Chemistry", Parts I and II, in Greek language only, University of Patras Publications, 2006.
6. G. Karaiskakis, N. Clouras, E. Manesi-Zoupa, "Experiments in Chemistry", in Greek language only, Open University Publications, 2003.
7. R. J. Sime, "Physical Chemistry: Methods-Techniques-Experiments", (Saunders Golden Sunburst Series), Saunders College Publishing, 1998.
8. D. A. McQuarrie, J.D. Simon, ''Physical Chemistry. A Molecular Approach''. University Science Book, 1997.

Biochemistry-1

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 512**	**SEMESTER**	**5th**
COURSE TITLE	BIOCHEMISTRY-1		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**5**
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Biochemistry)
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical courses of "Organic Chemistry" and "General Biology".
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2082/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Know in general about the chemical composition, structure and function of basic biomolecules (carbohydrates, proteins, lipids, nucleic acids).
2. Know the classification of proteins, and the levels of structure, the function and the structure-function relationship of the main members in each class.
3. Know the classification of enzymes, the determination of their kinetic constants, the general mechanisms of enzymatic reactions, and the modes of enzyme activity regulation, the types of enzyme inhibitors, the mechanism of action and their kinetics.
4. Present the major metabolic processes of carbohydrate metabolism such as glycolysis, glyconeogenesis and glycogen metabolism and their regulation.
5. Describe in general the pathways of oxidative release of energy from fuel molecules and its storage into reduced coenzymes, and the role of citric acid cycle (Krebs cycle) and glyoxylate cycle in this process.
6. Describe the pathway of energy release from reduced coenzymes through respiratory chain and storage of energy into ATP through oxidative phosphorylation.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to chemical composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids), energy release from fuel molecules, and carbohydrate metabolism.
2. Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems of an unfamiliar nature.
3. Ability to adopt and apply methodology to the solution of unfamiliar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others (teamwork learning) on chemistry-related or multidisciplinary problems (problem solving).
6. Familiarity with the use of ICT (PowerPoint), use of scientific databases, artificial intelligence (AI), and Whiteboard in Teaching.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3. COURSE CONTENT

1. Protein structure and function. Amino acids and their acid-base properties. Primary, secondary, tertiary and quaternary structure of proteins. Physicochemical properties of proteins, methods of protein isolation, purification, separation and detection. Determination of protein primary structure. Searching 3D structures from scientific databases, and AI applications in predicting the structure and kinetics of enzyme reactions.
2. Protein classification.
   a) Structural proteins (collagens, elastin, keratins).
   b) Functional proteins.
      b1) Catalytic proteins (enzymes). Enzyme classification, kinetics of enzymatic reactions, mechanisms of enzymatic reactions, regulation of enzyme activity.
      b2) Transfer proteins. Hemoglobin, myoglobin, structure and function, cooperative effect.
      b3) Defensive proteins (antibodies). Structure and function, use of antibodies in the analysis.
      b4) Contractible proteins. Myosin, actin, structure and function.
3. Nucleic acids. Chemical composition and structure. The genetic information flow.
4. Lipids and cell membranes. Types of membrane lipids (phospholipids, glycolipids, cholesterol). Structure of cell membranes. The fluid mosaic model.
5. Carbohydrates. Chemical composition and structure. Oligosaccharides, polysaccharides, glycosaminoglycans. Glycoproteins, proteoglycans.

6. Metabolism, basic concepts and design. ATP as the universal currency of free energy in biological systems.
7. Signal transduction. Basic concepts.
8. Carbohydrate metabolism. Glycolysis and glyconeogenesis. Glycogen metabolism.
9. Oxidative release of energy from fuel molecules and its storage into reduced coenzymes. The central role of acetyl-coenzyme A. Citric acid cycle (Krebs cycle) and glyoxylate cycle.
10. Energy release from reduced coenzymes (respiratory chain) and storage of energy into ATP (oxidative phosphorylation).

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHODS *Face-to-face, Distance learning, etc.*	Lectures, and tutorials face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. powerpoint) in teaching. Self-assessment with multiple choice questions, tutorials in groups of 25 students with exemplary problem solving.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally, two mid-term examinations with the final examination grade to be the mean mark. It is mandatory to obtain pass grade (≥5) in each examination. 2. Written exam, final grade, unless the student participated in the mid-term examinations during the semester, in which case the above applies. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	***Semester workload***
Lectures (3 contact hours per week × 13 weeks)	39
Tutorials (1 contact hour per week × 9 weeks) - solving of representative problems	9
Mid-term examinations (2 mid-term examinations × 2 contact hours each)	4
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for mid-term or/and final examination	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

5. RECOMMENDED LITERATURE

1. Nelson David L., Cox Michael M., "*Lehninger Principles of Biochemistry*", 3rd Greek Edition, Broken Hill Publishers Ltd, 2024.
2. Tymoczko John, Berg Jeremy, Stryer Lubert, "*Biochemistry*", Greek Edition, Broken Hill Publishers Ltd, 2018.
3. McEvoy M., Miesfeld R., "*Biochemistry*", 1st Greek Edition, Eds: Gazouli M., Theoxaris A.., Papazisis Publications, 2024.
4. C.A. Demopoulos, S. Antonopoulou, "Basic Biochemistry, 3rd Edition, NEON Publications, 2020 (in greek language).
5. J.G. Georgatsos, "*Introduction to Biochemistry*", 7th Edition, Giahoudis Publications, 2005 (in greek language).

Inorganic Chemistry-3 (Chemistry of 2nd and 3rd Row Metals and of Lanthanides)

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 527**	**SEMESTER**	**5th**
COURSE TITLE	INORGANIC CHEMISTRY-3 (CHEMISTRY OF 2ND and 3RD ROW METALS AND OF LANTHANIDES)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**5**
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Advanced Inorganic Chemistry)
PREREQUISITE COURSES:	Typically, there are no prerequisite courses. It is recommended that the students should have passed the previous courses "Introduction to Inorganic Chemistry", "Inorganic Chemistry-1" and "Inorganic Chemistry-2"
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/modules/document/?course=CHEM2063

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Know the spectrochemical series of ligands and use it to predict the magnetic properties and to interpret electronic spectra of transition metal complexes.
2. Describe the main classes of, discuss the reactivity of and explain the bonding in metallocarbonyls.
3. Differentiate and analyse the various types of distortion from perfect stereochemistry in metal complexes.
4. Discuss the factors that affect the thermodynamic stability of metal complexes.
5. Describe and classify the main mechanisms of inorganic reactions.
6. Know the basic features of the chemistry of 2nd and 3rd-row transition metals, and lanthanides.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement

and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

At the end of the course the student will have further developed the following skills/competences:

1. Ability to demonstrate knowledge and understanding of concepts and principles related to magnetochemistry, electronic structures, stability, molecular structures and reaction mechanisms of transition metal complexes.
2. Ability to demonstrate knowledge and understanding of concepts and principles related to the chemistry of 2nd- and 3rd-row transition elements, and lanthanides.
3. Ability to apply such knowledge and in-depth understanding to solve qualitative problems of an unfamiliar nature.
4. Ability to interact with others on interdisciplinary problems.

3. COURSE CONTENT

1. *Inorganic Chemistry through the centuries*

   Historical background and current trends of Inorganic Chemistry.
2. *Basic magnetochemistry*
   a) Diamagnetism and paramagnetism of metal complexes, and relation to their electronic structures.
   b) Low- and high-spin metal complexes. Spin-crossover complexes.
   c) The effective magnetic moment as a structural tool in transition metal chemistry.
3. *Electronic spectra of complexes of first-row transition metal ions*
   a) Spectroscopic terms in octahedral crystal fields. Orgel and Tanabe-Sugano diagrams. Selection rules.
   b) Interpretation of electronic spectra of octahedral and tetrahedral complexes of the $3d^n$ (n = 2, 3, 7, 8) ions.
4. *Metallocarbonyls*
   a) The 18-electron rule in Organometallic Chemistry.
   b) Preparative, reactivity and structural chemistry of metallocarbonyls.
   c) Chemical bonding in metallocarbonyls.
   d) Metal carbonyls in Catalysis.
   e) The isolobal approach in Inorganic Chemistry.
5. *Distorted stereochemistries in metal complexes*
   a) Stereochemicalaspects.
   b) Electronic effects. Jahn-Teller distortions.
6. *Thermodynamic stability of metal complexes*
   a) The Irving-Williams trend.
   b) Chelate effect.
   c) Hard and soft acids and bases model.
7. *Mechanisms of inorganic reactions*
   a) The trans effect.
   b) Substitution reactions in octahedral metal complexes.
   c) Mechanisms of redox reactions in metal complexes. Outer- and inner-sphere mechanisms.
8. *d-Block metal chemistry: the second and third row metals*
   a) Introduction.

b) Occurrence, extractions and uses.
c) Physical properties.
d) Periodicity.
e) Aqueous solution species.
f) Coordination complexes.
g) Dinuclear complexes with metal-metal bonds.
h) Polyoxometallates of molybdenum and tungsten.

9. *f-Block metal chemistry: the lanthanides*
   a) Introduction.
   b) 4f-orbitals and oxidation states.
   c) Atom and ion sizes.
   d) Occurrence and separation of the lanthanides.
   e) Inorganic compounds and coordination complexes of the lanthanides.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures and seminars face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. powerpoint) in teaching.
TEACHING ORRGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (3 contact hours per week × 13 weeks)	39
Seminars (1 contact hour per week × 13 weeks)-solving of representative problems	13
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of home-works	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final writing examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. J.E. Huheey, "Inorganic Chemistry: Prinsiples of Structures and Reactivity", 3rd Edition, Translation: N. Hadjiliadis, Th. Kabanos, S. Perlepes, Publication ION, St. Parikou O.E., 1993.
2. D. Kessissoglou, P. Akrivos, "Biocoordination Chemistry", Volume I: Theory, Ziti Publishing Company, 2006.

3. C.E. Housecroft, A.G. Sharpe, "Inorganic Chemistry", 3rd Edition, Pearson Prentice Hall, 2008.
4. C.E. Housecroft, "The Heavier d-Block Metals: Aspects of Inorganic and Coordination Chemistry", Oxford Chemistry Primers, Oxford University Press, 1999.

Principles of Chemical Technology

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 581**	**SEMESTER**	**5th**
COURSE TITLE	PRINCIPLES OF CHEMICAL TECHNOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	5

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Chemical Technology)
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical courses of "Physical Chemistry".
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, teaching can also be done in English if foreign students follow the program.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	upatras eclass | ΑΡΧΕΣ ΧΗΜΙΚΗΣ ΤΕΧΝΟΛΟΓΙΑΣ

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course, the student will be able to:

1. Know the various unit systems and manage the interconversions of units that are useful in chemical technology.
2. Understand the concepts of dimensional analysis
3. Know and apply the mass and energy balance in various cases of technological importance.
4. Know and understand the basic phenomena and laws governing the flow of fluids.
5. Be familiar with the basic instrumentations used to measure fluid flow and understand their operating principle.
6. Recognize the basic methods used in the transport of fluids.
7. To know and understand the basic phenomena and laws governing heat transfer and their application to heat exchangers.
8. Apply the principles of chemical technology to solving problems related to fluid flow and transport, as

well as heat transfer.

9. Apply the principles of chemical technology to the solution of problems related to distillation applications.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

At the end of this course the student will further develop the following skills:

1. Ability to demonstrate knowledge and understanding of the essential data, concepts, principles and theories related to chemical technology.
2. Ability to apply this knowledge and understanding to the solution of qualitative and quantitative problems of non-familiar nature.
3. Ability to adopt and apply the relevant methodology to resolve non-familiar problems and decision-making.
4. Study skills needed for continuous professional development.
5 Ability to interact with others in chemical or interdisciplinary problems.

Generally, upon completion of this course, the student will further develop the following general competencies (from the above list):

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Criticism and self-criticism
Production of free, creative and inductive thinking

3. COURSE CONTENT

Definitions and basic principles

Fundamental Definitions.

Units and dimensions.

Unit systems.

Dimensional analysis.

Mass and energy balance

Mass balance.

Energy Balance.

Fluids mechanics

Statics of fluids and their applications.

Basic phenomena of fluid flow.

Basic Fluid Flow Equations.

Uncompressed flow in pipes and fittings.

Flow around submerged bodies.

Fluid Flow Measurement.

Fluid Transfer.

Pumps.

Heat Transfer-applications

Heat Transfer Principles

Heat Exchangers.

Separation processes

Distillation processes.

Flash distillation.

Continuous distillation with reflux.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures and seminars face to face (possibility of e-learning in case face-to-face education is not allowed).
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (powerpoint presentations) in Lectures. Course lectures and exemplary solved problems for every chapter, in the form of ppt files, are uploaded in the internet in a platform where students have access through their personal passwords. Communication with the students is established through e-mail.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	*Activity* / *Semester workload* Lectures (2 hours of contact weekly × 13 weeks) — 26 Tutorial (1 hour contact weekly × 13 weeks) to solve representative problems — 13 Final examination (3 hours of contact) — 3 Study hours of the student and preparation for progress and/or final examination — 83 ***Total number of hours for the Course (25 hours of work-load per ECTS credit)*** — ***125 (total student workload)***
STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Written examination with development and problem solving questions. Possibility of distance examination in prohibitive conditions of face-to-face education with (a) a combination of multiple choice questions, development questions and/or problem-solving questions and/or (b) oral examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in the English language.

5. RECOMMENDED LITERATURE

1. W.L. McCabe, J.C. Smith, P. Harriot, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 2016.
2. Zampoulis, Zoumpoulis, Karapantsios, Matis, Mavros, "Chemical Technology", Tziolas Publications, 2012.

Biochemistry-2

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ΧΟ 612 Θ**	**SEMESTER**	**6th**
COURSE TITLE	BIOCHEMISTRY-2		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**5**
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Biochemistry)
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry and good knowledge of Biochemistry-1, particularly of the chapters referring to respiratory chain and oxidative phosphorylation, glycolysis, gluconeogenesis and citric acid cycle (Krebs cycle).
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The course can be, however, taught in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2197/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student should be able to:

1. Present the pathway of light energy (solar energy) conversion into chemical energy in the form of various biomolecules.
2. Describe the main biosynthetic pathways of fatty acids and other lipids, amino acids and proteins, nucleotides and nucleic acids from glucose.
3. Describe the main degradation pathways of biomolecules (carbohydrates, lipids, proteins and nucleic acids) to meet the energy needs of a cell or organism.
4. Know the points where the anabolic and catabolic pathways meet, and how the degradation products of some biomolecules can be used for the synthesis of some others.
5. Know the main steps of the genetic information flow (DNA replication, transcription-RNA biosynthesis, translation-protein biosynthesis).
6. Apply various spectrophotometric methods for the determination of several biomolecules.
7. Isolate and study simple proteins abundant in various natural products.

8. Carry out the kinetic study of an enzyme

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course the student will, furthermore, have develop the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and application which are related to Biochemistry, in particular to metabolism of biomolecules (carbohydrates, lipids, proteins and nucleic acids).
2. Ability to apply this knowledge and understanding to the solution of problems related to Biochemistry of non familiar nature.
3. Ability to adopt and apply methodologies to the solution of non familiar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in biochemical or of interdisciplinary nature problems, and development of information search skills from scientific databases and AI applications in the investigation of molecular targets in drug development.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):
Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Excercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3. COURSE CONTENT

Theory

1. Photosynthesis. The light reactions of photosynthesis. Photosystems I and II.
2. The dark reactions-The Calvin cycle. Pentose phosphate pathway. C3 and C4 plants.
3. Fatty acids metabolism.
4. The biosynthesis of saturated fatty acids with an even or odd number of carbon atoms. The eukaryotic and prokaryotic fatty acid synthase. Unsaturation of fatty acids, introduction of double bonds. Fatty acids degradation. B-oxidation of saturated and unsaturated fatty acids with an even or odd number of carbon atoms. A-oxidation of fatty acids with brands.
5. The degradation of dietary proteins.
6. The degradation of intracellular proteins, the ubiquitin-proteasome system. Aminotransferases, their function mechanism. Degradation of glucogenic and ketogenic amino acids. The urea cycle.
7. Nitrogenase, nitrogen fixation, synthesis of ammonia. Essential and non-essential amino acids. Biosynthesis of non-essential amino acids.
8. Nucleotides and deoxynucleotides metabolism. Salvage reactions.
9. The biosynthesis of triacyloglycerols, phospholipids, sphingolipids and cholesterol. The lipoproteins. The LDL receptors. The biosynthesis of steroid hormones.
10. Drug design and development. Structure-activity relationship search from scientific databases, and AI applications in the prediction of molecular drug target development.

4.TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures and tutorials face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (powerpoint) in Lectures. Course lectures and exemplary solved problems for every chapter, in the form of ppt files, are uploaded in the eclass platform (https://eclass.upatras.gr/courses/CHEM2197/), from where they can be freely downloaded using a password which is provided to the students at the beginning of the course. Problem-solving tutorials for the instructive solution of problems. Communication with the students is established either through mail or through eclass platform
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	39
Seminars (1 contact hours per week × 13 weeks) - solving of representative problems	13
1st progress examination	2
2nd progress examination	2
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for examinations	66
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 (total student workload)***

STUDENT ASSESSMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	a) Two (2) mid-term written examinations (optionally, the first one in week 7 of the semester and the second immediately after the end of the semester). The successful final mark (PASS) is the mean mark obtained from the 2 mid-term examinations (provided they are ≥ 5 each). b) Written examination after the end of the semester-final mark, unless the student participated and passed mid-term examinations. Minimum passing grade: 5. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English. Grades ≤3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following correspondence normally holds: 5 ↔ E, 6 ↔ D, 7 ↔ C, 8 ↔ B and ≥9 ↔ A

5. RECOMMENDED LITERATURE

1. Nelson David L., Cox Michael M., "*Lehninger Principles of Biochemistry*", 3rd Greek Edition, Broken Hill Publishers Ltd, 2024.
2. Tymoczko John, Berg Jeremy, Stryer Lubert, "*Biochemistry*", Greek Edition, Broken Hill Publishers Ltd, 2018.
3. McEvoy M., Miesfeld R., "*Biochemistry*", 1st Greek Edition, Eds: Gazouli M., Theoxaris A.., Papazisis Publications, 2024.
4. C.A. Demopoulos, S. Antonopoulou, "Basic Biochemistry, 3rd Edition, NEON Publications, 2020 (in greek language).
5. J.G. Georgatsos, "*Introduction to Biochemistry*", 7th Edition, Giahoudis Publications, 2005 (in greek language).

Experimental Biochemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 612 E**	**SEMESTER**	**6th**
COURSE TITLE	EXPERIMENTAL BIOCHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Seminars	1	**5**
Laboratory work	4	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Biochemistry)
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry and good knowledge of Biochemistry-1, particularly of the chapters referring to respiratory chain and oxidative phosphorylation, glycolysis, gluconeogenesis and citric acid cycle (Krebs cycle).
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The course can be, however, taught in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2198/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student should be able to:

1. Apply various spectrophotometric methods for the determination of several biomolecules.
2. Isolate and study simple proteins abundant in various natural products.
3. Carry out the kinetic study of an enzyme.
4. Knowledge and skills that will be acquired fall into the area of Information Technology, the handling of Electronic Computers and Artificial Intelligence (AI) applications.

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have develop the following skills (general abilities):
1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and application which are related to Biochemistry, in particular to metabolism of biomolecules (carbohydrates, lipids, proteins and nucleic acids).

2. Ability to apply this knowledge and understanding to the solution of problems related to Biochemistry of non familiar nature.
3. Ability to adopt and apply methodologies to the solution of non familiar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in biochemical or of interdisciplinary nature problems.
Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):
Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Excercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3. COURSE CONTENT

Laboratory Exercises

1. Spectophotometric methods for protein determination
   a) Biuret method
   b) Lowry method
   c) Bradford method
2. Preparation of buffer solutions. Determination of their capacity.
3. Titration of glycine. Determination of its isoelectric point.
4. Protein isolation
   a) Isolation of ovalbumin from eggs
   b) Isolation of casein from milk
5. Physicochemicals properties of proteins.
   Effect of pH, ionic strength and temperature on protein solubility. Determination of casein isoelectric point.
6. Immunochemical methods for protein detection. Westrern and/or dot blot analysis.
7. Enzyme kinetics. Determination of acid phosphatase Km and Vmax values.
8. Protein denaturation Effect of high temperature and high urea concentration on enzyme activity. Reverse and non-reverse denaturation.
9. Oxidoreductases. Study of succinate dehydrogenase and glutamate dehydrogenase in liver extract.
10. RNA isolation, cDNA synthesis and DNA amplification by real time RT-PCR

4.TEACHING and LEARNING METHODS - ASSESMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Tutorials face-to-face and laboratory practice
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Tutorials. Tutorials and exemplary solved problems for every exercise, in the form of ppt files, are uploaded in the internet (https://eclass.upatras.gr/courses/CHEM2198/), from where they can be freely downloaded using a password which is provided to the students at the beginning of the course. Problem-solving seminars are also provided. Communication with the students is established either through mail or through the eclass platform.
TEACHING ORGANIZATIONS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Laboratory work (4 conduct hours per week x 13 weeks)	52
Seminars (1 conduct hour per week x 13 weeks) - solving of representative problems	13
Hours for private study of the student and preparation for examinations of each exercise and final examination	60
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 hours (total student workload)***

STUDENT ASSESMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Multiple choice test on the theory of each laboratory exercise, during the semester, or written examination at the end of semester on the theory of laboratory exercises, if the student has not obtained a mean mark ≥ 6 in the multiple choice tests. Minimum passing grade of written examination: 5. The final mark in laboratory courses results from the mean mark of multiple choice tests or written examination (impact 60%), and the mean mark of laboratory exercises reports (impact 40%). All the above take place in Greek language and for the foreign students (for example, ERASMUS students) in English language. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following correspondence normally holds: 5 ↔ E, 6 ↔ D, 7 ↔ C, 8 ↔ B and ≥9 ↔ A

5. RECOMMENDED LITERATURE

1. A. Aletras, D. Vynios, S. Skandalis, "*Experimental Biochemistry-Notes*", University of Patras Publications, 2025. (in greek language)
2. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto, Jr., Lubert Stryer, "*Biochemistry*", Translation of 9th American Edition, Crete University Press, 2021.
3. G.M. Cooper, "*The Cell: A Molecular Approach*", 8th Greek Edition, Academicals Publications, 2021.
4 McEvoy M., Miesfeld R., "*Biochemistry*", 1st Greek Edition, Eds: Gazouli M., Theoxaris A.., Papazisis Publications, 2024.
5. Nelson David L., Cox Michael M., "*Lehninger Principles of Biochemistry*", 3rd Greek Edition, Broken Hill Publishers Ltd, 2024.
6. C.A. Demopoulos, S. Antonopoulou, "Basic Biochemistry, 3rd Edition, NEON Publications, 2020 (in greek language).
7. Rich A. Harvey, Denise R. Ferrier, "*Lippincott's Illustrated Reviews Biochemistry*", 6th Greek Edition, Parisianos Publications 2015.
8. J.G. Georgatsos, "*Introduction to Biochemistry*", 7th Edition, Giahoudis Publications, 2005 (in greek language).
9. C. P Tsiganos, N. Papageorgakopoulou, S. Anagnostidis, A. J. Aletras, "*Laboratory Practice in Biochemistry*", University of Patras Publications, 2008.

Laboratory Training in Chemical Technology

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 681 E**	**SEMESTER**	**6th**
COURSE TITLE	LABORATORY TRAINING IN CHEMICAL TECHNOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Seminars	1	**5**
Laboratory work	4	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development (Chemical technology)
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical courses of "Physical Chemistry".
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, teaching can also be done in English if foreign students follow the program.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student will be able to organize and carry out experimental studies on chemical technology. Specifically, he/she will be able to:

1. Collect all necessary information (design and characteristics of study devices, bibliographic data, properties and hazards of substances, etc.) and then prepares the experimental study on chemical technology, fluid flow, heat transfer, heat exchange, distillation, liquefaction, filtration, etc.
2. Takes measurements, which will allow him/her to experimentally understand the relevant phenomenon/process
3. Properly process the experimental results.
4. Compile complete and correct reports with critical consideration of the experimental results/conclusions, in combination with the studied phenomenon/process.
5. Knowledge and skills that will be acquired fall into the area of Information Technology and the handling of Electronic Computers.

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

At the end of this course the student will have further developed the following skills (general skills):

1. Ability to demonstrate knowledge and understanding of essential data, concepts, theories and applications related to Chemical Technology.
2. Ability to apply this knowledge and understanding to the analysis of data of an unfamiliar nature related to Chemical Technology.
3. Ability to adopt and apply methodology in solving non-familiar problems.
4. Ability to design and carry out experimental studies related to Chemical Technology.
5. Skills of correct application of experimental data acquisition in chemical technology applications.
6. Study skills needed for continuing professional development.
7. Ability to interact with others in problems of a chemical or interdisciplinary nature.

Generally, upon completion of this course, the student will further develop the following general competencies (from the above list):

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Adapting to new situations

Decision-making

Working independently

Team work

Criticism and self-criticism

Production of free, creative and inductive thinking

Respect for the natural environment

Project planning and management

3. COURSE CONTENT

1. Introductory concepts - Basic rules of Health and Safety in a field of Chemical Technology applications.
2. Fluidization - Measurement of Specific Surface Area of Granular Material
3. Heat Transfer
4. Fluid Flow Study
5. Flow Circuit Study
6. Study of Tubular Condenser/Exchanger
7. Study of the Operation of a Distillation Column
8. Flash Point of a Liquid Lubricant - Determination of Viscosity of a Liquid with the Falling Ball Viscometer - Redwood Viscosity
9. Study of the Filtration of a Solid Suspension
10. Study of Fabric Dyeing

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Face to face seminars and laboratory work (possibility of e-learning in case face-to-face education is not allowed).
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (powerpoint presentations) in Lectures. Seminar lectures and exemplary solved problems for every laboratory, in the form of ppt files, as well as additional video material, are uploaded in the internet in a platform where students have access through their personal passwords. Communication with the students is established through e-mail.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	*Semester workload*
Tutorial (1 hour contact weekly × 9 weeks) to solve representative problems	13
Laboratory work (4 hours of contact weekly × 10 weeks)	40
Final examination (3 hours of contact)	3
Study hours of the student for the preparation for the laboratory training and processing of	69

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	experimental data for the preparation of laboratory reports (equal number of laboratory exercises), preparation for the final exam.	
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 hours (total student workload)***
STUDENT ASSESMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Oral examination during laboratory training and correction of the report for each laboratory exercise (70% of the final grade, provided that the student has successfully completed the laboratory training cycle). 2. Written examination (30% of the final grade). Possibility of distance examination in prohibitive conditions of face-to-face education with (a) a combination of multiple-choice questions, development questions and/or problem-solving questions and/or (b) oral examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in the English language.	

5. RECOMMENDED LITERATURE

1. G. Gallios, Ch. Gotsis, D. Zampoulis, A. Zoumpoulis, M. Kostoglou, M. Lazaridis, K. Matis, P. Mavros, P. Spathis, G.K. Triantafyllidis "Laboratory Exercises of Chemical Technology", Tziolas Publications, 2009.
2. I. Kallitsis, G. Bokias, C. Deimede, L. Drakopoulou, "Principles of Chemical Tecnhlogy: Laboratory Exercises", University of Patras, 2021.
3. W.L. McCabe, J.C. Smith, P. Harriot, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 2016.
4. D. Zampoulis, A. Zoumpoulis, Th. Karapantsios, K. Matis, G.K. Triantafyllidis, "Chemical Technology", Tziolas Publications, 2012.

Food Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 682**	**SEMESTER**	**6th**
COURSE TITLE	FOOD CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	**5**
Seminars	1	
Laboratory work	2	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills development.
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. The students should have at least knowledge of the basic concepts of Chemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.chem.upatras.gr

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Acquire knowledge on the chemistry and the role of the main components of raw materials & food products (water, carbohydrates, proteins, enzymes, fats, vitamins, minerals, chemical additives).
2. Acquire knowledge on the nutritional value of food, especially standardized industrial foods (composition, health benefits, health risks, probability of contamination with toxic ingredients, quality assurance).
3. Acquire knowledge on new trends in food research and production (changes during production, processing & preservation, development and use of modern methods of analysis, investigation of nutritional value, functional foods, genetically modified food, etc.).
4. Describe all the safety rules to be applied in a chemical laboratory and recognize what one must not do.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
	Respect for difference and multiculturalism

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking*

By the end of this course the student will have developed the following skills/competences:

1. Ability to exploit knowledge for further academic / research / professional development in subjects of food chemistry and technology.
2. Ability to recognize the role and nutritional value of food ingredients in order to adapt their own daily diet to the benefit of their health and to deal with problems (diet, diabetes, anaemia, etc.) and to inform other people respectively.
3. Capability of assessing the nutritional value or the health risk of standardized industrial foods.
4. Ability to exploit knowledge for advisory roles in food production, processing and analysis companies, and also seek employment in these sectors.

Generally, by the end of this course the student will have further developed the following general abilities (from the list above):

- *Searching, analysis and synthesis of facts and information, as well as using the necessary technologies*
- *Adaptation to new situations*
- *Decision making*
- *Autonomous (independent) work*
- *Group work*
- *Work in interdisciplinary environment*
- *Exercise of criticism and self-criticism*
- *Promotion of free, creative and inductive thinking*

3. COURSE CONTENT

1. Water: Free and bound in food. Water activity (aw). Significance in human nutrition.
2. Chemistry of carbohydrates: Categories (monosaccharides, disaccharides, homo/hetero polysaccharides, glycosides, hydrocolloids, gums, pectin substances). Chemical structures and projections. Physical & chemical properties and their importance in food technology (hygroscopicity, crystallinity, solubility, reduction, oxidation, effect of alkali and acids, browning reactions, gelling capacity, bulking capacity, starch gelatinization and retrogradation, enzymatic hydrolysis).
3. Carbohydrate-rich foods: Cereals & their products. Bakery products (rising, microbiology, protein-starch functional properties, chemical additives, physicochemical & microbial spoilage).
4. Fruit and vegetables: Chemical composition. Ripening. Preservation.
5. Protein and amino acid chemistry: Structure. Properties. Role of protein in food. Importance of proteins in human nutrition. Effects of various treatments on the structural and nutritional properties of proteins. Protein-rich foods.
6. Chemistry of meat and meat products.
7. Chemistry of milk and dairy products.
8. Chemistry of edible fats and oils.
9. Chemical additives in industrial foods. Legislation-Codex Alimentarious. Categories of chemical additives. Chemical reactions. Functionality. Uses. Toxicity / safety.
10. Natural & artificial dyes in food.
11. Flavour components in food. The gustatory perception system. Volatile compounds in food. Condiments. Essential oils.
12. Vitamins in food. Changes during food processing. Significance for human health.
13. Inorganic ingredients in food. Significance for human health.
14. Food enzymes. Enzymes in baking, dairy and meat products, fruit and vegetables, alcoholic beverages. Production and purification of food enzymes. Enzymatic action. Properties of enzymes used in food.

15. Toxic substances in food. Heavy metals. Pesticides. Mycotoxins. Residues of packaging materials. Nitrates. Other contaminants.

4.TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures using Information and Communication Technologies (ICTs) (e.g. PowerPoint), seminars and laboratory exercises.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of .ppt files, where from the students can freely download them using a password, which is provided to them at the beginning of the course.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26
Seminars (1 contact hour per week × 13 weeks) - solving of representative problems	13
Laboratory exercises (2 contact hours per week × 12 weeks)	12
Final written examination (3 contact hours)	3
Private study time of the student and preparation for the half-term evaluations and final examination	71
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. The oral examination at the laboratory and the report to be delivered by the student for each laboratory exercise yield a grade that accounts for 20% on the final grade, provided that the student has attained the minimum grade of 5. 2. Optionally, preparation of a total of two courseworks on Food Chemistry topics by groups of 3 students (10% of the average grade is added to the final grade only when both students have obtained the minimum grade 5 and the final exam grade is at least 4). This measure will only apply when the number of students enrolled is considerably reduced, as well as for ERASMUS students. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

- Suggested bibliography:

1. D. Boskos, "Food Chemistry", New Edition, Gartagani Publisers, 2004. *(in Greek language only)*
2. H.-D. Belitz, W. Grosch, P. Schieberle, "Food Chemistry" 4th Edition, 2009. Springer, 2009.
3. N. K. Andrikopoulos, "Analysis of Food. Theory of Methodology-Organology and Laboratory Exercises", 2nd Edition, Self-publishing, Athens, 2015. ISBN 978-960-87371-9-8. *(in Greek language only)*
4. E. Voudouris, M. Kontominas, "Introduction to Food Chemistry", OEDB Publication, 2006. *(in Greek language only)*
5. O.R. Fennema. Food Chemistry. 3rd edit., Marcel Dekker Inc., New York, 1996.
6. Notes on genetically modified foods and food enzymes by the teaching staff.
7. Manual of the food chemistry laboratory exercises by the teaching staff.

- Related academic journals:

Annual Review of Food Science and Technology; Food Chemistry; Critical Reviews in Food Science and Nutrition; Trends in Food Science & Technology; Food Hydrocolloids; Journal of Agricultural And Food Chemistry; Journal of Food Composition and Analysis; Journal of Cereal Science; Journal of Dairy Science; Food Additives and Contaminants Part A-Chemistry Analysis Control Exposure & Risk Assessment

Semi-Optional Courses for 6th Semester

Chemistry and Technology of Materials (Polymers, Nanomaterials, Catalysts)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 671**	**SEMESTER**	**6th**
COURSE TITLE	CHEMISTRY AND TECHNOLOGY OF MATERIALS (POLYMERS, NANOMATERIALS, CATALYSTS)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	5
Seminars	1	
Laboratories	2	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Inorganic, Organic and Physical Chemistry as well as Instrumental Analysis
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to

1. Describe that synthesis and characterization of polymeric materials.
2. Understand the physicochemical principles in polymers.
3. Describe the properties of polymers in solid state.

4. Describe the structure of porous materials at various levels.
5. Describe the physicochemical characteristics of nanostructured carbon materials and other nanomaterials.
6. Describe the structure and texture of supported catalysts.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

At the end of the course the student will have further developed the following skills/competences:

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to structure and properties of materials.
2. Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems of an unfamiliar nature.
3. Ability to adopt and apply methodology to the solution of unfamiliar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others on inter or multidisciplinary problems.

3. COURSE CONTENT

Polymers

- Introduction-Applications.
- Polymer synthesis.
- MW characterization.
- Physical chemistry of polymer solutions.
- Amorphous polymers.
- Mechanical properties of polymers.

Nanocomposite materials

- Fullerenes, Carbon Nanotubes.
- Dendrimers.
- Colloids.

Porous Materials

- Non porous nanocrystals.
- Porous nanocrystals-Zeolites.
- Ordered Mesoporous amorphous particles (MCM, SBA, etc.).
- Foams.
- Intraparticle porosity.
- Nanoparticles aggregation–Development of Interparticle porosity.
- Shaped particles.
- Catalytic nanoparticles dispersed on the surface of porous materials.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and laboratory work face to face.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Oral and/or written examination during each laboratory exercise (20% of the final mark, taken into account only when the student secures the minimum mark of 5 in the final written examination). Written examination (80% of the final mark). Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	***Semester workload***
Lectures (3 hours of contact weekly × 13 weeks)	39
Laboratory work (2 hours of contact weekly × 6 weeks)	12
Final examination (3 hours contact)	3
Study hours of the student, laboratory exercises and preparation for progress and / or final examination	71
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125***

5. RECOMMENDED LITERATURE

- *Suggested bibliography:*

1. A.D. Dodos, "Synthetic Macromolecules", Kostarakis Publications, 2002.
2. G.P. Karagiannidis, E.D. Sideridou, "Chemistry of Polymers", Zitis Publications, 2006.
3. J.M.G. Cowie, "Polymers: Chemistry & Physics of Modern Materials", 2nd Edition, Chapman and Hall, 1991.
4. J.G. Odian, "Principles of Polymerization" John Wiley Inc., 1991.
5. R. Seymour, G. Garraher Jr., "Polymer Chemistry", Marcel-Dekker, Inc., 1996.
6. Y. Gogotsi, "Laboratory exercises in chemistry and technology of materials", Taylor & Francis, 2006.
7. Paul C. Hiemenz & Timothy P. Lodge "Polymer Chemistry", Taylor and Francis Group, LLC.

Environmental Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 691**	**SEMESTER**	**6th**
COURSE TITLE	ENVIRONMENTAL CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	5
Seminars	1	
Laboratories	2	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Environmental Chemistry, Liquid pollution & Air pollution) and Skills Development (Experimental Environmental Chemistry)
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of General and Inorganic Chemistry, Organic Chemistry, Analytical Chemistry, Physical chemistry, English and computer.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2003/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to

1. Explain in detail the processes taking place at each stage (what is the name of the process, what is the type, what is removed and how) of the flow chart of a typical treatment plant a) desalination for drinking water, b) surface water for drinking water c) groundwater for drinking water, and d) for municipal wastewater
2. Recognize the differences in wastewater characteristics and the treatment methods required for each type of wastewater.
3. Compare the available analytical methods for measuring wastewater COD and BOD.
4. Describe pollution phenomena for the various water bodies.
5. Describe global air pollution problems.
6. Explain the formation of gaseous air pollutants

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and Project planning and management

information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking*

At the end of the course the student will have further developed the following general abilities

1. Ability to compare different methodologies for measuring or calculating different parameters.
2. Ability to interact with others on chemical or interdisciplinary problems.
3. Ability to observe the environment and explain everyday phenomena by using his knowledge.
4. Ability to consider the existence of regulations
5. Realization that alternative ways of analysis exist (e.g. using microbes as in the case of BOD measurements)

3. COURSE CONTENT

1. Introduction to water pollution, water distribution, historical phenomena of pollution, new problems, water pollution (pollutants, sources, and effects), wastewater with organic loadings, nutrients, natural attenuation
2. Basic hydrology, hydrological cycle, groundwater, surface and submarine estuaries, saltwater intrusion, water pollution originating from land pollution
3. Water characteristics, alkalinity, hardness, Drinking water treatment, disinfection (regulations and history, chlorination, chlorine chemistry, ozone, fluorination) coagulation (particles, mechanisms of stability and instability of particles coagulants, removal of colour from water), chemical sedimentation (solubility product, hardness removal, occurrence and removal of iron and manganese from groundwater), removal of taste and odour, reverse osmosis
4. Municipal and industrial wastewater characteristics, first, second and third grade treatment, sludge treatment
5. Global air pollution phenomena
6. Air pollution
7. Laboratory exercises: dissolved oxygen, COD (traditional and standardized methods) and BOD measurements
8. Field trip to: wastewater biological treatment plant.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures using PowerPoint presentations (400-500 slides) that are then available at the educational platform eclass.upatras.gr, problem-solving seminars for the instructive solution of problems, laboratory exercises, field trip
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of power-point presentations, electronic educational platform eclass.upatras.gr
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26
Seminars (1 contact hour per week × 13 weeks) - solving of representative problems	13
Laboratory work (2 contact hours per week × 13 weeks)	26
Final examination (3 contact hours)	3

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS			
	Hours for private study of the student, and reports, for the Laboratory, and preparation for the Laboratory (study of techniques and theory)	57	
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125***	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The grade percentage is distributed as follows: Laboratory and field trip reports (10% of the final mark) Written examination (90% of the final mark; 40% for Liquid pollution and 50% for Air pollution) Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.		

5. RECOMMENDED LITERATURE

- *Suggested bibliography:*

1. Notes and laboratory notes of lecturers in Greek.
2. K. Fytianos, K. Samara-Konstantinou, "Environmental Chemistry", University Studio Press Publications, 2009. (in greek)
3. E. Lichtfouse, J. Schwarzbauer and D. Robert (eds.), "Environmental Chemistry: Green Chemistry and Pollutants in Ecosystems", Springer-Verlag, Berlin Heidelberg, 2005.
4. C. Baird and M. Cann, "Environmental Chemistry", 5th Edition, W. H. Freeman and Company, New York, 2012.
5. G.W. VanLoon and S. J. Duffy, "Environmental Chemistry: A Global Perspective", 3rd Edition, Oxford University Press, Oxford, 2010.
6. S.E. Manahan, "Fundamentals of Environmental Chemistry", 3rd Edition, CRC Press, Boca Raton, 2000.
7. S.E. Manahan, "Environmental Chemistry", 9th Edition, CRC Press, Boca Raton 2009
8. D. Barceló and A.G. Kostianoy (editors-in-chief), "The Handbook of Environmental Chemistry", founded by Otto Hutzinger, Springer International Publishing. (multivolume).
9. B. Pani, "Textbook of Environmental Chemistry", I. K. International Publishing House Pvd. Ltd, New Delhi 2007.
10. G S. Sodhi, "Fundamental Concepts of Environmental Chemistry", Alpha Science International Ltd, 2000.

Structural Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 661**	**SEMESTER**	**6th**
COURSE TITLE	STRUCTURAL CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	5
Seminars	1	
Laboratories	1	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Structural Chemistry), skills development
PREREQUISITE COURSES:	There are not prerequisite courses; however, the students should have a basic knowledge of General Chemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The course can be, however, taught in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Have an understanding of the 3D architecture of the different classes of crystalline materials at atomic level.
2. Be aware of the differences in the structure of the various crystalline materials and the effect on their chemical and physicochemical properties.
3. Combine and utilize the knowledge gained in other fields of Chemistry (such as Inorganic/Organic Chemistry, Biochemistry, etc.) in which the concepts of this course are extensively used.
4. Know the principles and basic steps of the crystal and molecular structure determination.
5. Handle computers, software and databases relevant to the structure of materials so he/she can solve new problems.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
	Respect for difference and multiculturalism

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* …… *Others…* …….

By the end of this course the student will have further developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications related to the structure of materials.
2. Ability to apply this knowledge and understanding to the solution of problems related to crystalline structures of non familiar nature.
3. Ability to adopt and apply methodology to the solution of non familiar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have developed the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Working in an interdisciplinary environment
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3. COURSE CONTENT

- Crystalline and amorphous state of matter. Crystal lattice, unit cell. Miller indices.
- Symmetry, point groups. Enantiomers. Crystal systems, Bravais lattices, space groups.
- Structure and basic types of crystalline compounds.
- Types of chemical bonds and interactions in the crystals.
- Structure of metals and alloys.
- Ionic crystals, crystal lattice energy.
- Covalent crystals. Molecular crystals.
- Quasicrystals.
- Liquid crystals.
- Structure of biological macromolecules. Representative structures.
- Basic concepts of crystal chemistry.
- Crystal growth and defects.
- Structure-properties relations in materials.
- Principles of crystal structure analysis.
- Single-crystal X-ray, neutron and electron diffraction.
- Powder X-ray diffraction. Electron microscopy methods.

<u>Laboratory training</u>

- Practice with 3D models (Bravais lattices, metals, ionic, covalent and molecular compounds, α-helix and pleated sheet).
- Educational software for the 3D structure visualization and exploration of the crystal packing of various compounds (e.g. chemical/pharmaceutical molecules and biomolecules: proteins, DNA, RNA, viruses).
- Supramolecular interactions and structure self-assembly: Application to selected examples using educational software.

- Database exploitation for structural data mining.

4. TEACHING and LEARNING METHODS - ASSESSEMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. Laboratory training: Use of the Internet for the exploitation of scientific sites and the extraction of information from databases on structural chemistry issues. Communication with the students is established either through email or through the webpage of the Chemistry Department.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	39
Seminars (1 contact hour per week × 13 weeks) - solving of representative problems	13
Laboratory work (1 contact hour per week × 13 weeks)	13
Half-term evaluations (2, the first in the middle and the second one at the end of the semester, 1 contact hour each)	2
Final written examination (2 contact hours)	2
Hours for private study of the student and preparation for the half-term evaluations and final examination.	56
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally, half-term written examinations: one at the middle and the other one at the end of the semester. The final grade is the average of the two half-term examinations. The student should secure at least the grade 6 (0-10 point scale) in the first half-term in order to participate in the second one. This score represents the 80% of the final grade of the course. 2. Written examination after the end of the semester (unless the student successfully participated in the half-term exams). Minimum passing grade: 5. This score represents 80% of the final grade of the course. 3. Grade of laboratory work: This score is the 20% of the final grade of the course (minimum passing grade: 5). All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. S.M. Allen, E.L. Thomas, "The Structure of Materials", MIT Series in Materials Science and Engineering, John Wiley & Sons, 1999.
2. W. Massa, "Crystal Structure Determination", Springer, 2010.
3. W. Borchardt-Ott, "Crystallography", Springer, 2012.
4. V. Nastopoulos, "Structural Chemistry", in Greek language, University of Patras Publication Centre, Patras, 2017.

Semi-optional Courses for 7th Semester

Physical Processes of Chemical Technology

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 783**	**SEMESTER**	**7th**
COURSE TITLE	PHYSICAL PROCESSES OF CHEMICAL TECHNOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	5
Seminars	1	
Laboratories	2	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development
PREREQUISITE COURSES:	There are no prerequisite courses. Students must have at least basic knowledge of Principles of Chemical Technology.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, teaching can also be done in English if foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course, the student will be able to:

1. Understand essential data, concepts, principles and theories relating to physical processes such as extraction, evaporation, diffusion and mass transfer, segmentation and mechanical separation, membrane separation, etc.;
2. Apply the principles of chemical technology to solve problems related to mass and heat transfer in natural processes.
3. Understand issues related to the advanced physical processes of chemical technology.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Respect for difference and multiculturalism

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking*

At the end of this course the student will further develop the following skills:

1. Ability to demonstrate knowledge and understanding of the essential data, concepts, principles and theories associated with physical processes such as extraction, evaporation, diffusion and mass transfer, segmentation and mechanical separation, membrane separation, a.
2. Ability to apply this knowledge and understanding to the solution of qualitative and quantitative problems of inappropriate nature.
3. Ability to adopt and apply the relevant methodology to resolve non-related problems.
4. Study skills needed for continuous professional development.
5. Ability to interact with others on chemical or interdisciplinary issues

More generally, upon completion of this course, the student will further develop the following general competencies (from the above list):

Search, analyse and synthesize data and information, using the necessary technologies
Adapt to new situations
Decision making
Autonomous work
Teamwork
Exercise of criticism and self-criticism
Promote free, creative and inductive thinking

3. COURSE CONTENT

Psychrometry and Drying.

Leaching.

Liquid / liquid extraction.

Evaporation.

Diffusion and Mass Transfer.

Partitioning and mechanical separation.

Separation with membranes.

Absorption of gases.

4. TEACHING and LEARNING METHODS - ASSESSEMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Teaching and Teaching. Lesson lectures for each chapter, in the form of PowerPoint, are posted in e-class, where students can retrieve them freely by signing up on the course page.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of*	

Activity	*Semester workload*
Lectures (2 hours of contact weekly × 13 weeks)	26
Tutorial (1 hour contact weekly × 9 weeks) to solve representative problems	9
Half-term evaluation (2 examinations, mid-term and end of semester, 2-hour contact duration each)	4
Laboratory work (2 hours of contact weekly × 13 weeks)	26

non-directed study according to the principles of the ECTS	Final examination (3 hours of contact)	3
	Study hours of the student, laboratory exercises and preparation for progress and / or final examination	57
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Two mid-term examinations instead of the final written examination when the grade in each is ≥ 7.0. 2. Problems solved in the Tutorial (10% of the final grade if they have been rated ≥ 7.0). 3. Oral examination and correction of the report for each laboratory exercise (10% of the final grade if the final written examination(s) is (are) rated ≥ 5.0). 4. Written examination (80% of the final grade). Greek grading scale: 1 to 10. Minimum passing grade: 5. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in the English language.	

5. RECOMMENDED LITERATURE

1. D. Zampoulis, A. Zoumpoulis Th. Karapantsios, K. Matis, K. Triantafillidis, "Chemical Technology", Tziolas Publications, 2013.
2. W.L. McCabe, J.C. Smith, P. Harriot "Chemical Reaction Engineering", Tziolas Publications, 2016.
3. J. Gentekakis "Physical Processes", Kleidarithmos Publications 2016.
4. D. Zampoulis, A. Zoumpoulis, N. Kostoglou, K. Lazaridis "Laboratory Exercises of Chemical Technology", Tziolas Publications, 2009.

Chemical Processes of Chemical Technology

1. GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	CHEMISTRY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**XE 784**	**SEMESTER**	**7th**	
COURSE TITLE	CHEMICAL PROCESSES of CHEMICAL TECHNOLOGY			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures			2	5
Seminars			1	
Laboratories			2	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development			
PREREQUISITE COURSES:	Typically, there are not prerequisite course.			

	Essentially, the students should possess knowledge provided through the previously taught theoretical courses of "Physical Chemistry" and "Principles of Chemical Technology"
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, teaching can also be done in English if foreign students follow the program.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Apply the principles of chemical technology to the solution of fluid flow and transport problems as well as heat transfer during homogeneous chemical processes.
2. Select the most suitable reactor type to conduct a homogeneous chemical reaction.
3. Calculate the volume and determine the proper operating conditions of a chemical reactor to produce a specific amount of product.
4. Identify the equation and the rate constant of a chemical reaction.
5. Recognize deviations from the ideal flow of reaction mixture in chemical reactors.
6. Apply the principles of chemical technology to solve problems related to mass and heat transfer in heterogeneous chemical processes.
7. Identify kinetic heterogeneous catalytic reactions.
8. Select the most suitable operating conditions for heterogeneous catalytic reactors.
9. Solve problems associated with bioreactors.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to demonstrate knowledge and understanding of the essential data, concepts, principles and theories related to the efficient operation of chemical processes (Design and Project Management).
2. Ability to apply this knowledge and understanding to the solution of qualitative and quantitative problems of inappropriate nature (Adaptation to new situations).
3. Ability to adopt and apply the relevant methodology to solve non-related problems (Decision Making).
4. Study skills needed for continuous professional development (Autonomous work).
5. Ability to interact with others on chemical or interdisciplinary issues (Teamwork).

3. COURSE CONTENT

Theory

1. Introduction to Chemical Processes.
2. Interpretation of Batch Reactor Data.
3. Introduction to Chemical Reactor Design.
4. Ideal Reactors for Single Chemical Reaction.
5. Reactor Design for Single Chemical Reactions.
6. Reactor Design for Parallel Chemical Reactions.
7. Representative Examples of Multiple Reactions.
8. Choosing the Right Kind of Reactor.
9. Basics of Non-Ideal Flow.
10. Heterogeneous Chemical Reactions.
11. Chemical Reactions Catalysed by Solid Catalysts.
12. Catalytic Fixed Bed Reactors.
13. Reactors for Biochemical Reactions.

Laboratory

1. Reaction Kinetics in Ideal Batch Reactor
2. Reaction Kinetics in Ideal Mixed Flow Reactor
3. Reaction Kinetics in Recycle Reactor
4. Exposition Experiment in High Pressure Fixed Bed Reactor
5. Exposition Experiment in High Pressure Semi-Batch Reactor

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of pdf files, where from the students can freely download them. Tutorials with exemplary problem solving, laboratory practice in groups of three people. Communication with students is continuous through personal contact, posting announcements on the Department's website and e-class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION	1. Two intermediate exams which are exempt for final written examination when the grade in each is ≥7,0.

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26
Seminars (1 contact hour per week × 12 weeks) - solving of representative problems	12
Interim examinations (2 written exams, mid and late semester, 2 contact hours each)	4
Laboratory work (2 contact hours per week x 5 weeks)	10
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for the Laboratory, interim and final examinations	70
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125***

Description of the evaluation procedure *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	2. Problem solving given in the Tutorial (20% increment of the final written examination grade if it is rated ≥5.0). 3. Performance in the laboratory (average oral test and written laboratory report - 20% of the final grade). 4. Written examination (80% of the final grade). Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

- *Suggested bibliography:*

1. O. Levenspiel, "Engineering of Chemical Reactions", Translated in Greek by: Ph. Pomonis, K. Matis, N. Papagiannakos, Ch. Kordulis, P. Mavros, K. Kolonia, Kostarakis Publications., Athens, 2004.
2. J.M. Smith, "Chemical Processes Engineering", Translated in Greek, Tziolas Publications, 1997.
3. P. Mavros, K. Matis, K. Triantafyllidis, "Elements of Chemical Processes", Tziolas Publications, 2009.
4. "Laboratory Notes for Chemical Processes", Patras University Publications, 2019.
5. Notes of lecturers in Greek.

Principles and Applications of Nuclear Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 742**	**SEMESTER**	**7th**
COURSE TITLE	PRINCIPLES AND APPLICATIONS OF NUCLEAR CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	5
Seminars	1	
Laboratories	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Nuclear Chemistry), skills development
PREREQUISITE COURSES:	Typically, there are not prerequisite courses
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Know the basic concepts related to radioactivity and its applications in Chemistry
2. Know the operation principles of radiation detection systems for γ-rays and β-particles and to handle them successfully
3. Manipulate radioactive substances safely and carry out measurements by using Geiger-Müller counter and scintillation detector.
4. Understand how basic determinations related to radioanalytical techniques are carried out.
5. Understand the basic processes that occur inside a nuclear reactor
6. Know the ways ionizing radiation interacts with matter (selected chemical and biological systems)
7. Know the process of monitoring and the units used to measure exposure to radiation and radiation dose
8. Know how matter have to be shielded and protected from ionizing radiation

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to demonstrate knowledge and understanding of essential concepts and principles related to radiochemistry and its applications.
2. Ability to apply such knowledge to the solution of chemical problems using radionuclides.
3. Ability to apply such specific knowledge in as many other fields.
4. Ability to get more specific knowledge for professional development.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and management

3. COURSE CONTENT

1. Introduction to Radiochemistry

Discovery of radioactivity, forces in matter and subatomic particles, nuclides and natural decay series.

2. Nuclear properties

Description of nucleus, mass and energy relationships

3. Types of radioactive decay

α-, β- and γ-decay

4. Rates of nuclear decay

Rates of radioactive decay, units of radioactivity

5. Nuclear reactions

Types, energetics, cross sections of nuclear reactions, fission, fusion.

6. Activation analysis

Overview and Principles of Nuclear Activation Analysis – Principles of Charged Particle Activation Analysis – Advantages and Disadvantages of Nuclear Activation Methods – Sources of Activating Particles or Radiations – Qualitative and quantitative determination of elements applying Neutron Activation Analysis – Interferences in Activation Analysis – Primary Interference Reactions – Gamma Ray Spectral Interferences – Overview of all Neutron Activation Procedures (TNAA, ENAA, FNAA, INAA, RNAA) – Application of all aforementioned types of Activation Analysis in different research areas and in real life.

7. Principles of Nuclear Reactors

Multiplication factor – Demonstration of the four factor formula – The Nuclear Fuel (Abundances of Isotopes of Natural Uranium, Enrichment) – Moderators and Coolants in different types of Reactors – Control Materials and Reactor's control via Delayed Neutrons – Types of Reactors (Light and Heavy Water Reactor, Homogeneous and Heterogeneous Reactor, Breeder Reactor)

8. Interactions of radiation with matter

Ionizing and non-ionizing radiation (α- & β- particles, γ-rays, accelerated charged particles beams and neutrons) – Ionizing Radiation Sources (natural or artificial radionuclides-sources, accelerators, nuclear reactors) – Modes of ionizing radiation interaction with matter (interaction of charged particles, neutrons and electromagnetic radiation with matter) - Linear Energy Transfer (LET) – Physical effects of radiation on matter

9. Health Physics

Radiation quantities and units – Primary and secondary dosimeters – Radiolysis of gases, water, aqueous solutions, solids, organic compounds and polymeric substances – Chemicals with radioprotective action – Biological Effects of Radiation – Sources of Radiation exposure (natural and artificial) - Radiation Protection and control – Anti-radioactive drugs

4. TEACHING and LEARNING METHODS - ASSESSEMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and laboratory work face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint, video etc) in teaching. The lectures content of the course for each chapter, all problems, in the form of a series of ppt files, and announces are uploaded on the internet, from where the students can freely download them.

TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	39
Tutorials (1 contact hours per week × 13 weeks)	13
Laboratory work (1 contact hour per week × 13 weeks)	13
Hours for private study of the student and optional problems solving given in each lecture, preparation for the Laboratory (study of techniques and theory) and writing reports, for the Laboratory exercises	54
Final written examination at the end of semester (3 contact hours × 1 time)	3

	Three optional tests during the semester (1 contact hour × 3 times)	3
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. At the end of the semester there is a final written examination with multiple choice questions and short answer questions (70% of the final mark). Laboratory exercises (30% of the total mark, taken into account only when the student secures the minimum mark of 5 in the final written examination). Minimum passing grade: 5 2. Optional delivery of solved problems (at least 2) each week, given in each lecture. Addition of 1 grade to the final exam grade (if it's higher than 5) of the students who have delivered all the solved problems and the percentage of the unit to the others, according to the number of solved problems each person has delivered. Addition of 1/10 of tests grade to the final exam grade (if it's higher than 5) Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.	

5. RECOMMENDED LITERATURE

1. G. Choppin, J.-O. Liljenzin, J. Rydberg, C. Ekberg "Radiochemistry and Nuclear Chemistry", 4th Edition, Academic Press, USA 2013.
2. W.D. Loveland, D. J. Morrissey, G. T. Seaborg, "Modern Nuclear Chemistry", 2nd Edition, John Wiley & Sons, Inc., USA 2006.
3. A. Mozumder, "Fundamentals of Radiation Chemistry", Academic Press, USA 1999.
4. K.H. Lieser, "Nuclear Chemistry and Radiochemistry: Fundamentals and Applications", 2nd Rev. Edition, Wiley -VCH, Verlag GmbH, 2001.
5. W.D. Ehmann, D. E. Vance, "Radiochemistry and Nuclear Methods of Analysis", 1st Edition, Wiley-Interscience, 1991.
6. G.R. Choppin, J. Rydberg, "Nuclear Chemistry, Theory and Applications", Pergamon Press, New York, 1980.
7. P. Misailidis, F. Noli, "Radiochemistry and Nuclear Chemistry", Ziti Publications, 2020. (in greek language)

Modern Spectroscopy Methods (NMR, MS) - Molecular Modelling

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 707**	**SEMESTER**	**7th**
COURSE TITLE	MODERN SPECTROSCOPY METHODS (NMR, MS) - MOLECULAR MODELLING		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	4
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Advanced Spectroscopy methods and Molecular Modelling)
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess the knowledge of Organic Chemistry and Spectroscopy taught in the previous semesters.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

Modern NMR Spectroscopy

1. Prepare samples for the NMR Spectroscopy and understand the functionality principles of both instruments.
2. Interpret spectra of ^{1}H NMR and ^{13}C NMR using all the basic information [chemical shift, integration (only for ^{1}H NMR), coupling and dynamic equilibrium].
3. Use information from multiple pulses ^{1}H NMR και ^{13}C NMR experiments (Inversion Recovery, T2, spin echo, spin decoupling, APT and DEPT, NOE).
4. Interpret the data from 2D NMR spectra, such as *J*-resolved, COSY, TOCSY, HSQC, HMBC, NOESY, and uses this information for the structural elucidation.

Molecular Modelling

1. Present methods for the conformational analysis of molecules.
2. Select and apply the most appropriate methods for conformational analysis of molecules.

3. Select and apply the most appropriate energy minimization methods for conformational analysis of molecules.
4. Detect the non-covalent interactions between bioactive molecules.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to 1D and 2D ^{1}H NMR και ^{13}C NMR Spectroscopy.
2. Ability to apply this knowledge in the understanding and resolving problems related to NMR and Molecular Modelling.
3. Study skills related to NMR and Molecular Modelling needed for continuing professional development.
4. Ability to interact with others in subjects related to NMR and Molecular Modelling or interdisciplinary nature problems.
5. Ability to use the Artificial Intelligence in solving synthetic problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and processing of data and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and managemen

3. COURSE CONTENT

Modern Spectroscopy Methods (NMR-MS)

1. Nuclear Magnetic Resonance Principles and Instrumentation.
2. Fourier transformation (FT) and continues wave scanning (CW). Nuclear Magnetic Resonance: Principles and instrumentation info, relaxation times T_1 and T_2, Inversion Recovery Experiment. Chemical shifts in ^{13}C NMR spectroscopy, spin echo experiment, APT and DEPT experiments. Examples. 2D NMR Spectroscopy.
3. Principles of nuclear coupling, Heteronuclear coupling. 1D Heteronuclear magnetic Resonance. Theory of 2D NMR spectroscopy. Acquire a 2D NMR spectrum. Various 2D NMR spectra COSY, TOCSY, RELAY, HSQC, HMBC, INADEQUATE. Examples. Interpretation of 2D Homonuclear and Heteronuclear Spectra.
4. Nuclear Overhauser Effect (NOE). Principles and interpretation, relation to the distance between nuclei and correlation time τ_c.

Molecular Modelling

1. Basic Principles of Molecular Modelling. Non-covalent interactions. Molecular Graphics. Conformations of Proteins and Peptides. Molecular Surfaces. Basic principle of Molecular Mechanics. Potential Energy Surfaces. Energy Minimizations methods. Examples and Applications.
2. Computer Simulation methods-Molecular Mechanics. Conformational Analysis of Bioactive Molecules. Examples and Applications.
3. **Application of Artificial Intelligence** (AI) in solving of NMR and Molecular Modelling problems.

4. TEACHING and LEARNING METHODS - ASSESSEMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and Tutorials face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. Use of Molecular Modelling software (e.g. Molecular Conceptor learning series) in teaching. Tutorials with exemplary analysis of problem solving in Spectroscopy and Molecular Modelling.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	See table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination (50% of the final grade). Minimum passing grade: 5. Students with writing problems can be examined orally at the same day and hour with the written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	***Semester workload***
Lectures (2 contact hours per week × 13 weeks).	26
Seminars (1 contact hour per week × 13 weeks)	13
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of home-works and preparation for the seminars	58
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

5. RECOMMENDED LITERATURE

1. T. Mavromoustakos, I. Matsoukas, "NMR: Principles and Applications of Nuclear Magnetic Resonance in Medicine, Pharmaceutical Chemistry, Biochemistry and Food Chemistry", in Greek language, 1st Edition, J.B. Parisianos Publications, 2006. (in greek language)
2. T. Mavromoustakos, P. Zoumpoulakis, "Molecular Modelling: Applications in Organic and Pharmaceutical Chemistry", 1st edition, Published by J.B. Parisanos Publications, 2008. (in greek language)
3. T. Mavromoustakos, et al. "Nuclear Magnetic Resonance", in Greek language, Symmetria Publications, 2018.
4. R.M. Silverstein, F.X. Webster, D.J. Kiemle, "Spectrometric Identification of Organic Compounds", 7th Edition, Published by John Wiley & Sons, 2005.

5. A.R. Leach, "Molecular Modelling: Principles and Applications", 2nd Edition, Published by Prentice Hall, 2001.
6. Notes of lecturers in Greek.

Physical Chemistry-4

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 738**	**SEMESTER**	**7nd**
COURSE TITLE	PHYSICAL CHEMISTRY-4		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		2	4
Seminars		1	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Physical Chemistry).		
PREREQUISITE COURSES:	Although there are no prerequisite courses, it is strongly recommended that the students should have a good knowledge of what has been taught in the modules of Physical Chemistry and those of Mathematics during the previous semesters.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)			

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

In brief, at the end of this course the student should be able to:

- Define basic concepts in the fields of Statistical Thermodynamics, Electric properties of molecules, Intermolecular Forces, and Colloid Chemistry.
- State the two axioms of Statistical Thermodynamics and discuss the objectives of this branch of Physical Chemistry
- Explain the physical meaning of the Boltzmann distribution and the partition functions.
- Describe the genesis of the induced dipole moment.
- Explain the influence of the electric field frequency on the polarizability.
- Describe and discuss experimental procedures for the determination of the permanent dipole moment and polarizability.
- State the various factors affecting the potential energy of interaction.

- Present examples of properties of macroscopic systems which are controlled by intermolecular forces and describe the kind of interactions which cause these forces.
- Describe and discuss methods for preparing colloidal solutions, for determining the size of colloidal particles and for determining the molecular weight of macromolecules.

At the end of this course the student will have further developed a number of **skills-competences**. Examples of such skills comprise the ability of the student to:

- Calculate the molecular partition functions for a number of simple cases (two-state system, harmonic oscillators, particle-in –a-box, etc.)
- Calculate the canonical partition functions for macroscopic (N, V, T) systems of independent particles.
- Calculate the thermodynamic properties of atomic crystals and of macroscopic (N, V, T) systems of independent particles using the methods of Statistical Thermodynamics.
- Choose the correct relationship among relative permittivity and electric properties of molecules, depending on the nature of the molecules and of the electric field.
- Recognize whether a given interaction is long- or short-ranged.
- Assess the strength of a given intermolecular interaction in relation to the Brownian motion.
- Recognize the kind of interactions which may develop between two particles and express the resulting potential energy of interaction.
- Solve exercises and problems related to the material taught in this course.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Physical Chemistry.
2. Ability to apply this knowledge and understanding to the solution of problems related to Physical Chemistry of non-familiar nature.
3. Ability to adopt and apply methodology to the solution of non-familiar problems of Physical Chemistry.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking
Work design and management

3. COURSE CONTENT

A. Statistical Thermodynamics

A1. Boltzmann Distribution

A2. Molecular Partition Functions
A3. Molecular Energies
A4. The Canonical Ensemble
A5. Internal Energy and Entropy
A6. Thermodynamic Functions and Equilibrium Constants

B. Molecular Interactions

B1. Electrical Properties of Molecules
B2. Intermolecular Interactions
B3. Liquids
B4. Macromolecules
B5. Self-Assembly

C. Solids

C1. Solids (Study of the Structure and Physical Properties of Solids)

- Crystal Structure: Periodic Crystal Lattices; Determination of Lattice Planes
- Diffraction Techniques: X-Ray Crystallography; Neutron and Electron Diffraction
- Bonding in Solids: Metals; Ionic Solids; Covalent and Molecular Solids
- Mechanical Properties of Solids
- Electrical Properties of Solids: Electronic Band Theory; Doping and Semiconductor Properties; Semiconductor Devices; Metallic Conductors; Insulators and Semiconductors; Superconductors
- Optical Properties of Solids: Excitons; Metals and Semiconductors; Nonlinear Optical Phenomena

C2. Introduction to Amorphous/Non-Crystalline Materials

- The Glass Transition and Related Theories
- Types of Amorphous Materials
- Technological Applications of Amorphous/Glassy Materials

D. Introduction to Colloid Chemistry

- Basic Concepts, Definitions, Classification
- Electric Double Layer: Gouy–Chapman Theory; Double-Layer Thickness; Stern Model; Electrophoresis and Zeta Potential; Debye–Hückel Theory
- Adsorption and Isotherms; Nucleation and Crystal Growth; Optical Properties of Colloids; Surface Tension

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, problem-solving Tutorials face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in lectures, problem-solving seminars and introductory lessons for the laboratory. Relevant material (e.g., transparencies, additional problems, solutions to problems) are frequently uploaded to the site of the Department from where students may freely download it. Various announcements to the students as well as their registration to mid-term assessments are also done via the site of the Department.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION	1. Optional mid-term assessments (2) which may contribute to the total marks.

Activity	*Semester workload*
Lectures (2 contact hours per week x 13 weeks)	26
Tutorial (1 contact hour per week x 13 weeks) - solving of representative problems	13
Hours for private study of the student and preparation of technical reports for each laboratory experiment.	61
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100***

Description of the evaluation procedure *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	2. Final writing examination Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. P. W. Atkins, J. De Paula, J. Keeler, "*Physical Chemistry*", 11th Universal Edition, , Crete University Press, 2024.
2. E. N. Economou, "*Solid State Physics*", 3rd Edition, Crete University Press, 2017. (in greek language)
3. K. Panagiotou, "*Interfacial phenomena and colloidal systems*", 2nd edition, Ziti Press, 1998. (in greek language).
4. D. A. McQuarrie, "*Statistical Mechanics*", Harper & Row, New York, 1976.
5. C. Kittel, P. McEuen, "*Introduction to Solid State Physics*", 9th Edition, Wiley, New Jersey, 2018

Food Chemistry and Technology – Oenology I

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 785**	**SEMESTER**	**7th**
COURSE TITLE	FOOD CHEMISTRY AND TECHNOLOGY – OENOLOGY I		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	4	8
Laboratories	4	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science and Skills Development.
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. The students should have at least knowledge of the basic concepts of Chemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.chem.upatras.gr

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will acquire the necessary knowledge on:

1. Chemistry, nutritional value, microbiology, and methods of production of carbohydrate-, protein- and fat-containing foods, juices, alcoholic beverages and dairy products at industrial, semi-industrial and/or household scale.
2. Industrial practices and new trends on improving the quality and the production processes of food, as well as for the production of new foods with health benefits.
3. The importance of fermentation technology in food production and the linking of biotechnology with the food industry.
4. Applying analytical methods for the determination of food composition.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to

Working independently	*gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	……
Production of new research ideas	*Others…*
	…….

By the end of this course the student will have developed the following skills/competences:

1. Practical skills for the separation and analysis of food ingredients using classical and instrumental analytical techniques.
2. Ability to recognize the role and nutritional value of food ingredients in order to adapt their daily diet to the benefit of their own health and to deal with problems (diet, diabetes, anaemia, etc.) and to be able to advise other people respectively.
3. Capability to assess the nutritional value of industrial foods.
4. Knowledge on the production of different types of wine (dry, sweet, red, white).
5. Ability to assess the impact of the various processes of food production on its composition and quality.
6. Possibility to seek employment in companies, industries and laboratories, the majority of which in Greece are in the food sector.
7. Ability to critically evaluate knowledge for the selection of appropriate products/technologies to create new companies of food production, processing, or analysis.
8. Ability to have a consulting role in food production, processing, and analysis companies and to seek employment in these companies.

Generally, by the end of this course the student will have further developed the following general abilities (from the list above):

- *Searching, analysis and synthesis of facts and information, as well as using the necessary technologies*
- *Adaptation to new situations*
- *Decision making*
- *Autonomous (independent) work*
- *Group work*
- *Work in interdisciplinary environment*
- *Exercise of criticism and self-criticism*
- *Promotion of free, creative and inductive thinking*

3. COURSE CONTENT

1. Carbohydrate containing foods: Production of syrups (raisin syrup, carob syrup). Production of sugar - molasses. Starch and glucose industry. Honey. Sweeteners.
2. Bakery products. Raw materials. Chemical composition. Swelling. Functional properties of starch and gluten. New Trends (Starter Cultures, Enzymes, Applications of Genetic Engineering, Chemical Additives).
3. Oenology: Composition and correction of must. Alcoholic fermentation. White and red vinification. Sweet wines and Mistelles (non-fermented fortified wines). Sparkling wines. Retsina (resinated wine). Stafiditis (raisin wine). Mavrodaphni (Greek red fortified wine). Thermovinification. Wine composition. Alcoholic fermentation by-products. Aging. Diseases and defects. Wine clarification. Racking. Sulphurization. Pasteurization. Bottling. Wine Mechanics: Crushing/grape crushers. Must draining/drainers. Presses. Must transfer pumps. Bioreactor types (fermentation tanks). Must recycling (tide) during vinification. Filters. Pasteurizers. Bottle washing machines. Filling machines. Capping-tamping machines. Installation of bottling line. Wine tasting: Colour, appearance, aroma, taste, ingredients with sweet, sour or astringent feel. Sulphurized musts. Wine and other grape derivatives in human diet.
4. Vinegar. Alcoholic beverages: Distillates. Tsipouro, Tsikoudia, Ouzo, Brandy, Whiskey, Vodka. Potable alcohol from raisins, molasses, cereals and potatoes.
5. Rapid alcoholic fermentations by *Saccharomyces cerevisiae* and *Zymomonas mobilis*. Bioreactors. Alcoholic fermentation parameters. Refineries. Liquors.
6. Beer production. Malting. Brewing. Maturation. Treatments.
7. Yeasts in food & food ingredients production (other than wine). Isolation. Growth. Metabolism. Raw materials for the production of food grade yeasts. Industrial production. Food uses (beer, spirits, bakery

products, food supplements, probiotics, microbiology extracts, food flavour enhancers, single cell protein, dairy yeasts, yeasts for the production of food ingredients).

8. Citrus juice industry: Raw material, juicing, factors that affect the quality of juice, heat treatment of citrus juices, concentration of citrus juices, essential oils.
9. Fats and oils. Fat and oil alterations. Treatment of raw materials and products (refining, discoloration, deodorization, hydrogenation).
10. Meat Technology: Composition, microbiology, canning, meat products.
11. Milk Technology: Composition, microbiology, treatments (filtration, cooling, pasteurization, condensation, homogenization, decreaming).
12. Dairy products.

Laboratory exercises:

1. Analytical presentation of all laboratory exercises - Tutorial.
2. Flour analysis: (a) Determination of gluten. (b) Ash determination. (c) Detection of oxidants.
3. Oil Analysis: (a) Saponification number. (b) Degree of acidity. (c) Iodine number. (d) Colour reactions. (e) Detection of antioxidant additives and paraffin oil in olive oil by thin layer chromatography.
4. Milk analysis: (a) Protein determination by the Kjeldahl method. (b) Fat determination by the Gerber method. (c) Specific weight.
5. Determination of total fat in olive pit or cocoa or nuts by Soxhlet extraction.
6. Sugar analysis: Determination of (a) reducing sugars, (b) total sugars, and (c) sucrose in honey.
7. Sugar analysis: Determination of (a) glucose, (b) fructose, and (c) detection of sugar syrup, and (d) starch syrup in honey.
8. Oenology: *Saccharomyces*. (a) Preparation of wet and solid yeast culture. (b) Preparation of liquid yeast culture in must in order to enhance the fermentation of wine. (c) Determination of yeast concentration in fermenting must.
9. Oenology: Examination and alcoholic fermentation of grape must. (a) Measurement of density. (b) Determination of total acidity. (c) Corrections of must. (d) Alcoholic fermentation for white dry wine. (e) Alcoholic fermentation for red sweet wine. (f) Preparation of Mistelle. (g) Rapid alcoholic fermentation by addition of yeast. Kinetics of fermentation. Determination of cell concentration. (h) Microscopic examination of yeasts (observation of healthy cells, dead cells, bacteria contamination). Microscopic examination of yeast cells prior to fermentation.
10. Oenology: Chemical analysis of wines: (a) alcoholic strength, (b) total acidity, (c) volatile acidity, (d) free sulphite, (e) bound sulphite, (f) total sulphite.
11. Oenology: Treatments for the preparation of white dry and red sweet wine: (a) Fermentation monitoring every 48 hours: Macroscopic. Microscopic observation of yeasts. Enhancement of stuck fermentation with yeast. (b) Cease of fermentation by addition of alcohol in sweet wine production. (c) Determination of the end of fermentation. Racking. Clarification. Sulphurization. Wine cooling. Filtration.
12. Gas chromatographic analysis of oils (fatty acid methyl esters).
13. Sensory evaluation of wine.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	1. Lectures face-to-face using Information and Communication Technologies (ICTs) (e.g. PowerPoint), and presentation of the theoretical background of the laboratory exercises. 2. Laboratory exercises in groups of 2-3 students.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of .ppt files, where from the students can freely download them using a password, which is provided to them at the beginning of the course.
TEACHING METHODS	

Activity	*Semester workload*

The manner and methods of teaching are described in detail. *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Lectures (4 contact hours per week × 13 weeks) — 52 Laboratory exercises (4 contact hours per week × 13 weeks) — 52 Final written examination (6 contact hours) — 6 Private study time of the student and preparation for the half-term evaluations and final examination — 90 ***Total number of hours for the Course (25 hours of work-load per ECTS credit)*** — ***200***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Laboratory exercises (40% of the final course grade). Average score of oral and written test after the end of each exercise, and final written examination of the laboratory exercises. 2. Final written exam (60% of the final grade). Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. A.A. Koutinas, M. Kanellaki. Food Chemistry and Technology. University of Patras Publications, 2009-2010. *(in Greek language only)*
2. Notes by the teaching staff.
3. N.K. Andrikopoulos. Analysis of Food. Theory of Methodology-Organology and Laboratory Exercises. 2nd Edition, Self-publishing, Athens, 2015. ISBN 978-960-87371-9-8. *(in Greek language only)*
4. R. Jackson. Wine Science: Principles and Applications. 3rd Edition, Elsevier Inc., 2008.
5. E. Voudouris, M. Kontominas. Introduction to Food Chemistry. OEDB Publications, 2006. *(in Greek language only)*
6. H.-D. Belitz, W. Grosch, P. Schieberle. Food Chemistry. 4th Edition, Springer, Berlin, 2009.
7. O.R. Fennema. Food Chemistry. 3rd Edition, Marcel Dekker Inc., 1996.

Chemistry of Organometallic Compounds and Mechanisms of Inorganic Reactions

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 726**	**SEMESTER**	**7th**
COURSE TITLE	CHEMISTRY OF ORGANOMETALLIC COMPOUNDS AND MECHANISMS OF INORGANIC REACTIONS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**

	Lectures	3	4
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Organometallic Chemistry and Mechanisms of Inorganic Reactions) and Presentation Skills Development.		
PREREQUISITE COURSES:	Typically, there are no prerequisite courses. However, it is recommended that students should have passed the previous courses "Introduction to Inorganic Chemistry", "Inorganic Chemistry 1", "Inorganic Chemistry 2" and "Inorganic Chemistry 3".		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.klouras.chem.upatras.gr/el/organometalliki-ximeia-el.html		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Decide whether a compound is organometallic or not**.**
2. Write the IUPAC name given the structural formula of an organometallic compound and vice versa.
3. Count electrons and charges of ligands by the ionic or by the covalent (or radical) convention.
4. Choose the proper solvent for an organometallic reaction.
5. Describe main group organometallic compounds and their properties, preparation methods and applications as well.
6. Explain and apply the 18-electron rule to transition element organometallic compounds.
7. Explain the bonding in metal carbonyls and provide evidence for synergetic bonding.
8. Discuss the bonding types of carbonyl ligands.
9. Formulate synthetic methods, important reactions and properties of transition metal carbonyls.
10. Recognize the role of phosphines as ligands.
11. Describe complexes with alkyl, alkene and alkyne ligands.
12. Identify the sandwich compounds, describe a method of preparation, their properties and uses as well.
13. Name some important applications of organometallic compounds in industrial catalysis.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

At the end of the course the student will have further developed the following skills/competences:

1. Ability to give several examples illustrating how organometallic molecules are strikingly different from those encountered in classical Inorganic and Organic Chemistry.
2. Skills of applying the 18-electron rule in order to predict composition and stability of organometallic compounds and to design new compounds.
3. Skills in using Grignard and organolithium compounds in synthetic organic chemistry.
4. Competence to provide examples for the synthesis of silicones, polymers of great commercial importance, according to the Rochow process.
5. Ability in using important terms of Organometallic Chemistry like hapticity, back-bonding, cluster compounds, hydroboration, ring whizzing and fluxionality.
6. Ability to explain the various applications of ferrocene and its derivatives.
7. Ability to explain the mode of catalytic action of some transition-metal complexes in industrial applications.

3. COURSE CONTENT

1. Naming Organometallic Compounds
2. Counting Electrons
3. Solvents for Organometallic Chemistry
4. Main Group Organometallic Compounds
   - Organometallic Compounds of the Alkali Metals.
   - Organometallic Compounds of the Alkaline Earth Metals.
   - Grignard Reagents.
   - Organometallic Compounds of the Group 13, 14, 15 and 12 Elements.
5. Organometallic Compounds of the Transition Elements
   - The 18-Electron Rule.
6. Transition Metal Carbonyls
   - Bonding in Carbonyl Compounds.
   - Evidence for Synergetic Bonding.
   - Types of Carbonyl Ligands.
7. Synthesis and Properties of Simple Metal Carbonyls
   - Carbonyls of the Groups 4 – 11 Elements.
8. Reactions of Transition Metal Carbonyls
9. Other Carbonyl Compounds
   - Metal Carbonyl Anions.
   - Metal Carbonyl Hydrides.
   - Metal Carbonyl Halides.
10. Complexes with Phosphine Ligands
11. Complexes with Alkyl, Alkene and Alkyne Ligands, Synthesis of Transition Metal Alkyls
12. Complexes with Allyl and 1,3-Butadiene Ligands
13. Metallocenes
14. Complexes with η^6-Arene Ligands
15. Complexes with Cycloheptatriene and Cyclooctatetraene Ligands
16. Fluxionality
17. Organometallic Compounds in Industrial Catalysis
   - Acetic Acid Synthesis: The Monsanto Process.
   - Alkene Polymerization: The Ziegler – Natta Catalyst.
   - Hydrogenation of Alkenes: Wilkinson's Catalyst.
   - Hydroformylation.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and presentation of one bibliographic work by the students face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) by the tutor and the students.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1) Written examination after the end of the semester. The mark from this examination consists of the 60% of the final grade. Minimum passing grade (in the 0-10 scale): 5 2) Writing of one bibliographic work by students in groups of two. The mark from this work is the 20% of the final grade. Minimum passing grade (in the 0-10 scale): 5 3) Presentation of the bibliographic work (half by each student). The mark from this presentation (and the subsequent examination) is the 20% of the final grade. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	*Semester workload*
Lectures and seminars (3 contact hours per week × 13 weeks)	39
Final examination (2 contact hours)	2
Presentation of the bibliographic work (1 contact hour)	1
Hours for the preparation of the bibliographic work by each student	18
Hours for private study by the student	40
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100***

5. RECOMMENDED LITERATURE

1. N. Klouras, "Organometallic Chemistry", Publications of University of Patras, 2007.
2. I. Haiduc, J.J. Zuckerman, "Basic Organometallic Chemistry", Translation: N. Klouras, Papazisis Publications, 1987.
3. G.O. Spessard, G.L. Miessler, "Organometallic Chemistry", Prentice Hall, 1997.
4. C. Elschenbroich, "Organometallics", 3rd Edition, Wiley-VCH Verlag-GmbH & Co, 2006.
5. R.H. Crabtree, "The Organometallic Chemistry of the Transition Metals", 3rd Edition, John Willey & Sons, 1994.
6. I. Omae, "Applications of Organometallic Compounds", John Willey & Sons, 1998.
5. C.E. Housecroft, A.G. Sharpe, "Inorganic Chemistry", 3rd Edition, Pearson Prentice Hall, 2008.
7. C.E. Housecroft, "The Heavier d-Block Metals: Aspects of Inorganic and Coordination Chemistry", Oxford Chemistry Primers, Oxford University Press, 1999.

Quality Control in Analytical Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 756**	**SEMESTER**	**7th**
COURSE TITLE	QUALITY CONTROL IN ANALYTICAL CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	4
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Analytical Chemistry)
PREREQUISITE COURSES:	Typically, there are not prerequisite course.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2068/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

1. Quality characteristics of analytical methods such as: accuracy, trueness, reproducibility, repeatability, detectability, sensitivity, specificity, robustness.
2. Experimental approaches used for the evaluation of the quality characteristics of analytical methods.
3. Calibration of analytical methods.
4. Experimental design and method optimization.
5. Analysis of variance.
6. Validation of analytical instruments and other laboratory equipment
7. Method validation. Acceptance criteria.
8. Traceability.
9. Method comparison studies.
10. Intra- and inter-laboratory quality control systems.
11. Laboratory accreditation.
12. Quality assurance.
13. ISO standards.
14. Understand and appreciate the importance of sampling issues in chemical analysis.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking*

The student will be able to:

- Evaluate the performance of analytical methods and validate analytical methods.
- Deal with internal and external quality control programs.
- Carry out method comparison studies.
- Organize the accreditation of a laboratory.
- Apply ISO to an analytical laboratory.
- Develop appropriate sampling strategies.

3. COURSE CONTENT

- Quality characteristics of analytical methods such as: accuracy, trueness, reproducibility, repeatability, detectability, sensitivity, specificity, robustness.
- Experimental approaches used for the evaluation of the quality characteristics of analytical methods.
- Validation of analytical instruments and other laboratory equipment
- Calibration of analytical methods.
- Experimental design and method optimization.
- Analysis of variance.
- Method validation. Acceptance criteria.
- Traceability.
- Method comparison studies.
- Intra- and inter-laboratory quality control systems.
- Laboratory accreditation.
- Quality assurance.
- ISO standards.
- Understand and appreciate the importance of sampling issues in chemical analysis.

4. TEACHING and LEARNING METHODS - assessment

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and seminars face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26
Seminars (1 contact hour per week × 13 weeks) – typical examples of quality control and method validation	13
Homework (2 home-works at the end of semester)	4
Final examination -Final report (3 contact hours)	3

	Hours for private study of the student and preparation of home-works (2 per semester) and for the final examination-final report	54
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination and/or final written report after the end of the semester - final grade. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.	

5. RECOMMENDED LITERATURE

- *Suggested bibliography:*

1. Notes of lecturers in Greek and/or in English.

Biochemistry-3 (Gene Expression and Regulation-Gene Engineering)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 713**	**SEMESTER**	**7th**
COURSE TITLE	BIOCHEMISTRY-3		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	4
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Biochemistry)
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess basic knowledge of General Biology and Biochemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Understand the major considerations of gene expression and its regulation.
2. Recognize the critical control points of regulation of gene expression.
3. Evaluate the specificity of gene expression and its possible application in genetic engineering techniques.
4. Combine and apply the appropriate methodologies for production of recombinant products.
5. Use Artificial Intelligence (AI) tools in molecular biology and genetic engineering issues.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills:

1. Acquisition of comprehensive knowledge and understanding of the essential data, concepts, principles, theories and applications related to the flow of genetic information and gene expression.
2. Ability to apply this knowledge and understanding to the solution of qualitative and quantitative problems of non-familiar nature.
3. Ability to adopt and apply methodology to the solution of non-familiar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, by using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Working in an interdisciplinary environment
Promotion of free, creative and inductive thinking
Project design and management

3. COURSE CONTENT

1. Rearrangement and replication of genes.
2. Transcription and processing of RNA.
3. RNA translation – Protein biosynthesis.
4. Regulation of gene expression, hormonal and epigenetic control, effect of chromatin, histones and protein interactions in gene expression.

5. Post-translational control of gene expression.
6. Applications of Artificial Intelligence (AI) in gene regulation and genetic engineering
7. Principles and methods of molecular biology
   a. *Genetic engineering*
   b. Recombinant DNA technology.
   c. Restriction enzymes.
   d. Manipulation of eukaryotic DNA.
   e. Cell transfection.
   f. Recombinant proteins.
   g. RT-PCR.
   h. Gene silencing (RNAi, CRISPR/Cas9).

4. TEACHING and LEARNING METHODS - ASSESEMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and tutorials face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course. Laboratory demonstration and implementation of molecular biology applications. Assign thematic problems to students to resolve.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination or oral examination by presentation of a lecture by the students of selected subjects from the subject matter. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	***Semester workload***
Lectures (2 contact hours per week × 13 weeks)	26
Tutorials (1 contact hours per week × 13 weeks)	13
Designing of the thematic study (10 contact hours)	10
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of the thematic study and final examination	48
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100***

5. RECOMMENDED LITERATURE

1. G.M. Cooper, "*The Cell: A Molecular Approach*", 8th Greek Edition, Academicals Publications, 2021.

2. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto, Jr., Lubert Stryer, "*Biochemistry*", Translation of 9th American Edition, Crete University Press, 2021.
3. Nelson David L., Cox Michael M., "*Lehninger Principles of Biochemistry*", 3rd Greek Edition, Broken Hill Publishers Ltd, 2024.
4. C.A. Demopoulos, S. Antonopoulou, "Basic Biochemistry, 3rd Edition, NEON Publications, 2020 (in greek language).
5. Rich A. Harvey, Denise R. Ferrier, "*Lippincott's Illustrated Reviews Biochemistry*", 6th Greek Edition, Parisianos Publications 2015.
6. D. Doenecke, J. Koolman, G. Fuchs, W. Gerok, "*Karlsons Biochemistry και Pathobiochemistry*", 15th Greek Edition, Ed.: E.G. Fragkoulis, Medical Publications Litsas, 2012.
7. J.G. Georgatsos, "*Introduction to Biochemistry*", 7th Edition, Giahoudis Publications, 2005 (in greek language)
8. C. P Tsiganos, N. Papageorgakopoulou, S. Anagnostidis, A. J. Aletras, "*Laboratory Practice in Biochemistry*", University of Patras Publications, 2008.
9. B. Lewin, "*Genes VIII*", 2nd Greek Edition, translation: G. Stamatogiannopoulos, Academic Publications I. Basdras, 2022.
10. Burton E. Tropp, "*Principles of Molecular Biology*", 1st Greek Edition, Academic Publications I. Basdras, 2014.
11. James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine, Richard Losick, "*Molecular Biology of the Gene*", 2nd Greek-7th American Edition, Utopia Publications, 2015.

Clinical Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 714**	**SEMESTER**	**7th**
COURSE TITLE	CLINICAL CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	4
Laboratories	2	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Biochemistry), skills development
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical courses of 'General Biology'' and 'Biochemistry''
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/modules/document/?course=CHEM2083

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Recognize and apply the basic analytical biochemical and clinical chemistry techniques as well as the methods of evaluation in the clinical chemistry laboratory.
2. Evaluate the analytical data of the clinical laboratory in regards to the (patho)physiology of body organs and systems.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to clinical chemistry.
2. Ability to apply such knowledge and understanding to clinical chemistry - biochemistry laboratory and to expand his/her education to more complex issues of clinical chemistry and biochemistry.
3. Study skills needed for continuing professional development.
4. Ability to interact with others on inter or multidisciplinary problems.
5. Ability to adopt and apply methodology for the solution of unfamiliar problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3. COURSE CONTENT

1. Methods of separation and analysis. Laboratory techniques of separation and analysis. Molecular diagnostic techniques.
2. Quality control in clinical chemistry laboratory. Reliability of methods, faults and errors, physiological values, choice and development of analytical methods, quality control, reception and processing of biological material.
3. Analysis of aminoacids, proteins and enzymes in clinical chemistry. Analysis of aminoacids and derivates. Hemoglobins, plasma proteins, proteins of urine and encephalospinal fluid. Changes of enzymes in diseases and their localization.
4. Analysis of carbohydrates, lipids and lipoproteins. Control of carbohydrates, lipids and lipoproteins in pathological conditions.

5. Control of endocrine system. Control of thyroid, suprarenal glands, hypophysis and gonads.
6. Acid-base balance, electrolytes and renal function.Control of acid-base balance, electrolyte concentration and renal function.
7. Control of hepatic, gastric, pancreatic and intestinal function. Control of hepatic, gastric, pancreatic and intestinal function. Indicators of dysfunction.
8. Laboratory courses. Analysis of biological samples and indicators of diagnostic interest. Analysis of blood and urine. Analysis of carbohydrates, hemoglobins, proteins, lipoproteins, urea, bilerubine, transaminases, cholesterol, triglycerides, alkaline phosphatase isoenzymes, clearance test.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and laboratory work face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	See table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally, preparation of a literature project that consists 50% of the final grade. 2. Written examination after the end of the semester. For students who have performed the literature project the mark of the final examination consists 50% of the final grade. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26
Laboratory work (2 contact hour per week × 13 weeks)	26
Literature project and presentation (1 contact hour per student x×15 students)	15
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for final examination	30
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100***

5. RECOMMENDED LITERATURE

1. W. Marshall, “Clinical Chemistry”, 6th Edition, P.X. Paschalidis Publications, 2011.
2. W.J. Marshall, “Clinical Biochemistry”, K. & N. Litsas Publications, 2000.
3. D. Vynios, A. Theoxaris, “Exercises of Clinical Chemistry”, University of Patras Publications, 2017.
4. Skorilas, “Principles of clinical chemistry and molecular diagnostic”, Symmetria Publications, 2009.
5. P. Karlson, W. Gerok, W. Grob, “Clinical Pathobiochemistry”, Translation: K. Sekeris, Litsas Medical Publications, 1993.

Catalysis and Green Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
DEPARTMENT	CHEMISTRY		
LEVEL OF COURSE	UNDERGRADUATE		
COURSE CODE	**XE 792**	**SEMESTER OF STUDIES**	**7th**
COURSE TITLE	CATALYSIS & GREEN CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	4

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Organic – Inorganic – Physical Chemistry and Chemical Technology)
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical courses of "Inorganic Chemistry", "Organic Chemistry", "Physical Chemistry" and "General Principles of Chemical Technology".
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek although teaching may also be conducted in English if foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Be familiar with the basic principles of Green Chemistry and their contribution to the formation of chemical processes in industry
2. Present the basic concepts and methods of homogeneous and heterogeneous catalysis including enzymatic catalysis, photocatalysis and electrocatalysis.
3. Classify catalysts and catalytic reactions in important categories and presents the fundamental aspects of catalytic activity for each catalyst category.
4. Understand the differences between general and specific acid (and basic) catalysis.
5. Understand the reactions accelerated by transition metal organometallic catalysts and propose catalytic cycles with logical intermediates.

6. Describe the mechanisms of Heck, Suzuki, Stille, Sonagashira, Negishi, Kumada, Hiyama, alkenes hydrogenation and hydroformylation reactions, the nature of the reagents and catalysts required and the selectivity achieved.
7. Understand the basic principles of organocatalysis and phase- transfer catalysts.
8. Describe the structure as well as the methods for the preparation, characterization and evaluation of solid catalysts.
9. Explain the contribution of catalysis to the chemical industry, the destruction of pollutants, the improvement of traditional fuels and the development of fuel and environmentally friendly processes.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to demonstrate knowledge and understanding of the essential data, concepts, principles and theories related to the efficient operation of catalytic processes (Design and Project Management).
2. Ability to apply this knowledge and understanding to the solution of qualitative and quantitative problems of inappropriate nature (Adaptation to new situations).
3. Ability to adopt and apply the relevant methodology to solve non-related problems (Decision Making).
4. Study skills needed for continuous professional development (Autonomous work).
5. Ability to interact with others on chemical or interdisciplinary issues (Teamwork).

3. COURSE CONTENT

Principles of Green Chemistry

Introduction to Catalysis - Applications Range

- Kinds of catalysis and types of catalysts
- Comparison of Homogeneous and Heterogeneous Catalysis and Catalysts.
- Catalyst operation and ways of accelerating chemical reactions
- Catalytic Reaction Mechanisms and Catalytic Circles
- Catalytic Activity and Selectivity

Homogeneous Catalysis

- Specific and General Acid-Base Catalysis
- Lewis Acids as Catalysts
- Catalysing Organic Reactions by Lewis Acids - Selectivity

Organometallic Catalysts

- Reactions / Mechanisms taking place in the coordination sphere of catalytic complexes
- Shift reactions (ROP, RCM)
- Coupling reactions (Suzuki, Sonagashira, Negishi, Heck, Stille, Kumada ..)
- Types of ligands
- Stereoelectronic and chelating tuning of ligands
- Coupling reactions C-O, C-N, C-C of Buchwald-Hartwig type
- Catalytic carbonylation
- Catalytic Hydrogenation
- Catalytic Hydroformylation

- The Monsanto Process
- The Wacker Process

Organocatalysis

- Nucleophilic Catalysis - General
- Organic catalysis by imines and iminates
- Carbenium organatalysis
- The Stetter reaction
- The Morita - Baylis - Hillman reaction
- Phase-Transfer Catalysis (Organic Salts and Crown Ethers)

Heterogeneous Catalysis

- Catalysis by Enzymes
- Surface Acid-Base Catalysis-Zeolites.
- Partial Oxidation Reactions over the Transition Metal Oxide Surface.
- Catalysis over the Metal Surface.
- Hydrotreatment of Petroleum Fractions on the Surface of Supported Sulphides.
- Photocatalysis.
- Electrocatalysis.
- Solid Catalysts.
- Preparation of non-Supported Catalysts and Carriers.
- Preparation of Supported Catalysts.
- Determination of Geometric Characteristics of Solid Catalysts.
- Determination of Chemical Characteristics of Solid Catalysts.
- Determination of Kinetic Parameters of Heterogeneous Reactions: Laboratory Catalytic Reactors.
- Surface kinetics.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and seminars face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint and molecular models) in teaching. The lecture notes of each chapter are uploaded, in the form of a series of pdf files, on the e-class webpage where the students can download them freely. Communication with students is continuous through personal contact, posting announcements on the Department's website and e-class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures / Seminars (3 contact hours per week × 13 weeks)	39
Interim examinations (2 written exams, mid and late semester, 2 contact hours each)	4
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for, interim and final examinations	54
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written*	1. Two intermediate exams or home assignments which if passed with grade>7.0 the final written examination is waived off. 2. Oral examination-Presentation of Articles (up to 20% increment of the final written examination grade if it is rated ≥5.0). 3. Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. Behr, P. Neubert, "Applied Homogeneous Catalysis", Wiley-VCH, 2012.
2. R. A. Sheldon, I. Arends, U. Hanefeld, "Green Chemistry and Catalysis", Wiley-VCH, 2007.
3. P.T. Anastas, R.H. Grabtree (editors), "Green Catalysis", 3 Volumes Set, Wiley-VCH, 2013.
4. P.T. Anastas (series editor), Chao-Jun Li (volume editor), "Green Processes", 3 Volumes Set, Wiley-VCH, 2013.
5. A.S. Lycourghiotis, C. Kordulis, "Catalysis: Lessons of Undergraduate Level" (In Greek) Patras University Editions, 2010.
6. A.S. Lycourghiotis, "Introduction in the Contact Catalysis, Volume I: Selection, Preparation and Textural Characterization of Solid Catalysts" (In Greek) Stamoulis Editions, 1987
7. I.M. Campbell, "Catalysis at Surfaces", Chapman and Hall Ltd., 1988.
8. R.A. Van Santen, "Theoretical Heterogeneous Catalysis", World Scientific Lecture and Course Notes in Chemistry, Vol. 5, World Scientific Publishing Co., 1991.
9. B.C. Gates, "Catalytic Chemistry", The Wiley Series in Chemical Engineering, Wiley, 1992.
10. J.A. Moulijn, P.W.N.M. van Leeuwen, R.A. van Santen (editors), "Catalysis: An Integrated Approach to Homogeneous, Heterogeneous and Industrial Catalysis", Studies in Surface Science and Catalysis, Elsevier, 1993.
11. J.M. Thomas, W.J. Thomas, "Principles and Practice of Heterogeneous Catalysis, VCH, 1997.
12. G. Ertl, H. Knözinger, F. Schüth, J. Weitkamp (editors), "Handbook of Heterogeneous Catalysis", Volumes 1-8, 2nd Edition, Wiley-VCH, 2008.
13. R.J. Wijngaarden, A. Kronberg, K.R. Westerterp, "Industrial Catalysis: Optimizing Catalysts and Processes", Wiley-VCH Verlag GmbH, 1998.
14. Cornils and W.A. Herrmann, M. Muhler, C.-H. Wong (editors), "Catalysis from A to Z: A Concise Encyclopedia", Volumes 1-3, 3rd Edition, Wiley-VCH, 2007.J. Hagen, "Industrial Catalysis: A Practical Approach", 2nd Edition, Wiley-VCH Verlag GmbH, 2006.
15. J. Hagen, "Industrial Catalysis: A Practical Approach", 2nd Edition, Wiley-VCH Verlag GmbH, 2006.
16. A.S. Lycourghiotis, C. Kordulis, "Catalysis" (In Greek) Hellenic Open University, 2003.
17. Kordulis, A. S. Lycourghiotis, "Catalytic Surfaces" (In Greek) Hellenic Open University, 2003.
18. Notes of lecturers in Greek.

Enzymology

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 715**	**SEMESTER**	**7th**
COURSE TITLE	ENZYMOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**

Lectures	3	4
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Scientific Area, skills development	
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Knowledge of Organic Chemistry, Biochemistry and Molecular Biology is highly desirable.	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.	
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES	
COURSE WEBSITE (URL)	https://eclass.upatras.gr/modules/document/?course=CHEM2012	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course, the student will be able to understand:

1. The chemical composition of the enzymes, the ways of measuring their activity, methods of their purification and isolation
2. The chemical background of enzyme function including enzyme catalysis and the functional characteristics of the active site of different enzymes.
3. The kinetics of enzyme reactions without or with inhibition and their explanation through simple mathematical models.
4. The phenomena of allosterism and synergy as well as some mathematical models explaining them by using the R and T enzyme forms.
5. The regulation of enzyme activity following covalent modification of their structure by (i) zymogen proteolysis; (ii) phosphorylation; (iii) oxidations (general: carbonylation, specific: formation of methionine sulfoxides, glutathionylation, nitrosylation); (iv) addition of fatty acids.
6. The interaction of enzymes with xenobiotics and the organism's response to them (reactions and enzymes of phases 1 and 2).
7. Enzyme design with desirable properties (enzyme engineering).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will be able to:

1. Ability to understand the essential data, concepts, principles, and theories related to the nature, function, and overall significance of enzymes — both as independent molecular machines and as components of biological systems.
2. Ability to apply this knowledge and understanding to solve qualitative and quantitative problems of an unfamiliar nature.
3. Ability to adopt and apply appropriate methodologies in solving unfamiliar problems.
4. Study skills required for continuous professional development.
5. Ability to interact with others on problems of chemical (biochemical) or interdisciplinary nature, and to develop skills in retrieving information from scientific databases and use artificial intelligence (AI) applications in the investigation of enzyme-catalyzed reactions.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

3. COURSE CONTENT

1. History of Enzymology. Name and rank of enzymes depending on the reactions that catalyse them. Predicting 3D structures of enzymes from amino acid sequences with high accuracy using AI applications.
2. Methods for determining enzyme activity (units, measurement expressions, continuous, discontinuous methods and a concise description thereof).
3. Purification and isolation of enzymes: downstream processing protocol with description of basic chromatographic techniques (ionic, hydrophilic, reverse phase, metallochemical, affinity, size exclusion).
4. Mechanisms of enzymatic catalysis and functional characteristics of the active enzyme center. Role of coenzymes, description of active center, specialization and physicochemical explanation of its function. Chemical background of enzyme function: covalent catalysis, base acid catalysis, deviations of pKa of amino acid residues of active sites, electrostatic catalysis. Examples of catalytic mechanism for specific enzymes.
5. Kinetic enzymatic reactions: simple mathematical models, dynamic equilibrium state, Km and kcat concepts and experimental calculation. Calculation of Keq at the point of equilibrium of an enzymatic reaction. Effect of temperature, pH and time on the rate of an enzymatic reaction.
6. Inhibition: simple mathematical models for describing competing, competitive, and mixed inhibition. Non-competitive inhibition, inhibition by product, irreversible inhibition. Nomenclature and mechanisms of reactions with many substrates.
7. Allosterism and synergy. Characteristics of allosteric enzymes. Types of synergy, saturation fraction. Explanation of positive homotropic synergy with mathematical models using R and T enzyme forms. Biochemical explanation of allosteric-synergy phenomena (ATKase example). Sigmoidal kinetics without synergy effects.
8. Regulation of enzyme activity following covalent modification of its structure: (i) zymogen proteolysis, (ii) phosphorylation, (iii) oxidations (general: carbonylation, specific: formation of methionine sulfoxides, glutathionylation, nitrosylation), (iv) addition of fatty acids. Examples of biological functions (digestion, blood coagulation, signal transduction pathways, blood sugar regulation) following covalent modification of specific enzymes are presented.
9. Interaction of enzymes with xenobiotic compounds. General principles of the nervous system, neuronal thrust transmission, agonist-antagonists. Xenobiotic compounds, insecticides, insecticidal target enzymes. Response of the organism to xenobiotics: Phase 1, phase 2 reactions and enzymes (conjugates). Example: paracetamol metabolism.
10. Design of enzymes with desirable properties (enzymatic engineering): (i) Enzyme hydrolysis with proteases or CNBr. (ii) Chemical modification targeting specific amino acid residues (polymer substitution, generation of artificial endonucleases from non-catalytic proteins, etc.). (iii) Use of

recombinant DNA techniques: reasonable recombination with a few premeditated mutations, directed enzymatic progression with random mutations targeted for specific activity, enhancing enzyme activity using structural data and specific software, generation of chimeric or multifunctional enzymes with more than one catalytic function, creation of mimes (non-protein or protein) of catalytic function. (iv) *In silico* design of completely new enzymes with desirable properties using AI applications.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	PowerPoint type lectures by the teacher, posted on the Internet with free access to the students.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	See table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	*Semester workload*
Lectures and seminars (3 contact hours per week × 13 weeks)	39
Final examination (3 contact hrs)	3
Hours for private study of the student and for the final exam	58
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

5. RECOMMENDED LITERATURE

1. I. Clonis, "Enzymology", Embryo Publications, 2016.

Microbiology

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**BI 722**	**SEMESTER**	**7th**
COURSE TITLE	MICROBIOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures,*	**TEACHING HOURS**	**ECTS CREDITS**

laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits	**PER WEEK**	
Lectures	2	4
Laboratory work	2	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General knowledge, skills development
PREREQUISITE COURSES:	Formally there are no prerequisites. However, knowledge of General Biology, Biochemistry and Molecular Biology is recommended.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/modules/document/?course=CHEM2049

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course, the student will develop the following skills (general competencies):

1. Understanding of the organization and structure of the prokaryotic and eukaryotic cell.
2. Comprehension of the molecular biology of microorganisms and the mechanisms used to produce energy (aerobic and anaerobic respiration, fermentations, photosynthesis).
3. Classification of bacterial, archaea and fungi.
4. Understanding of the biology of representative genera of bacteria and fungi.
5. Knowledge of the use of micro-organisms for the production of products (e.g. bioreactors, production of citric acid and wine).
6. Skills: preparation of nutrients, isolation of microorganisms from the environment and cultivation in the laboratory. Macroscopic distinction of fungi, yeasts and bacteria. Microscopy of pure cultures of fungi, yeasts and bacteria. Bacterial cell stains (Gram, endospore). Control of susceptibility of bacteria to antibiotics (antibiogram).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

The students will be able to:

- use aseptic techniques,
- isolate microorganisms from environmental samples and establish pure microbial cultures,
- examine macroscopically microbial colonies and differentiate among fungi, yeasts and bacteria,

- estimate density of microbial populations in foods (i.e. milk),
- examine microscopically pure microbial cultures,
- apply microbial stain techniques,
- study the life cycle of fungi,
- examine the sensitivity of bacteria to antibiotics.

3. COURSE CONTENT

A. General Microbiology

1. The historical development of the science of microbiology.
2. Organization and structure of prokaryotic and eukaryotic cells. Cytoplasmic membrane and its functional role. Types of cell walls, flagella, chemotaxis, not moving appendages. The bacterial endospore. Plasmids, ribosomes, structure of mammalian and plant cells.
3. Microbial Metabolism. Description of anabolism, catabolism and the different glycolytic pathways of microorganisms. Production of energy from electron flow to oxygen or other recipients (reduction of nitrates, sulfates, CO_2, methanogenesis). Fermentation and fermentation types. Cycle of nitrogen. anoxic and oxygenic photosynthesis.
4. The types of microbes. Classification systems and features used in classification. Presentation of the phyla of bacteria with emphasis on specific species. Properties of Archaea. Presentation of the phylum of the Archaea. Kingdom of fungi: structural, functional and morphological characteristics. Mycorrhizae and yeasts. Classification of fungi. Reproduction and life cycle of different classes.

B. Applied Microbiology

5. Bioreactors: Summary bioreactors. Configure the bioreactor. The bioreactor modes. Practical considerations for the design of the bioreactor.
6. Production of products from microorganisms: Major products and methodology of industrial microbiology. Upstream and downstream descending processing. Examples of products produced by microorganisms with special emphasis on the citric acid. Packaging - Product standardization.
7. Manufacture of wine from microorganisms: yeasts. Reproduction in yeast. Identification of species of winemaking yeasts. Strain-killers and wineries. Glycolysis - Alcoholic Fermentation. Secondary products of fermentation. Lactic bacteria. Acetic bacteria. Microbial interactions in winemaking and aging of wines.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and laboratory work face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	PowerPoint type lectures by the teacher, posted on the Internet with free access to the students. Presentation of power point assignments by students on specific subjects of the course.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure*	1. Written examination at the end of the semester on the total lectures, with a maximum of 7 and a minimum probable grade of 3.5.

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks).	26
Laboratory work (7 laboratory exercises × 2 contanct hours)	14
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of laboratory reports	57
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	2. Practical examination of the identification of micro-organisms with maximum grade 1. 3. Written examination on subjects of laboratory workshop with a maximum of 1. 4. Grading of laboratory reports to a maximum of 1. 5. The total grade of the Laboratory is derived from paragraphs 2 to 4, it has a maximum value of 3 and is considered to be promotable from 1.5 and above. 6. The students have the option to present up to two power point presentations on a subject of Microbiology to a student audience and are scored after a student-teacher discussion, with a maximum of 1 for each presentation. The grade of the work shall be added to the grade in paragraph 1. 7. The final grade of the course is set off against paragraphs 1 (theory) and 5 (laboratory) and must be from 5 and above. Greek grading scale: 1 to 10. Minimum passing grade: 5. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENTED LITERATURE

1. G. Aggelis, "*Microbiology and Microbial Technology*", **UNIBOOKS** Publications, 2017 and scientific papers relevant to the lectures of the topic.

Practical Training

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XII 786**	**SEMESTER**	**7th or 8th**
COURSE TITLE	PRACTICAL TRAINING		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	Practical training		4
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Skills development		
PREREQUISITE COURSES:	Formally there are no prerequisites courses. Students should have successfully completed their obligations in courses corresponding cumulatively to at least 100 ECTS.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.praktiki.chem.upatras.gr/ and https://eclass.upatras.gr/courses/CHEM2185/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Through practical training students are given the opportunity:

1. to acquire a first job experience related to the subject of their studies
2. to demonstrate and put into practice the skills and knowledge they have acquired during their studies
3. to get acquainted with labor market trends and the skills required
4. to begin to acclimate to the work environment and its demands
5. to develop professional awareness and demonstrate communication, cooperation and initiative skills
6. to have a complete picture of the job-finding process (interviews, sending resumes, etc.)

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

At the end of Practical Training, the student will have further developed the following skills/competences:

Search for, analysis and synthesis of data and information with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Criticism and self-criticism
Project planning and management
Production of free, creative and inductive thinking

3. COURSE CONTENT

The Practical Training is carried out in companies/public organizations related to chemistry (Industries, Enterprises, Analytical laboratories, Biochemical laboratories, General Chemical State Laboratory, Biochemical Laboratories of Hospitals, Research Centers or Institutes, etc.). The duration of the Practical Training is three months and the student follow the working hours of the respective company/public organization.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face practical training in chemistry-related companies/ public organizations.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Power point presentations by the students.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational*	Students follow the working hours of the respective company/public organization

visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Detailed written report (50% of the final grade). 2. Presentation of a relevant seminar (50% of the final grade). Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Experimental Diploma Thesis

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**EX 704, EX 705, EX 804, EX 805**	**SEMESTER**	**7th and 8th**
COURSE TITLE	EXPERIMENTAL DIPLOMA THESIS-1 (EDT-1) EXPERIMENTAL DIPLOMA THESIS-2 (EDT-2) EXPERIMENTAL DIPLOMA THESIS-3 (EDT-3) EXPERIMENTAL DIPLOMA THESIS-4 (EDT-4)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
EX 704: EXPERIMENTAL DIPLOMA THESIS-1 (EDT-1)	**8**	**6**
EX 705: EXPERIMENTAL DIPLOMA THESIS-2 (EDT-2)	**8**	**6**
EX 804: EXPERIMENTAL DIPLOMA THESIS-3 (EDT-3)	**10**	**9**
EX 805: EXPERIMENTAL DIPLOMA THESIS-4 (EDT-4)	**4**	**3**
Total number of hours for the Course (25 hours of work-load per ECTS credit)		**24**

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background and Skills development
PREREQUISITE COURSES:	Formally there are no prerequisites. Students should have successfully completed their obligations in courses corresponding cumulatively to at least 120 ECTS.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of set of courses "Experimental Diploma Thesis", the student will be able to:

1. search and combine bibliographic data from scientific sources in a systematic way
2. apply safety and hygiene rules and good practice to a chemical laboratory
3. design experiments, under appropriate supervision, and analyze/combine data to understand, study and investigate issues of chemical interest
4. know and apply techniques related to the subject of the diploma thesis
5. know the wider thematic area related to the diploma thesis
6. write methodologically sound scientific reports,
7. present to the audience scientific results

In addition, under the EDT-3 and EDT-4, the student will have developed the following skills:

1. design and implementation of integrated teaching on the topics of the diploma's thesis that is part of the curriculum of high school education
2. conversion of scientific knowledge into the high school education

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

Generally, by the end of this course the student will have develop the following general abilities (from the list above):

Search for, analysis and synthesis of data and information
Adapting to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Showing social, professional and ethical responsibility and sensitivity to gender issues
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and management

3. COURSE CONTENT

Experimental Diploma Thesis (EDT) is a set of four courses. Experimental Diploma Thesis is one of the most important educational processes for the student of the Department of Chemistry. Through the elaboration of Experimental Diploma Thesis, the student will have the ability to combine, deepen and apply the knowledge gained during his/her studies, while he/her will be familiarized with research activities. At the same time, he/her is given the opportunity to take initiatives and develop his/her creativity.

The Experimental Diploma Thesis can be performed at the Department of Chemistry or collaborating Chemistry Departments, as well as collaborating Research Institutes. The Experimental Diploma Thesis under is supervised by a faculty member of the Department of Chemistry, who is also responsible for the student performance evaluation. In the cases of collaborations, a co-supervisor from the collaborating Department/Institute is also designated by the Assembly of the Department.

The Experimental Diploma Thesis is conducted at the 7th and 8th semester, provided that the student has has successfully completed his obligations in courses in previous semesters corresponding cumulatively to at least 120 ECTS.

The Experimental Diploma Thesis is a set of four courses corresponding cumulatively to 24 ECTS. It includes literature search (Experimental Diploma Thesis-1), research in one of the research laboratories of the Department and/or collaborating laboratories (Experimental Diploma Thesis-2 and Experimental Diploma Thesis-3), writing and public presentation of its results (Experimental Diploma Thesis-4).

In particular, the framework of EDT-3 and EDT-4 in the 8th semester includes the organization of full teaching through the preparation of a course teaching plan (attached as an appendix to the diploma thesis) and the preparation of a 15-minute micro-teaching part of this plan using a teaching tool Of Natural Sciences (eg experiment, simulation, etc.) on the subject of the degree that is part of the curriculum of secondary education (high school education).

4. TEACHING and LEARNING METHODS - ASSESSMENT

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Literature search through face to face training.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Information and Communication Technologies (IT) in searching for information/literature survey.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Total number of hours for the Course (25 hours of work-load per ECTS credit)</td><td>600 hours (sum for EDT-1, EDT-2, EDT-3 and EDT-4)</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>A cumulative grade is assessed for all four courses “Experimental Diploma Thesis”. To assess the student performance, the following are evaluated:
1) the responsibility and the good laboratory practice
2) the written diploma thesis
3) the public presentation of the diploma thesis.

Greek grading scale: 1 to 10. Minimum passing grade: 5.
All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.</td></tr>
</table>

5. RECOMMENDED LITERATURE

It is determined by the subject of the Experimental Diploma Thesis

For students who choose Bibliographic Diploma Thesis

Bibliographic Diploma Thesis

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ΒΠΕ**	**SEMESTER**	**8th**
COURSE TITLE	BIBLIOGRAPHIC DIPLOMA THESIS (BDT)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
ΒΠΕ: BIBLIOGRAPHIC DIPLOMA THESIS (BDT)	**10**	**8**
Total		**8**

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background and Skills development
PREREQUISITE COURSES:	Formally there are no prerequisites.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

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- *Guidelines for writing Learning Outcomes*

At the end of set of courses "Bibliographic Diploma Thesis", the student will be able to:

1. search and combine bibliographic data from scientific sources in a systematic way
2. apply safety and hygiene rules and good practice to a chemical laboratory
3. design experiments, under appropriate supervision, and analyze/combine data to understand, study and investigate issues of chemical interest
4. know and apply techniques related to the subject of the diploma thesis
5. know the wider thematic area related to the diploma thesis
6. write methodologically sound scientific reports,
7. present to the audience scientific results

In addition, under the EDT-3 and EDT-4, the student will have developed the following skills:

1. design and implementation of integrated teaching on the topics of the diploma's thesis that is part of the curriculum of high school education
2. conversion of scientific knowledge into the high school education

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	……
Production of new research ideas	*Others…*
	…….

Generally, by the end of this course the student will have develop the following general abilities (from the list above):

Search for, analysis and synthesis of data and information
Adapting to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Showing social, professional and ethical responsibility and sensitivity to gender issues
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and management

3. COURSE CONTENT

A. Bibliographic Diploma Thesis (BPE) can be carried out by the student who will not choose to carry out an Experimental Diploma Thesis, following a reasoned decision of the department meeting and with the consent of the supervising Professor. The student is required to carry out a thorough and in-depth bibliographic search of a scientific topic determined by the supervising Professor. The student must have fully understood the subject of the literature review after the writing and public presentation of the Bibliographic Diploma Thesis.

B. Bibliographic Diploma Thesis can be performed at the Department of Chemistry under the supervision by a faculty member of the Department of Chemistry, who is also responsible for the student evaluation. I

C. Bibliographic Diploma Thesis is conducted at the 8th semester.

D. Bibliographic Thesis corresponds to 8 credits (ECTS) and is graded after its completion. It includes the search in the literature of a scientific subject, defined by the supervising Professor, its writing and its public presentation.

In addition, in the context of the BDT in the 8th semester includes the organization of full teaching through the preparation of a course teaching plan (attached as an appendix to the diploma thesis) and the preparation of a 15-minute micro-teaching part of this plan using a teaching tool Of Natural Sciences (eg experiment, simulation, etc.) on the subject of the degree that is part of the curriculum of secondary education (high school education).

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Literature search through face to face training.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (IT) in searching for information/literature survey.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	

Activity	***Semester workload***
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***200 contact hours***

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	A cumulative grade is assessed for "Bibliographic Diploma Thesis". To assess the student performance, the following are evaluated: 1) the extensive and in-depth review of the scientific topic that the student should develop. 2) the written diploma thesis 3) the public presentation of the diploma thesis. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

It is determined by the subject of the Bibliographic Diploma Thesis

Food Biochemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 816**	**SEMESTER**	**8th**
COURSE TITLE	FOOD BIOCHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**4**

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General knowledge
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry and Biochemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2023/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Know in general the composition of various foods in carbohydrates, proteins, lipids, vitamins, pigments etc. and the role of these constituents in foods.
2. Know in general about the food enzymes, their role, and which the enzymes that are used in food processing.
3. Know in general about the food alterations and the biochemical basis of carbohydrates, proteins, lipids, vitamins, pigments etc. changes that occur.
4. Know in general about the effect of several food treatments on carbohydrates, proteins, lipids, vitamins, pigments etc. and their chemical basis.
5. Know the biochemical processes that occur during fruits ripening and meat tenderization.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Adapting to new situations

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking*

At the end of the course the student will have further developed the following skills/competences

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to role and importance of carbohydrates, lipids, proteins, vitamins, pigments etc. in foods, as well as the biochemical processes that occur and affect these constituents during of foods processing.
2. Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems of an unfamiliar nature.
3. Ability to adopt and apply methodology to the solution of unfamiliar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others on inter or multidisciplinary problems and use artificial intelligence (AI) applications in predicting the nutritional content or metabolic profiles of food components.

3. COURSE CONTENT

1. Carbohydrates. The role of carbohydrates in foods. Changes of carbohydrates during foods processing (Hydrolysis, crystallization, isomerisation, dehydration, non-enzymatic browning).
2. Pectins. Properties of pectins and their involvement in the formation of gels. Role of pectins in food and health.
3. Lipids and oils. The role of lipids in foods. Changes of lipids during foods processing (polymerization, lipolysis, oxidation, self-oxidation). Effect of self-oxidation on the structure, colour, taste and smell of lipids.
4. Proteins. Proteins in foods. Proteins of meat and seafoods. Post-mortem biochemical changes of proteins. The milk proteins and their role in cheese production. Proteins of eggs, seeds, and vegetables, their nutritional significance. Effects of foods processing on proteins.
5. Natural pigments in foods. Chlorophylls, carotenoids, phenolic compounds.
6. Biochemical processes, occurred during fruits ripening and meat tenderization that affect the food texture, colour, taste and smell.
7. Enzymes. Enzymes in foods. Factors that affect the enzyme activity during foods processing. Application of enzymes in foods technology. Enzymes hydrolyzing carbohydrates, proteolytic enzymes, lipolytic enzymes, oxidoreductases.
8. Enzymatic browning. Reaction mechanism, polyphenolases. Methods of enzymatic browning control and restriction.
9. Vitamins. Fat-soluble and water-soluble vitamins. Vitamins in foods. Vitamins loss during foods processing.
10. Food additives. Conservatives, taste and smell additives, pigments, structure additives.
11. Alterations of foods by microorganisms (Biodegradation).
12. AI applications in food biochemistry, including the prediction of nutrition content, microbial growth, enzymatic reactions, metabolomics data and food quality.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	PowerPoint presentation lectures, posted on the Internet with free access to students. Presentation of power point assignments by students on specific subjects of the course.
TEACHING METHODS *The manner and methods of teaching are described in detail.*	***Activity*** | ***Semester workload***

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Lectures and seminars (3 hours of contact weekly × 13 weeks)	39
	Final examination (3 conduct hours for Synthetic Organic Chemistry)	3
	Hours for private study of the student and preparation of home-works (3 per semester), for the final exam.	58
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Final written examination at the end of the semester. Greek grading scale: 1 to 10. Minimum passing grade: 5. 2. Optional elaboration of a maximum of two Food Biochemistry topics, presented as a power point to a student audience and scored after an audience, student-teacher discussion, with a maximum of 1 for each presentation. The grades of these presentations are added to the grade of the written examination. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. A. Vafopoulou-Mastrogiannaki, "Food Biochemistry", Ziti Publications, 2003.
2. D. Galanopoulou, J. Zampetakis, M.-Mavri-Vavagianni, A. Siafaka, "Food Biochemistry", Stamoulis Publications, 2007.

Pharmaceutical Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 809**	**SEMESTER**	**8th**
COURSE TITLE	PHARMACEUTICAL CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	**4**

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Organic Chemistry)
PREREQUISITE COURSES:	There are no prerequisite courses. It is recommended that students possess a good knowledge of Organic Chemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Lectures may be delivered in English if foreign students attend the course.

IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Be familiar with the general structure of an R&D department of a pharmaceutical company as well as the aspects of drug discovery and development work carried out in each subdivision.
2. Understand the general mindset of the pharma industry for investing in novel drug development.
3. Be familiar with the types of drugs depending on either the type of molecule or route of administration and understands the terms Drug substance and Drug product.
4. Understand the concepts of solubility, permeability, polar surface, lipophilicity and hydrophilicity.
5. Understand the concepts of pharmacodynamics, bioavailability, pharmacokinetics as well as the physicochemical properties of a molecule that influence its absorption, distribution, metabolism, excretion and toxicity (ADMET).
6. Know the common types of biological drug targets and understands the importance of target validation.
7. Know potential pools of molecules for preliminary screening and the assays involved in determining binding characteristics.
8. Predict the optimum approach for designing and developing lead-compounds from early hits and the available data for the target and its natural substrate.
9. Understand how the potency, selectivity, and pharmacokinetics of lead compounds are optimized through Structure Activity Relationships and Structure Properties Relationships and the concept of druglikeness.
10. Know the leading causes of drug toxicity and the importance of Drug-Drug interactions.
11. Be familiar with the process from Candidate Selection to Clinical Trials and Approval of a novel drug.
12. Be familiar with aspects of selecting and developing a large-scale synthesis and the final manufacturing route of a drug.
13. Understand the importance of salt versions and polymorphs in drug performance.
14. Be familiar with the Biopharmaceutics Classification System and the way this influences the formulation strategy in the development of the drug product.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of essential facts, concepts, theories and applications which are related to Medicinal Chemistry and Drug Development.
2. Ability to apply this knowledge and understanding to problem solving of drug design and development.
3. Ability to adopt and apply first-principles approaches to problem solving of drug design and development.
4. Study skills needed for continuing professional and academic development.
5. Ability to interact with others in chemical or interdisciplinary problem solving and brainstorms.

Generally, by the end of this course the student will, furthermore, have develop the ability to:

Search, identify, analyse and combine facts, patterns and information

Adapt to new situations

Decision making

Work independently

Teamworking

Apply critique and self-assessment

Develop free and creativity thinking and deductive thought processing

Consider impact of chemistry to the natural environment

Work design and time management

3. COURSE CONTENT

1. **Drugs in general**
   - From drug discovery to drug approval
   - Structure and avtivities of an R&D deprtment in the pharmaceutical industry
   - Drug Substance and Drug Product
   - Drug categories according to type of molecule or route of administration
   - Drug Targets
2. **Introduction to pharmacokinetics**
   - The concepts of solubility, permeablity, polar surface, lipophilicity, hydrophilicity and acid-base behavior
   - The journey of a drug from administration towards the target
   - Bioavailability
   - Absorption, Distribution, Metabolism, Excretion
   - Drug half-life – therapeutic dosing regime and therapeutic index
3. **Drug Discovery and Development – Selecting a drug target**
   - Traditional and contemporary approaches in target selection
   - Forward and reverse genetics and chemical genetics
   - Criteria for target validation
   - Target Druggability
4. **Drug design**
   - Compound pools for preliminary screening
   - Screening of natural products and chemical libraries
   - Fragment-based design
   - Rational/Ligand-based Design
   - Combinatorial Synthesis
   - Design based on existing drugs
   - Structure-based design
   - Homology modeling – conformational analysis and *in silico* evaluation
5. **Hit to lead**
   - Filtering off "garage" molecules
   - Druglikeness - Lipinski, Veber and other empirical guidelines
   - In vitro and in vivo assays
   - High Throughput Screening
   - Assessing potency and efficiency (IC_{50}, EC_{50})
   - Binding and Selectivity assays
   - Bioavailability assays
6. **Lead optimization to Candidate Selection**

- Binding interactions of functional groups
- Determining the Pharmacophore
- Structure-Activity Relationships (SARs)
- Structure-Property Relationships (SPRs)
- Quantitative Structure-Activity Relationships (QSARs)
- Toxicity and anti-targets
- Drug-Drug Interactions

7. Drug Candidates and Chemical Synthesis and Process development

- IND Application- Preclinical requirements
- Objectives of human trials
- Developing a drug synthesis on an industrial scale
- Selecting appropriate salt version and polymorphs
- Stability studies
- BSC classification – formulation strategies

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Lectures and molecular models. Course lectures, in the form of ppt or pdf files, are uploaded in the e-class from where the students can freely download them using their password. Communication with the students is established either through mail or through the webpage of the Chemistry Department.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Team-assignments (maximum of three) in groups of 5. Provided a grade of 6/10 is achieved in each, the mean mark of home-works contributes 20% to the final mark. Written examination after the end of the semester contributes 80% towards the final grade. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	*Semester workload*
Lectures and seminars (3 contact hours per week × 13 weeks)	39
Team assignments (2 x 3 contact hours) – Case studies on target validation and candidate selection	6
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of home-works and preparation for the seminars	52
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

5. RECOMMENDED LITERATURE

1. Graham L. Patrick, "*An Introduction to Medicinal Chemistry*", 6th Edition, Oxford University Press, 2017.
2. Lecture notes on e-class.

- Related academic journals:

Journal of Medicinal Chemistry; European Journal of Medicinal Chemistry; Bioorganic Chemistry; Bioorganic Chemistry and Medicinal Letters, ChemMedChem.

Biotechnology

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 817**	**SEMESTER**	**8th**
COURSE TITLE	BIOTECHNOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	4
Laboratory work	2	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General knowledge
PREREQUISITE COURSES:	Typically, there are no prerequisite courses. Essentially, the students should possess basic knowledge of: General Biology, Biochemistry, Molecular Biology, Chemical Technology and Organic Chemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2021/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student should be able to:

1. Describe biological systems or biological procedures applied (or proposed to be applied) in industrial level for chemical production.
2. Understand molecular techniques and their applications in Health sections (diagnostics and therapeutics), Food production (genetically modified plants and animals), protein engineering and analysis.
3. Know the specific applications of biological systems in Analytical Chemistry (Biosensors) and Environment (Biological Cleaning, Urban/Agricultural/Industrial Wastewater Treatment).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement

and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Biotechnology.
2. Ability to apply this knowledge and understanding to the solution of qualitative and quantitative problems related to Biotechnology of non-familiar nature.
3. Ability to adopt and apply methodology to the solution of non-familiar problems of Biotechnology.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems and use artificial intelligence (AI) tools in studying biotechnological applications..

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):
Searching, analysis and synthesis of facts and information, by using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Working in an interdisciplinary environment
Promotion of free, creative and inductive thinking
Project design and management
Respect to natural environment

3. COURSE CONTENT

1. Historical review.
2. Growth of microbial culture (upstream processing): kinetics and bioreactors.
3. Biotechnological applications of microorganisms.
4. Downstream processing: technology for the separation, purification and production of proteins and enzymes with emphasis on the large (industrial) scale.
5. Immobilized biocatalysts and their applications.
6. Modification of proteins and enzymes.
7. Biocatalysis and biotransformation in organic solvents.
8. Animal cell cultures, monoclonal antibodies.
9. Genetic engineering and its applications.
10. AI applications for protein structure prediction, gene expression analysis, enzyme function identification, biomarker discovery, image analysis, new drug discovery, molecular modeling, etc.

Laboratory excercises:

a. Isolation and characterization of alcohol dehydrogenase from yeast.
b. Enzyme immobilization in solid supports. Application of immobilized enzymes in bioreactors. Comparative studies.
c. Enzymatic reactions in organic solvents.
d. Multimedia exercises with audiovisual material on the use of enzymes in food industries and environmental applications.
e. Multimedia exercises with audiovisual material on pharmacogenomics.

4. TEACHING and LEARNING METHODS – ASSESSEMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and laboratory work face-to-face.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. powerpoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course. Laboratory demonstration and implementation of biotechnological applications. Assign thematic problems to students to resolve
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (2 hours of contact weekly × 13 weeks)	26
Laboratory work (2 conduct hour per week × 13 weeks)	26
Designing of the thematic study (12 contact hours)	12
Final examination (2 contact hours)	2
Hours for private study of the student and preparation of home-works (3 per semester), for the final exam.	34
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Development of a Biotechnology Advanced subject study (individual or in groups of two students), with a 30-minute Public Presentation using powerpoint. Depending on the performance in the study, this may be dispensable with the final examination. 2. Written examination from which the final grade is determined, unless the student participated in the study during the semester. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. D.A. Kyriakidis, "Biotechnology", in Greek language only, Ziti publications, 2002.
2. V. Moses, R.E. Cape, D.G. Springham (editors), "Biotechnology: The Science and the Business", Harwood Academic Publishers, 1999.
3. D. Vynios, "Biotechnology: Laboratory exercises", in Greek language only, University of Patras.

- Related academic journals:

Current Opinion in Biotechnology; Biotechnology Advances; Biotechnology and Bioengineering; Nature Biotechnology; Trends in Biotechnology; Biosensors and Bioelectronics; Critical Reviews in Biotechnology; Applied Microbiology and Biotechnology

Polymer Science

1. GENERAL

SCHOOL	NATURAL SCIENCES

ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 885**	**SEMESTER**	**8th**
COURSE TITLE	POLYMER SCIENCE		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	4
Seminars	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background
PREREQUISITE COURSES:	There are not prerequisite courses. Students should have some basic knowledge of organic chemistry
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The course can be, however, taught in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras/courses/CHEM2102

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. know the basic methods for polymer synthesis such as polycondensation, free radical polymerization, cationic and anionic polymerization
2. know the most important industrial polymers and how can be synthesized as well as their properties and applications
3. Know the methods for the synthesis copolymers (in particular for block and graft copolymers)
4. know the most important polymer properties in solid state (T_g, T_m) and the parameters which affect them
5. know the polymer solution properties
6. combine and apply the proper synthetic methodologies in order to synthesize new polymers and somehow to predict their properties

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will furthermore develop the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and application which are related to Polymer Science
2. Ability to apply this knowledge and understanding to the solution of problems related to polymer synthesis and polymers properties

Generally, by the end of this course the student will furthermore develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3. COURSE CONTENT

1. *Introduction*
   - Polymer Nomenclature
   - Polymerization degree and average molecular weights
   - Classification of polymerization reactions
   - Polymer isomerism
2. *Step growth polymerization*
   - Polymer classes synthesized via step growth polymerization (polyesters, polyamids, etc)
   - Polymers with high thermal and mechanical stability
   - cross-linked polymers (thermosetting polymers)
   - reaction rate
   - acid catalyzed step growth polymerization reaction
   - step growth polymerization reaction without acidic catalyst
   - distribution of molecular weights, degree of polymerization (deviation from functional groups stoichiometry)
   - Carothers equation (relates the degree of polymerization with the degree of conversion)
3. *Free Radical Polymerization*
   - Monomers
   - initiators, thermal, photochemical, initiation, initiation using redox system, initiator efficiency
   - mechanism (Initiation, Propagation, termination)
   - Reaction rate and degree of polymerization
   - Chain transfer reactions, effect of chain transfer reactions on the degree of polymerization
   - Important commercial polymers
4. *Cationic polymerization*
   - initiators, (strong protic acids, Lewis acid-Lewis base complex)
   - monomers
   - Mechanism (Initiation, Propagation, termination)
   - Chain transfer reactions
   - Kinetics
5. *Anionic polymerization*
   - Initiators
   - monomers
   - Mechanism (Initiation, Propagation, termination)
   - degree of polymerization and distribution of molecular weight
   - effect of solvent polarity on polymerization reaction rate
   - stereoselectivity and dienes
   - Living anionic polymerization
   - Poisson distribution in living polymerization
   - Synthesis of block copolymers
   - synthesis of star copolymers

- synthesis of graft copolymers

6. *Living Radical polymerization*
   - Stable free radical polymerization
   - Atom transfer radical polymerization (ATRP)
7. *Stereospecific polymerization*
   - Ziegler-Natta catalysts
   - Polymerization mechanism
8. *Copolymerization*
   - copolymer composition
   - Kinetics-copolymerization reaction rate
   - copolymerization equation
   - Reactivity ratios
   - ideal copolymerization
   - azeotropic copolymerization
   - alternating copolymerization
   - calculation of reactivity ratios
9. *Polymer conformations*
   - conformations, bond rotation
   - average end to end distance for ideal polymer chains
   - radius of gyration
10. *Thermodynamics of Polymer Solutions*
    - Statistical Thermodynamics (ideal and regular solutions)
    - Flory Huggins theory
    - entropy of mixing and enthalpy of mixing for regular polymer solutions
    - interaction parameter χ
11. *Solid state properties of polymers*
    - glass transition temperature (T_g) and melting temperature (T_m)
    - description of glass transition temperature using the free volume theory
    - parameters that affect the glass transition temperature (T_g)

4. TEACHING and LEARNING METHODS – ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and seminars face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Lectures. Course lectures and exemplary solved problems for every chapter, in the form of ppt files, are uploaded in the internet in a platform where students have access through their personal passwords. Communication with the students is established through e-mail.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26
Seminars (1 contact hour per week × 9 weeks) - solving of representative problems	9
Half-term evaluations (2, one in the middle and the other at the end of the semester, 2 contact hours each)	4
Final written examination (3 contact hours)	3
Private study time of the student and preparation for the half-term evaluations and final examination	58
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Optionally, half-term written examinations, the first one in week 7th of the semester and the second in week 13th. It is prerequisite that the students should obtain the grade 5 in both examinations in order to pass the course. 2. Written examination after the end of the semester - final mark, unless the students participated in half-term examinations. (In the latter case, the percentage of the marks of the two half-term written examinations will be the final mark). Minimum passing grade: 5. 3. All above described assessment activities of the progress of students concern solving problems which combine concepts and theories taught. Each problem is associated with a certain mark so that the total number of marks is equal to 10. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. P.C. Hiemenz, T.P. Longe, "Polymer Chemistry", Χημεία Πολυμερών», 2nd Edition, CRC Press, 2007.
2. A.D. Dondos, "Synthetic Macromolecules", Kostarakis Publications, 2002.
3. G. Karayannidis, I. Sideridou, "Polymer Chemistry", Ziti Publications, 2006.
4. J. M. G. Cowie, "Polymers: Chemistry & Physics of Modern Materials", Blackie Academic & Professional, 1994.
5. G. Odian, "Principles of Polymerization" John Wiley Inc., 1991.
6. C. E. Carraher, "Seymour/Carraher's "Polymer Chemistry", 6th Edition, Marcel Dekker Inc., 2003.

Chemical Industries (Inorganic and Organic)

1. GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	CHEMISTRY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**XE 886**	**SEMESTER**	**8th**	
COURSE TITLE	CHEMICAL INDUSTRIES (INORGANIC AND ORGANIC)			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures			3	4
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background			
PREREQUISITE COURSES:	There are not prerequisite courses. Students should have some basic knowledge General Chemistry, Physical Processes, Chemical Technology and Catalysis.			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The course can be, however, taught in English in case foreign students attend the course.			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)				

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Present the production processes of the most important inorganic and organic products, with emphasis on the Greek Chemical Industry.
2. Know the thermodynamics and kinetics of the processes involved in the production of basic inorganic and organic products and understand their importance in the design of the respective industrial process.
3. Define commonly encountered concepts such as: crude oil, mineral hydrocarbons, octane number, feed, heat exchanger, etc.
4. Describe the basic parts of the structure of an industrial chemical unit,
5. Combine processes to produce the desired product from a particular raw material.
6. Understand the essential technological, environmental and financial requirements for the design of basic industrial processes.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	……
Production of new research ideas	*Others…*
	…….

By the end of this course the student will furthermore develop the following skills (general abilities):

1. Be able to find the information needed from any related Chemistry books.
2. Identify and name the various parts and their function in a chart of a chemical industry unit.
3. Choose the appropriate process for a given feed and desirable end-product properties.
4. Ability to apply knowledge of physical processes and chemical technology to the solution of qualitative and quantitative problems involved in various stages of the industrial process.
5. Ability to adopt and apply this knowledge and understanding to similar industrial processes.
6. Develop the kinetics for a catalytic process based on data and constraints.
7. Study skills needed for continuous professional development.
8. Ability to interact with others in chemical or interdisciplinary problems.

Generally, by the end of this course the student will furthermore develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3. COURSE CONTENT

1. Water as a raw material in industry and water purification processes.
2 Nitrogen industries. Synthetic ammonia, nitric acid, nitrogenous chemical fertilizers.
3. Phosphate Fertilizer Industries.
4. Sulfuric and sulfuric acid. Industrial production of sulfuric acid by the contact method.
5. Hydrochloric acid and halogens.
6. Carbonic soda. Caustic soda.
7. Electrolytic industries. Aluminum, magnesium.
8. Portland Cements.
9. Iron and steel.
10. Raw Materials for the Organic Chemical Industry.
11. Natural Gas and Crude Oil: Historical review of the discovery and uses of mineral hydrocarbons, origin, physical and chemical properties.
12. Natural gas processing and uses.
13. Structure of crude oil refinery, diagram.
14. Analysis and determination of the composition and quality of crude oil.
15. Atmospheric fractionation and vacuum distillation, products and uses thereof.
16. Catalytic reforming of naphtha, products and uses thereof.
17. Catalytic isomers, products and uses thereof.
18. Hydrogenation.
19. Pyrolysis processes products and uses thereof.
20. Methane, ethylene, propylene, butenes, benzene, toluene, xylenes as petrochemical feedstocks.

The feed and product properties are presented for all processes, as well as reaction conditions and reactor types, catalytic materials and their action, industrial unit diagrams.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and seminars face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint presentations) in Lectures. Course lectures and exemplary solved problems for every chapter, in the form of ppt files, are uploaded in the internet in a platform where students have access through their personal passwords. Communication with the students is established through e-mail.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory*	1. Optionally, half-term written examinations, the first one in week 7th of the semester and the second in week 13th. It is prerequisite that the students should obtain the grade 5 in both examinations in order to pass the course. 2. Written examination after the end of the semester - final mark, unless the students participated in half-term examinations. (In the latter case, the percentage of the marks of the two half-term written examinations will be the final mark). Minimum passing grade: 5.

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	39
Half-term evaluations (2, one in the middle and the other at the end of the semester, 2 contact hours each)	4
Final written examination (3 contact hours)	3
Private study time of the student and preparation for the half-term evaluations and final examination	54
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	3. The half-term examinations and the final written examination take place in the Greek language and for the foreign students (for example, ERASMUS students) in the English language. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English. All above described assessment activities of the progress of students concern solving problems which combine concepts and theories taught, multiple choice, correct/error matching, fill-in, etc. Questions are also asked to identify and name parts of chemical industry processes in an industrial chart and to describe their operation. Each problem is associated with a certain mark, so that the total number of marks is equal to 10.

5. RECOMMENDED LITERATURE

1. 'The Petroleum Handbook', Royal Dutch, Shell Group of Companies, Koninklijke Nederlandsche, Petroleum Maatschappij, Elsevier, 1986.
2. 'Industrial Organic Chemicals in perspective' H. A. Wittcoff, B. G. Reuben, J. Wiley & sons, USA, 1980.
3. Note w in Greek language by the teaching staff.

Food Chemistry and Technology – Oenology II

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 887**	**SEMESTER**	**8th**
COURSE TITLE	FOOD CHEMISTRY AND TECHNOLOGY – OENOLOGY II		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	4

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science.
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. The students should have at least knowledge of the basic concepts of Chemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.chem.upatras.gr

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the*

European Higher Education Area

- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. All the factors (microbial, etc.) that affect food spoilage.
2. Food preservation methods at industrial, craft, and/or household scale.
3. The effects of food spoilage on human health.
4. The biochemistry of wine production.
5. The nutritional value of genetically modified and functional foods.
6. Legislation.
7. **Describe all the safety rules to be applied in a chemical laboratory and recognize what one must not do.**

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will have developed the following skills/competences:

1. Know and be able to apply the best conditions under which food is best preserved, and to easily recognize spoiled foods such as meat, cheese, milk, etc.
2. Knowing the wine production biochemistry, will be able to intervene during fermentation in order to alter its course or make any other necessary corrections.
3. With the knowledge on food microbiology and food legislation, the student completes his knowledge on food and is better prepared for employment seeking in the industry, food companies, or to start his own business in the food sector.

Generally, by the end of this course the student will have further developed the following general abilities (from the list above):

- *Searching, analysis and synthesis of facts and information, as well as using the necessary technologies*
- *Adaptation to new situations*
- *Decision making*
- *Autonomous (independent) work*
- *Group work*
- *Work in interdisciplinary environment*
- *Exercise of criticism and self-criticism*
- *Promotion of free, creative and inductive thinking*

3. COURSE CONTENT

A. Food Spoilage

1. Food microbiology: Bacteria (species, morphology, physiology, environmental factors that influence growth). Fungi (morphology, physiology, classification, environmental factors that affect growth, biochemical activity).
2. Food spoilage: Causes. Spoilage of the main food ingredients (carbohydrates, proteins, fats and oils, vitamins, natural dyes). Spoilage of certain groups of food (fruits and vegetables, meat, milk, cereals and their products).

3. Food preservation: Drying. Drying of various products (fruit, vegetables, food of animal origin, beverages). Condensation. Salting. Smoking - smoked foods. Canning. Freezing. Chemical preservatives. Radiation. Means of food packaging.

B. Oenology

1. Microbiology of wine: Morphology, physiology, composition and food of the yeast cell. Species related to alcoholic fermentation: Candida, Saccharomyces, Torulopsis. Saccharomyces species: Saccharomyces cerevisiae, S. elipsoides, S. apiculatus, S. pombe, S. bayanus, S. pastorianus. Sugars in the alcoholic fermentation. Biochemistry of alcoholic fermentation. Microorganisms that cause wine spoilage. Control of wine fermentation. Factors that affect yeast survival and the appearance of spoilage. Causes of stuck fermentation and its treatment. Malolactic fermentation. Methods for isolation of yeast strains. Liquid and solid yeast cultures. Preparation of grape must in order to enhance the fermentation. The role of oxygen in alcoholic fermentation. Redox potential of wine. Redox ingredients of wine. Production of baker's and fodder yeasts. Other microorganisms in alcoholic fermentation: the bacterium Zymomonas mobilis.
2. Alcohol: Production, Chemical properties, Biological activities, Methods of determination in alcoholic beverages.

C. New trends in food production

1. Imitation foods. Genetically modified food. Nutritional value of genetically modified food.
2. Functional foods. Novel foods. Nanofoods. Probiotic Foods. Prebiotic food ingredients. Antioxidant ingredients. Phytosterols. Omega-fatty acids.

D. Wastes and by-products of the food industry

Waste types. Statistical data. Ways of processing-recovery (recovery, chemical conversion, biotechnological exploitation). Value-added products from waste (Biofuels, Chemicals, Animal feeds, Bioactive Ingredients, New Foods, Biosorbent materials, etc.).

4. TEACHING and LEARNING METHODS - ASSESSMENT

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face lectures using Information and Communication Technologies (ICTs) (e.g. PowerPoint).
Visits to industries.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of ICTs (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of .ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (3 contact hours per week × 13 weeks)</td><td>39</td></tr>
<tr><td>Final written examination (3 contact hours)</td><td>3</td></tr>
<tr><td>Private study time of the student and preparation for the half-term evaluations and final examination</td><td>58</td></tr>
<tr><td>Total number of hours for the Course
(25 hours of work-load per ECTS credit)</td><td>100 hours</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral</td><td>Final written examination.
Greek grading scale: 1 to 10. Minimum passing grade: 5.
All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.</td></tr>
</table>

examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

5. RECOMMENDED LITERATURE

1. A.A. Koutinas, M. Kanellaki. Food Chemistry and Technology. University of Patras Publications, 2009-2010. *(in Greek language only)*
2. Notes by the teaching staff.
3. J. Jay. Modern Food Microbiology. 6th Edition, Springer-Verlag, 2000.
4. H.-D. Belitz, W. Grosch, P. Schieberle. Food Chemistry. 4th Edition, Springer, Berlin, 2009.
5. R.S. Jackson. Wine Science: Principles and Applications. 3rd Edition, Elsevier, 2008.
6. O.R. Fennema. Food Chemistry. 3rd Edition, Marcel Dekker Inc., 1996.

Bioinorganic Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	CHEMISTRY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**XA 827**	**SEMESTER**	**8th**	
COURSE TITLE	BIOINORGANIC CHEMISTRY			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	Lectures		3	4
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Inorganic Chemistry)			
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess: knowledge provided through the previously taught theoretical courses (a) ''Introduction to Inorganic Chemistry'', (b) Inorganic Chemistry-1, (c) Inorganic Chemsitry-2, (d) Inorganic Chemistry-3			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2086/			

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*

- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Discuss the role of metal ions that are used in living organisms and explain why nature might have chosen them.
2. Explain how the metal ions get into cells and how their concentrations are regulated.
3. Describe how metal ions bind to biopolymers, how metal ion binding can fold biopolymers leading to function, and how they are inserted into their active centers.
4. Understand the major roles of metal ions in biological systems, as electron carriers, centers for binding and activating substrates, agents for transferring atoms and groups, and as "bioinorganic chips".
5. Know the employment of metal complexes in Medicine.
6. Describe the toxic and environmentally harmful effects of metal ions, including the ways in which such toxicities are overcome both by the natural systems and by human intervention.
7. Know the role of inorganic elements in nutrition.
8. Design small metal complexes as structural and/or functional models for the metalloenzymes' active centers.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to demonstrate knowledge and understanding of concepts and principles related to the study of naturally occurring inorganic elements in Biology, the introduction of metals into biological systems as probes and drugs, the role of metal ions in nutrition, the toxicity of inorganic species, and the metal-ion transport and storage in Biology.
2. Ability to apply such knowledge and in-depth understanding to solve problems of unfamiliar nature.
3. Ability to interact with others on interdisciplinary problems and to

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking
Respect to natural environment
Work design and management

3. COURSE CONTENT

(1) Bioinorganic Chemistry: Introduction

Definitions.

Metal functions in metalloproteins.

Metal functions in metalloenzymes.

Communication roles for metal ions in Biology.

Interactions of metal ions and nucleic acids.
Metal-ion transport and storage in Biology.
Metals in Medicine.

(2) Properties of Biological Molecules

Proteins.
Nucleic acids.
Other metal-binding biomolecules.

(3) Physical Methods in Bioinorganic Chemistry

Time scales.
X-ray methods.
Spectroscopic methods.
Magnetic measurements.
Electrochemistry.

(4) Choice, Uptake and Assembly of Metal-Containing Units in Biology

Bioavailability of metal ions.
Intracellular chemistry of metal ions.
Spontaneous self-assembly of metal clusters.
Control and Utilization of Metal-Ion Concentration in Cells
Beneficial and toxic effects of metal ions.
The generation and uses of metal-ion-concentration gradients.

(5) Metal-Ion Folding and Cross-Linking of Biomolecules

Stabilization of protein structure by metal ions.
Stabilization of nucleic acid structure by metal ions.
Protein binding to metallated DNA.
Metallointercalators.

(6) Binding of Metal Ions and Complexes to Biomolecule-Active Centers

Selection and insertion of metal ions for protein sites.
Preservation of electroneutrality.
Metal-ion and metal-complex binding to nucleic acids.

(7) Electron-Transfer Proteins

Electron carriers.
Long-distance electron transfer.

(8) Substrate Binding and Activation by Nonredox Mechanisms

Hydrolytic enzymes.
Carbonic anhydrase and alcohol dehydrogenase.
Nucleotide activation.

(9) Atom- and Group-Transfer Chemistry

Dioxygen transport.
Oxygen-atom-transfer reactions.
The Cu-Zn superoxide dismutase, catalase and peroxidases.

(10) Metal Complexes in Medicine

Metal complexes in nutrition.
Anticancer activity of metal complexes.
Diagnostic agents.

4.TTEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and seminars face-to-face.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Written examination (50% of the final mark). 2. An assay comprising the writing of one literature report accompanied by an oral presentation (50% of the final mark). Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	39
Hours for private study of the student and preparation of oral presentations	6
Final examination (3 contact hours)	3
Hours of Private Study of the Student for the preparation of the Final Examination	52
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***100 hours***

5. RECOMMENDED LITERATURE

1. S.J. Lippard, J.M. Berg, "Principles of Bioinorganic Chemistry", University Science Books, 1994.
2. R.M. Roat-Malone, "Bioinorganic Chemistry: A Short Course", Wiley-Interscience, 2002.
3. R.W. Hay, "Bioinorganic Chemistry", Translation: E. Manesi-Zoupa, D. Raptis, Papazisis Publications, 1992.

Computational Chemistry, Theoretical Spectroscopy and Molecular Design

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 839**	**SEMESTER**	**8th**
COURSE TITLE	COMPUTATIONAL CHEMISTRY, THEORETICAL SPECTROSCOPY AND MOLECULAR DESIGN		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**	

Lectures	2	**4**
Seminars	1	
Laboratory work	1	

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background, Skills development
PREREQUISITE COURSES:	There are no prerequisite courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, teaching can also be done in English if foreign students follow the program.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of the course the student will have further developed the following skills/competences: Advanced use of computers and in-depth exploration of the possibilities offered by the Internet. The knowledge and skills that will be acquired fall into the area of Information Technology and the handling of Electronic Computers.

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Search for analysis and synthesis of data and information, with the use of the necessary technology
2. Production of new research ideas
3. Production of free, creative and inductive thinking

3. COURSE CONTENT

A. Introduction and use of the Computer to the solution of problems in the general area of Analytical Chemistry, Organic Chemistry and Quantum Chemistry. Chemical Information. Pattern recognition, similarity and clustering. General application of Computers. Cosmochemistry/Astrochemistry and Quantum Pharmacology. Artificial Intelligence.

B. Theoretical and computational study of rotational spectra in the gas phase.

Theoretical and computational study of vibrational spectroscopy.

C. Chemical Graph Theory.

- Topological Matrix and Huckel Molecular Orbital Theory.
- Molecular complexity.
- Quantitative Structure-Property Relationships (QSPR).
- Quantitative Structure-Activity Relationships (QSAR).

- Algorithms of minimization of energy, molecular orbitals, electronic theory (Hartree-Fock, CI, CC, MCSCF, MP, DFT) and chemical appications.
- Introduction to Molecular Mechanics (MM).
- Molecular Design.
- Applications to Medicinal Chemistry.

Practical/Laboratory courses

Ab initio calculations for small organic and inorganic molecules.

Prediction of molecular structure and spectroscopic properties of small molecules.

4. TEACHING and LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures, Tutorials and laboratory work face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of the blackboard and projection of transparencies. Professional use of the Internet for the location of Data and specialized material online. Laboratory exercises, hands on the Computer, for the development of skills on subjects related to Mathematics, Physics and Chemistry.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	26
Laboratory work (1 contact hours per week x 13 weeks)	13
Tutorials (1 contact hour per week × 13 weeks)	13
Possibility of preparing a project	18
Final examination (1 contact hours)	3
Hours for private study of the student and preparation for the Laboratory and final examinations	27
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***125 hours (total student workload)***

STUDENT ASSESMENT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1.Overall lab examination (70% of the final grade). 2.Evaluation of the project/essay (30% of the final grade). Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. Kolocouris, “Computational Chemistry”, Parisianos Publications, 2017.

2. Hill, “Python for Chemists”, Gotsis Publications, 2025.

3. Related Scientific Journals.

Didactics of Natural Sciences

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**AN 841**	**SEMESTER**	**8th**
COURSE TITLE	DIDACTICS OF NATURAL SCIENCES		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	3

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background and skills development
PREREQUISITE COURSES:	There are no prerequisite courses. However, knowledge of basics of Educational Sciences and Learning Psychology would be useful.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to

1. Comprehend the importance of teaching of Natural Sciences
2. Approaching the basic concepts of didactics of Natural Sciences
3. Acquire knowledge related to the requirements of science teaching (required knowledge: Laboratory skills, Mathematics, Computing).
4. Apply basic concepts of teaching methods and teaching 'tools'.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*

Working in an interdisciplinary environment
Production of new research ideas

At the end of the course the student will have further developed the following skills/competences

1. Ability to design a Natural Sciences course.
2. Ability to choose the appropriate method for effective teaching, based on parameters such as number of students, knowledge level, equipment provided, time, etc.
3. Ability to select sources and evaluate them.
4. Ability to control and evaluate the whole teaching and learning process.

3. COURSE CONTENT

From traditional Pedagogy to Didactics of Natural Sciences.

Theories of learning, experiential knowledge, transformation of scientific knowledge.

Aims and objectives of didactics of natural sciences.

Importance of Understanding natural sciences for every citizen.

Teaching tools.

Teaching methods (modern trends). Teaching aids.

Course design.

Laboratory teaching. Equipment.

Education of a teacher of natural sciences. Related activities of a teacher of natural sciences. Correlation of natural sciences with other disciplines (interdisciplinarity).

Informal learning sources.

Evaluation. Lifelong learning. The fields of research and development.

The state of natural sciences teaching and the training of related scientists at European level.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY
Face-to-face, Distance learning, etc.

Lectures face-to-face.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students

Use of ICTs (e.g. PowerPoint) in teaching. Course lectures are uploaded in e-class where students have access through their personal passwords.

TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26
Written assays (one every four weeks) on subjects related to the course. They require a literature survey and information synthesis. (6 × 6 hours for each assay)	36
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for the final examination.	10
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory

1. Written examination at the end of the semester. Greek grading scale: 1 to 10. Minimum passing grade: 5.
2. Optional elaboration of a maximum of three topics. The grades of these presentations are added to the grade of the written examination (up to 30% of the final grade).

All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

5. RECOMMENDED LITERATURE

- Suggested bibliography:

1. K. Ravani, "Introduction to Didactics of Natural Sciences", New Technologies Publications, 2003. (in Greek language only)
2. Kr. Chalkia, "Teaching Natural Sciences", Patakis Publications, 2012. (in Greek language only)
3. M.S. Yadav, "Teaching of Science". Publ. Ltd., New Delhi, 1992.
4. Publications from http://www.unideusto.org/tuningeu/publications.html

- Related academic journals:

Journal of Chemical Education, World Journal of Chemical Education, Physical Review Physics Education Research, Science Education, Science & Education

Introduction to Economics for Engineers and Scientists

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**OI 831**	**SEMESTER**	**8th**
COURSE TITLE	INTRODUCTION TO ECONOMICS FOR ENGINEERS AND SCIENTISTS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	3

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge
PREREQUISITE COURSES:	There are no prerequisite courses. However, it would be useful to remember basics Mathematics and Statistics.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http:/eclass.upatras.gr/courses/ECON1238/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Present the most important applications of economic theory in the real economy and the firm: microeconomics, macroeconomics, finance.
2. Know the organizational and functional structure of the firm.
3. Recognize the basic definitions and economic mechanics.
4. Combine and apply the appropriate methodologies and computational techniques for capital budgeting under uncertainty.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

At the end of the course the student will have further developed the following skills/competences:

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to economic theory and the theory of firms (business economics).
2. Ability to apply such knowledge and understanding to the solution of quantitative problems into the context of business decision making.
3. Ability to interact with others in reaching solutions to risk management problems.

3. COURSE CONTENT

1. Historical background in the evolution of the economic thought.
2. Introduction to microeconomics.
3. Introduction to Macroeconomics.
4. International finance, capital markets and financial institutions.
5. Introduction to financial management.
6. Capital budgeting.
7. Theory of firm.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face using power-point presentations and blackboard.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (3 contact hours per week × 13 weeks)	39
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for the final examination.	33
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	A review work in an advanced thematic issue by each student, followed by a 30min multimedia presentation (70% of the final mark, taken into account only when the student secures the minimum mark of 5 in the final written examination) Written examination (30% of the final mark) Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. Campbell R. McConnell, Stanley L. Brue, Sean M. Flynn "Economics: Principles, Problems, and Policies", 20th Edition, McGraw-Hill Education, 2014.
2. K. Siriopoulos, "International Capital Markets: Theory and Analysis", Anikoula Publications, 1999. (*in Greek language only*)
3. Notes and articles.

Business Administration and Organization for Engineers and Young Scientists

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**OI 832**	**SEMESTER**	**8th**
COURSE TITLE	BUSINESS ADMINISTRATION AND ORGANIZATION FOR ENGINEERS AND YOUNG SCIENTISTS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	3	3

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge
PREREQUISITE COURSES:	There are no prerequisite courses. However, it would be useful to remember basics Mathematics and Statistics.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course aims to introduce students to the science of Management with emphasis on programming, organization, management and control, as well as the roles and abilities of managers. In addition, the key concepts and functions of Business Administration in the current changing business environment will be critically analysed.

At the end of this course the student will be able to:

1. Understands the basic theories and concepts of Business Administration.
2. Critically understands the functions of Management in modern enterprises.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

At the end of this course the student will have developed the following skills:

1. Analysis of theoretical concepts and investigation of their application in administrative practices.
2. Developing ideas for case studies of administrative efficiency.

Generally, by the end of this course the student will furthermore develop the following general abilities (from the list above):

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Decision making

Autonomous (Independent) work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

3. COURSE CONTENT

1. Introduction to Management.
2. Programming.
3. Organization.
4. Management.
5. Control.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face using power-point presentations and blackboard.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography,*	

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	39

tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Final examination (3 contact hours)	3
	Hours for private study of the student and preparation for the final examination.	33
	Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Case studies. Written examination. The final grade is based on the grade of final written examination and individual work during the semester. Greek grading scale: 1 to 10. Minimum passing grade: 5. All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.	

5. RECOMMENDED LITERATURE

1. L. Chitiris, "Management - Principles of Business Administration", Faidimos ed., 2013. (*in Greek language only*)
2. J. Schermerhorn, "Introduction to Management", Broken Hill Ed., 2012.

English Chemical Terminology

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**AN 842**	**SEMESTER**	**8th**
COURSE TITLE	ENGLISH CHEMICAL TERMINOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	3

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge
PREREQUISITE COURSES:	Students are required to be Independent Users – Upper Intermediate Level (B1, B2)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The objectives are:

- To familiarize students with English Chemical terminology for the effective understanding and use of the bibliography related to their subject.
- To develop students' different combinations of various language operations so that they can attend conferences, present reports and papers and communicate their English adequately in a scientific context.
- To enable students to follow spoken and written instructions and to produce effectively the language of their science.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

Skills acquisition is related to:

- Ability to use English chemical terminology for their academic and professional development.
- Development of reading comprehension and writing skills.
- Mastering pronunciation and academic vocabulary.
- Performing writing tasks.

3. COURSE CONTENT

1. English Chemical Terminology – Root words used frequently in chemistry – Word formation (prefixes & suffixes)
2. Greek Chemical Heritage – Etymology of the names of the elements – Brief history of chemistry
3. The Periodic Table – Chemical elements, symbols and pronunciation – History of the periodic table
4. Naming chemical compounds – Chemical Nomenclature
5. Videos and exercises – Oxygen, potassium, chlorine, fluorine
6. Laboratory equipment – Laboratory safety rules and guidelines
7. States of matter – Physical and chemical properties and changes
8. Acids, bases and salts
9. Inorganic Nomenclature
10. Solutions
11. Careers in Chemistry
12. How to write a laboratory report
13. A brief guide to writing in chemistry
14. How to make a presentation

4. TEACHING and LEARNING METHODS - ASSESSMENT

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures face-to-face. Students are encouraged to interact with each other, to take notes, to summarize, to classify, to describe experiments and follow instructions. Listening comprehension and multimedia techniques are also used.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of ICTs (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of .ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (2 contact hours per week x 13 weeks)</td><td>26</td></tr>
<tr><td>Final examination (3 contact hours)</td><td>3</td></tr>
<tr><td>Hours for private study of the student and preparation for the final examination.</td><td>46</td></tr>
<tr><td>Total number of hours for the Course (25 hours of work-load per ECTS credit)</td><td>75 hours (total student workload)</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral</td><td>Assessment is performed through written examinations at the end of the semester and includes:
• Multiple choice test
• Short answers to questions
• Report
Greek grading scale: 1 to 10. Minimum passing grade: 5.</td></tr>
</table>

examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	All of the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5. RECOMMENDED LITERATURE

1. E. Spiliopoulou, "Notes for the students of the Chemistry Department", Publications of University of Patras, 2009.
2. M. McCarthy, F. O'Dell, "Academic Vocabulary in Use", Cambridge University Press, 2008.
3. K. Kelly, "Science", Macmillan Vocabulary Practice Series, Macmillan, 2007.
4. K. Efstathiou, "English-Greek and Greek-English Dictionary of Chemical Terminology", 2005.

Viticulture

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**BI 823**	**SEMESTER**	**8th**
COURSE TITLE	VITICULTURE		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		2	3
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge		
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. The students should have at least knowledge of the basic concepts of Chemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chem.upatras.gr		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will acquire the necessary knowledge for:

1. The cultivation practices to be applied to the production of good quality viticulture products (varieties, grafting, planting of vineyards, pruning and planting, cultivation cares, plant protection, sensory

evaluation).

2. The chemical composition and importance of viticulture products (grape and wine) on human nutrition.
3. The basic principles of organic viticulture (ecological principles of species diversity, soil management, plant maintenance).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course the student will have developed the following skills/competences:

1. Skills related to the knowledge of the vine varieties grown in Greece in relation to the geographical area, the importance of the raw material quality required for an excellent vinification, and the importance of organic vine-growing.
2. Ability to seek employment in downstream integrated wineries, where the raw material is produced in the vineyards of the winemaker.
3. Capacity of advisory role for winemakers and industrial winemakers for the cultivation of appropriate varieties, as well as for the proper management of grapes as winemaking raw material.
4. Generally, by the end of this course the student will have further developed the following general abilities (from the list above):

- *Searching, analysis and synthesis of facts and information, as well as using the necessary technologies*
- *Adaptation to new situations*
- *Decision making*
- *Autonomous (independent) work*
- *Group work*
- *Work in interdisciplinary environment*
- *Exercise of criticism and self-criticism*
- *Promotion of free, creative and inductive thinking*

3. COURSE CONTENT

1. Wine-growing in Greece and internationally.
2. Morphology and physiology of the vine.
3. Annual vine growing cycle. Proliferation. Soil and climatic requirements. Vineyard planting.
4. Rootstocks (Rootstock selection. American rootstocks).
5. Vine grafting (Bench grafting. Grafting on the field. Grafting rules).
6. Vine canopy management (Winter pruning. Summer pruning. Removal of excess leaf and grapes).
7. Vine training systems (Guyot and Cordon pruning. Height of training systems. Trellising).
8. Vineyard cares (Soil cultivation. Weed control. Green pruning. Irrigation. Special crops. Greenhouses).
9. Fertilization of vineyards.
10. Vineyard diseases (Soil and weather effects. Physiological diseases. Diseases due to viruses, bacteria and fungi. Diseases caused by animals and insects. Botrytis. Eutypa dieback. Cancer. Downy mildew. Acidic and White rot. Anthracnose).
11. Vineyard enemies (Phylloxera. Pseudococcus. Bud worm. Green june beelte. Nematodes. Wasps. Plant Protection and Treatments).

12. Microflora of the grape.
13. Grape varieties (Table grape varieties. Winemaking varieties. Greek varieties. Foreign varieties).
14. Chemical composition of grape and must. Grape development stages. Biological and Technological Maturity. Sugars. Organic acids. Phenolic compounds. Volatile compounds. Alcoholic degree. Harvesting. Nutritional value.
15. The grape as raw material in relation to the quality of the wines.
16. Organic viticulture.
17. Sensory evaluation.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures using Information and Communication Technologies (ICTs) (e.g. PowerPoint), and presentation of the theoretical background of the laboratory exercises.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of .ppt files, where from the students can freely download them using a password which is provided to them at the beginning of the course.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (2 contact hours per week × 13 weeks)	26
Final written examination of the lab (1 contact hour)	3
Private study time of the student and preparation for the half-term evaluations and final examination	46
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. A course-work on a viticulture topic by a group of 2 students (40% of the mean mark of the course-work is added to the grade obtained in the final written examination, provided that the student has secured at least the grade 5). 2. Written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. All the above take place in the Greek language, as well as in English for foreign students (e.g. ERASMUS students).

5. RECOMMENDED LITERATURE

1. N.A. Nikolaou. Viticulture. Syghroni Paideia Publications, 2008. (*in Greek language only*)
2. Notes by the teaching staff.
3. A. Tsakiris. Viticulture for good quality wines. Psyhalos Publications, 2016 (*in Greek language only*)
4. K. Kousoulas. Viticulture. 2nd Edition, Ekdotiki Agrotehniki, SA. 2002. (*in Greek language only*)
5. U. Hofmann, P. Kopfer, A. Werner. Organic Viticulture. transl. Korkas Ilias 2003. Psyhalos Publications, (*in Greek language only*)
6. M. Keller. The Science of Grapevines: Anatomy and Physiology. Elsevier, 2010.
7. G. Zarmpoutis, M. Tsiveriotou. Principles of viticulture and enology. ION Publications, 2003. (*in Greek language only*)
8. I. Vagianos. Practical Viticulture-Oenology. Psyhalos Publications, 1986. (*in Greek language only*)

- Related academic journals:

1. American Journal of Enology and Viticulture
2. Vitis
3. South African Journal of Enology and Viticulture
4. Ciencia E Tecnica Vitivinicola
5. Australian Journal of Grape and Wine Research

Main European Languages (French)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**AN 843**	**SEMESTER**	**8th**
COURSE TITLE	MAIN EUROPEAN LANGUAGES (FRENCH)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	3

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge
PREREQUISITE COURSES:	There are no prerequisite courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	French
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to

1. write simple texts in French
2. understand simple texts in French
3. be able to communicate in French at a basic level

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course the student will furthermore develop the following general abilities (from the list above):

Adaptation to new situations

Decision making

Autonomous (Independent) work

Team work

Respect for difference and multiculturalism

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

3. COURSE CONTENT

Basics of reading, writing, listening and speaking in French language.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching.

TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26
Written assays (one every four weeks) on subjects related to the course. They require a literature survey and information synthesis. (3 × 6 hours for each assay)	18
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for the final examination.	28
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

5. RECOMMENDED LITERATURE

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Main European Languages (German)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**AN 844**	**SEMESTER**	**8th**
COURSE TITLE	MAIN EUROPEAN LANGUAGES (GERMAN)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures	2	3

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge
PREREQUISITE COURSES:	There are no prerequisite courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	German
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to

1. write simple texts in German
2. understand simple texts in German
3. be able to communicate in German at a basic level

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course the student will furthermore develop the following general abilities (from the list above):

Adaptation to new situations

Decision making

Autonomous (Independent) work

Team work

Respect for difference and multiculturalism

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

3. COURSE CONTENT

Basics of reading, writing, listening and speaking in German language.

4. TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (2 contact hours per week × 13 weeks)	26
Written assays (one every four weeks) on subjects related to the course. They require a literature survey and information synthesis. (3 × 6 hours for each assay)	18
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for the final examination.	28
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

5. RECOMMENDED LITERATURE

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Main European Languages (Italian) (not available)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**AN 845**	**SEMESTER**	**8th**
COURSE TITLE	MAIN EUROPEAN LANGUAGES (ITALIAN)		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures		2	3
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge		
PREREQUISITE COURSES:	There are no prerequisite courses.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Italian		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)			

2.LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to

1. write simple texts in Italian
2. understand simple texts in Italian
3. be able to communicate in Italian at a basic level

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	
Production of new research ideas	
By the end of this course the student will furthermore develop the following general abilities (from the list above): *Adaptation to new situations* *Decision making* *Autonomous (Independent) work* *Team work* *Respect for difference and multiculturalism* *Exercise of criticism and self-criticism* *Promotion of free, creative and inductive thinking*	

3.COURSE CONTENT

Basics of reading, writing, listening and speaking in Italian language.

4.TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (2 contact hours per week × 13 weeks)	26
Written assays (one every four weeks) on subjects related to the course. They require a literature survey and information synthesis. (3 × 6 hours for each assay)	18
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for the final examination.	28
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

5.RECOMMENDED LITERATURE

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Main European Languages (Spanish) (not available)

1.GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	CHEMISTRY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**AN 846**	**SEMESTER**	**8th**	
COURSE TITLE	MAIN EUROPEAN LANGUAGES (SPANISH)			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures			2	3
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge			
PREREQUISITE COURSES:	There are no prerequisite courses.			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Spanish			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO			
COURSE WEBSITE (URL)				

2.LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
At the end of this course the student should be able to 1. write simple texts in Spanish 2. understand simple texts in Spanish 3. be able to communicate in Spanish at a basic level
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and Project planning and management*

information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking*

By the end of this course the student will furthermore develop the following general abilities (from the list above):

Adaptation to new situations

Decision making

Autonomous (Independent) work

Team work

Respect for difference and multiculturalism

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

2.COURSE CONTENT

Basics of reading, writing, listening and speaking in Spanish language.

3.TEACHING and LEARNING METHODS - ASSESSMENT

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures face-to-face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICTs (e.g. PowerPoint) in teaching.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures (2 contact hours per week × 13 weeks)	26
Written assays (one every four weeks) on subjects related to the course. They require a literature survey and information synthesis. (3 × 6 hours for each assay)	18
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for the final examination.	28
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***75 hours (total student workload)***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

5.RECOMMENDED LITERATURE

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V. POSTGRADUATE STUDIES

The PhD Program offered by the Department of Chemistry is described as: "PhD in Chemistry". The Program of Postgraduate Studies of the Department of Chemistry of the University of Patras was established in 1993 and is active since 1994. Since 2010, the Program has been reorganised and updated, following the recent European and international standards. The Postgraduate Program enrols graduates from all Departments of the Schools of Sciences and Polytechnic Institutions of the Country or corresponding Departments abroad.

A three-member committee (one main supervisor and two co-supervisors) is assigned for every PhD candidate. The average time required for the doctorate Diploma is three years. An MSc Diploma is currently mandatory for the application to a PhD Program. During the first year of the doctorate studies, the student is obliged to follow four courses (two courses each semester) and pass the associated exams. These courses are proposed by the three-member advisory committee, and may be the same as those of the previous MSc program of the PhD candidate. The list of courses for the doctorate studies includes all courses of the approved interdepartmental and international Post-Graduate Programs of the Department of Chemistry, as well as courses that have been proposed by the Departmental Sectors. The minimum passing grade is 5 out of 10. The exams take place at the end of each semester and repeat exams take place in September. No specific requirements for admission and registration apply to the ERASMUS students. Specifically, the Postgraduate Studies Program of the Department of Chemistry offers the following:

V.1 Master of Science (MSc) specialisations

1. Chemistry and Technology of Materials with Applications to Industry, Energy and Environment.

2. Analytical Chemistry and Nanotechnology.

3. Other Inter-Departmental/Inter-Institutional programs (see I.3.1)

V.2 The Doctor of Philosophy Diploma (PhD)

The PhD diploma covers all research activities of the Department of Chemistry. The Program of Postgraduate Studies enrols graduates from all Departments of the Schools of Sciences and Polytechnic Institutions of the Country or corresponding Departments abroad.

V.2.1 Regulations for the PhD Diploma

Under the current institutional framework of Postgraduate studies, as described in Law 3685/15.07.2008 and the decisions no. 13/05.11.2008, 9/03.07.2009, 4/26.03.2010, 8/24.04.2012 and 4/13.05.2015 of the General Assembly of the Department of Chemistry (GADC), the Regulations for the PhD Diploma at the Department of Chemistry are configured as shown below, with effect from the Academic year 2015-16.

Article 1: Structure and operating rules

The proper functioning of the Program is controlled directly by the GADC of the Department. The duration of studies for the PhD Diploma is at least three years from the date of appointment of the three-member advisory committee. Especially for doctoral candidates, non-owners of a MSc, falling into the category of exceptional cases (Law 3685/2008, article 9, paragraph 1b), the period of doctorate studies is set at four years at least, under the current legal regime.

Article 2: Select admitted to a course for PhD

Applicants for a PhD Diploma must be holders of an MSc Diploma. The application can be submitted at any date and discussed at the next meeting of the GADC of the Department. The applicants should contact previously a faculty member of the Department, which will agree to be appointed as supervisor of the doctorate thesis and endorse the request. In exceptional cases, namely graduates with bachelor (*ptychion*) degree of 8.5 or more (Excellent) can be admitted as doctoral candidates without holding an MSc. These applications are also examined by the GADC of the Department. Graduates of Schools equivalent to Universities can be admitted as doctoral candidates only if they are holders of a MSc.

Article 3: Initial registration - Renewing registrations

The initial registration of doctoral candidates will be made within twenty days from the date of their selection or within the dates determined by the Department. For reasons of exceptional necessity registration may be done within a month after deadline, after reasoned request from the candidate and decision of the GADC. The PhD students are required to renew their registration. The renewal is done by request within deadlines set by the GADC. Renewing of registrations will be made once in a year at the beginning of each academic year. A PhD student, who did not renew the registration and did not attend or conduct research for two consecutive semesters, ceases to be enrolled in the doctorate program. Suspension of studies is possible for a given period, which may not exceed twelve months, based on serious grounds and following a decision of the GADC taken after request of the PhD candidate. During the study suspension any benefits are removed, which are recovered following a new request of the interested candidate. The status of PhD candidate is incompatible with the provision of any form of teaching/educational work relative to the courses of the Curriculum of the Department of Chemistry of the University of Patras, if it is outside of his/her obligations within the Department. The PhD students, when registering in the PhD program will ensure with solemn declaration of compliance with this paragraph. The relative affidavit will be submitted by each PhD student to the Secretariat of the Department upon registration.

Article 4: Academic Calendar

Teaching and examinations of the Autumn semester are conducted from the 3rd week of October to the end of February (18 training weeks), and of the Spring semester from early March until the 3rd week of July (18 training weeks). At the end of each semester, the examinations of the corresponding courses take place. The examination period may not exceed one week. The time course and exam schedule of each semester is announced at least ten days before the semester starts. For the examinations, the same rules apply as for the undergraduate students.

Article 5: Attendance of Courses - Grading

The attendance of teaching courses and exercises (laboratory, tutorial) is mandatory. The courses are taught in Greek, but also in English if necessary. The teaching of the course and conduct of exercises or seminars, where applicable, is delegated by the GADC as defined in Article 5 par. 1 and 3 of Law 3685/2008. If there are extremely serious and substantiated reasons of the PhD candidates to fail attend the courses and participate in the planned program of exercises, absence may be justified, the

maximum duration of which cannot exceed 1/6 of the courses or exercises performed. The performance in each subject is assessed by the instructor(s) according the existing grading scale (as for undergraduates). In case that the duration of absence exceeds the defined limit, the PhD student is obliged to repeat the course. If a PhD student fails in a course, he/she is obliged to attend the course in a subsequent semester. In case of a second failure, the PhD student is removed from the program following a decision of the GADC. The grades are sent to the Secretariat of the Department of Chemistry within twenty days after the end of the examination period. In the transcripts, provided by the Secretariat of the Department, all passing grades are found.

The PhD students are obliged to provide four hours per week auxiliary educational work in laboratory or tutorial education of undergraduate or Postgraduate students of the Department, for at least two semesters (in any semester of their program). They also have the obligation, upon request, to provide other educational services, such as participation in surveillance examinations within the first three years. Doctoral candidates, who prepare the main experimental part of their doctoral thesis at an institution outside the University of Patras, will not be counted in the allocation of money to purchase consumables and will not have the obligation to provide auxiliary and educational work.

Article 6: Appointment of supervisor committees

The supervisor and the three-member Advisory Committee on the supervision and guidance of the candidate are designated in accordance with Article 9 paragraphs 2 and 3 of Law 3685/2008. The proposal for the establishment of the three-member advisory committee is in the responsibility of the supervisor. The final decision is obtained by the GADC of the Department. The three-member advisory committee in collaboration with the doctoral candidate proposes the topic of the doctoral thesis that must be defined in the next GADC and within two months of registration of the doctoral candidate in the PhD Diploma Program.

The three-member committee comprises a Professor of the Department, as Supervisor, and two other members, Professors or Lecturers of the same or another Department of the same University or other domestic or foreign, retired university professors due to age limit, Technological Institutions Professors or researchers of grades A, B or C of recognized research institutes, Greek or international, being PhD holders. Committee members should be of the same or similar academic field in which the PhD candidate works. PhD students, in collaboration with the three-member Advisory Committee, submit a progress report to the GADC the Department at the end of each year from its definition. The GADC in no. 6/6.26.2013 meeting to facilitate preparation of annual progress reports, as provided for by Law 3685/2008, established a blueprint as a model, which is at Appendix I of the Regulations.

The PhD students present a 30-min seminar, connected to each progress report. The summary of the seminar will be announced by the supervisor and posted on the Department's website at least five (5) days before the presentation. PhD students, after the deposit of the three-member advisory committee document to start writing of the PhD Thesis, are not obliged in seminar presentation. The members of the advisory committee should have active research activity.

Article 7: Evaluation and review of doctoral candidates

For the final assessment of the Phd Thesis of the doctoral candidate, following completion of his/her obligations, a seven-member examining committee is defined by the GADC, on a proposal from the three-member Advisory Committee, which brings together the members of the advisory committee. Four (4) at least members of the examining committee must be Professors or Lecturers, of which at least two (2) belong to the relevant department. The other members of the Committee may be Professors or Lecturers of Universities in Greece or from an Institution abroad, retired university professors due to age limit, Technological Institutions Professors or researchers of grades A, B or C of recognized research institutes, Greek or international, being PhD holders. At least one member of

the examining committee must not belong to the Chemistry Department, according to the Decision 13/11.5.08 of GADC. All members of the examining committee should be of the same or similar academic field in which the PhD candidate completed his dissertation. The members of the examining committee should have active research activity within the last five years, which is established under the responsibility of the advisory committee. The examining Committee defines the date, time and place of the public support of the PhD thesis. This decision of the committee communicated to the PhD candidate and the Department at least five days before the date of the public support of the thesis.

The PhD student presents his thesis, in public, before the seven-member examining committee, which then considers the originality of the thesis and whether this is a contribution to science. For the approval of the doctoral thesis, assent is required of at least five (5) members of the examining committee. The doctoral thesis should have new results, not recorded in the MSc thesis. Thus, the MSc thesis together with the PhD thesis will be filed to the seven-member examining committee, to check the originality of PhD Thesis. Any text, figure or table of another scientific report requires a bibliographical reference. For approval of the PhD thesis, the minimum required is either one publication in a scientific journal or presentation by the candidate of one oral or poster work at an international conference, or interest in a patent application, which will be demonstrated by the submission of necessary data. The final nomination of the candidate to doctorate is made by GADC when he/she completes with his/her obligations stemming from his/her doctoral studies and fulfills these requirements, which will be certified by a written confirmation of the advisory committee, which will accompany the record of decision.

For the nomination are required: i) four plasticized or leather bound copies of the text of doctoral thesis (with final adjustments), ii) the record of decision signed by the members of the examining committee, accompanied by written confirmation of the Advisory Committee (Appendix II),iii) a cd with the final text of doctorate thesis and a cd with summaries in Greek and English, iv) a completed census bulletin of the National Archive of Dissertations of the National Documentation Centre, v) certificate of the Central Library of the University that the thesis is deposited in the repository NEMERTES.

In Conferred doctorates there is no grading or designation. The number of doctoral students supervised by each faculty member cannot exceed five. Doctoral candidates who have completed three years from the announcement of the dissertation topic or from the date of registration in the PhD Diploma courses are not counted.

Article 8: Benefits

Doctoral candidates, who do not have health coverage, are entitled to the student welfare benefits in accordance with the applicable legal framework.

VI. DESCRIPTION OF THE POSTGRADUATE COURSES

PhD Diploma

The courses list for the PhD diploma includes all courses of the five specializations of the MsC Diploma, as well as of other interdepartmental or international Programs of Postgraduate Studies coordinated by the Department of Chemistry. Advanced courses proposed by the three Divisions of the Department are also included.

Course	Teaching Staff	Semester
Biochemical Analysis – Clinical Biochemistry	D. Vynios N. Karamanos	Autumn
Advanced Biochemistry	N. Karamanos Z. Piperigkou S. Skandalis	Autumn
Molecular Pharmacology – Immunology	N. Karamanos S. Skandalis	Spring
Molecular Biology – Molecular Biotechnology	Z. Piperigkou A. Vlamis D. Vynios A. Theocharis N. Karamanos	Spring
Synthetic Organic, Inorganic and Organometallic Chemistry	D. Papaioannou C. Athanassopoulos Th. Tselios G. Rassias S. Perlepes Th. Stamatatos	Autumn
Synthesis of Advanced Polymeric and Nanostructured Materials	J. Kallitsis G. Bokias	Autumn
Techniques for the Identification and Characterization of Synthetic Products and Materials	C. Tsitsilianis Th. Tsegenidis G. Tsivgoulis G. Voyiatzis G. Spyroulias V. Tangoulis C. Athanassopoulos V. Nastopoulos G. Bokias Ch. Deimede S. Perlepes Ch. Kordulis Ch. Papadopoulou A. Koliadima	Spring
Properties and Applications of Functional and Nanostructured Materials	J. Kallitsis G. Bokias Ch. Deimede S. Perlepes E. Dalas	Spring
Development, Characterization and Evaluation of Solid Catalysts	Ch. Kordulis A. Lycourghiotis	Autumn

Course	Teaching Staff	Semester
	Ch. Papadopoulou	
Air Pollution Control	H. Papaefthymiou	Autumn
Water and Soil Pollution Control	H. Karapanagioti	Spring
Bio-fuels Production	Ch. Papadopoulou	Spring
Micro/Nanotechnology - Chemical Sensors	Th. Christopoulos	Autumn
Investigating the Micro- and Nanoworld: Microscopy	Ch. Papadopoulou	Autumn
Investigating the Micro- and Nanoworld: Spectroscopy	C. Athanassopoulos Ch. Papadopoulou	Spring
Separation Science	G. Karaiskakis A. Koliadima D. Kalogianni	Spring
Green Chemistry and Catalysis in Green Chemistry	C.Poulos Ch. Matralis	Autumn
The environmental impact of chemical processes and alternative solvents	H. Karapanagioti S. Bogosian C. Poulos	Autumn
Renewable Sources for Energy and Chemicals Production	Ch. Kordulis M. Kornaros Ch. Papadopoulou	Spring
Energy Efficiency, New Technologies and Industrial Ecology	X. Verykios E.Amanatides D. Kondarides I. Kookos Ch. Deimede	Spring
Synthetic Pharmaceutical Chemistry	G. Rassias C. Athanassopoulos	Autumn
Peptide and Combinational Chemistry	S. Mourtas D. Gatos	Autumn
NMR Spectroscopy and Molecular Design	G. Spiroulias G. Tsivgoulis Th. Tselios	Autumn
Biomolecular Analysis	Ch. Kontogiannis K. Poulas M. Orkoula	Autumn
Pharmaceutical Products-Naturals and Synthetics	F. Lamari V. Magafa G. Pairas M. Fousteris	Autumn
Molecular Pharmacology	G. Panagiotakopoulos	Autumn
Molecular and Cell Immunology	A. Mouzaki	Autumn
Molecular Medicine	A. Papachatzopoulou A. Sgourou E. Stefanou	Autumn
Toxicology	S. Topouzis	Autumn
Synthetic Organic Chemistry	D. Papaioannou C. Athanassopoulos	Autumn
Spectroscopy of Organic Compounds	G. Tsivgoulis C. Athanassopoulos	Autumn
Organic Chemistry of Biological Processes	D. Papaioannou S. Skandalis	Autumn
Pharmacology - Natural Products	F. Lamari G. Iatrou	Autumn
Molecular Biology	A. Theocharis A. Vlamis Z. Lygerou	Autumn

Course	Teaching Staff	Semester
	C. Stathopoulos I. Zarkadis M. Klapa	
Cellular Biology	N. Karamanos A. Aletras A. Theocharis A. Vlamis Z. Lygerou C. Stathopoulos I. Zarkadis A. Papachatzopoulou P. Katsoris M. Klapa	Autumn
Medicinal Chemistry	S. Nikolaropoulos P. Magriotis G. Pairas M. Fousteris	Autumn
Advanced Synthetic Organic Chemistry	D. Papaioannou G. Rassias	Autumn
Structure and Function of Biomacromolecules – Pharmacology	G. Spyroulias E. Papadimitriou K. Poulas S. Topouzis C. Stathopoulos	Autumn
Discovery, Design and Development of Drugs – Pharmacokinetics	G. Spyroulias S. Nikolaropoulos P. Magriotis G. Pairas M. Fousteris	Spring
Methods of Analysis of Biologically Active Molecules	Th. Tsegenidis N. Karamanos D. Vynios Ch. Papadopoulou C. Athanassopoulos G. Spyroulias Z. Lygerou S. Taraviras E. Patmanidi	Spring
Chemical Biology	D.Papaioannou N. Karamanos Th. Karamanos G. Rassias F. Lamari M. Fousteris C. Stathopoulos	Spring
Advanced Food Chemistry	M. Kanellaki A. Bekatorou A. A. Koutinas	*Spring*
Advanced Food Chemistry: Laboratory exercises	M. Kanellaki A. Bekatorou A. A. Koutinas	*Autumn*
Food Biotechnology	M. Kanellaki A. Bekatorou A. A. Koutinas	*Autumn*

** Autumn or Spring semester according to the teaching requirements of the Department.*

Master of Science (MSc) specialisations

The Department of Chemistry since the academic year 2018-2019 organizes and operates the Postgraduate Program (MSc) in "Chemistry" [Official Government Gazette (OGI) 1620/10-5-2018] according to the provisions of Law 4485/2017 (OGI 114/is. A') (Re-establishment decision: OGI B' 1620/10-05-2018, dec. No 670/11793). The MSc students must attend and successfully pass all courses offered in the specialization they have enrolled. Distribution of the courses of the MSc specializations are shown in the following Tables.

Presentation and examination of the Postgraduate Diploma Thesis is done provided that the Postgraduate student has successfully passed the compulsory courses and has completed his / her obligations regarding the seminar presentations and laboratory exercises that are required in order to obtain the MSc. In any case, long-distance education at a level higher than 35% is prohibited.

The courses will be taught in Greek and, if appropriate, in English.

1. MSc in "Chemistry and Technology of Materials with Applications to Industry, Energy and Environment

The aim of the MSc specialisation in "*Chemistry and Technology of Materials with Applications to Industry, Energy and Environment*" is to offer high level knowledge to graduate students which can meet the needs of industrial units active in the fields of plastics, dyes, packaging materials, refineries, biofuel production units, etc. The knowledge that will be offered will also allow the continuation of studies at doctoral level in scientific fields such as polymers, catalysts, energy, and environment (link: https://www.upatras.gr/en/node/110).

Table 1. Structure of the MSc in "*Chemistry and Technology of Materials with Applications to Industry, Energy and Environment*" curriculum (compulsory courses), including ECTS credits.

Code	ECTS	Course title
Semester A		
XTY-101	6	Chemistry of Polymeric Materials
XTY-102	6	Chemistry of Inorganic Materials
XTY-103	6	Characterisation and Processing of Materials
XTY-104	6	Materials Surface Characterisation Techniques
XTY-105	6	Literature review
Total	30	
Semester B		
XTY-201	6	Applications of Polymeric Materials
XTY-202	6	Applications of Functional Materials
XTY-203	6	Materials for Energy Related Applications
XTY-204	12	Design of the Postgraduate Diploma Thesis and Initiation of Research Activities
Total	30	
Semester C		
XTY-301	30	Postgraduate Diploma Thesis (completion of the research activities, writing and presentation of the thesis)

2. MSc in "Analytical Chemistry and Nanotechnology"

The aims of the MSc specialisation in "*Analytical Chemistry and Nanotechnology*" are (1) the design and development of analytical methods and chemical sensors for various types of analyzers (from simple ions and small molecules to complex large molecules), (2) the familiarity with modern trends in Analytical Chemistry, (3) the exploitation of the achievements of nanotechnology in the development of new analytical methods, (4) the critical consideration of the information provided by the various analytical techniques and the ability to compare techniques, (5) the acquisition of flexibility in combining analytical techniques to solve complex problems, (6) the integration of the principles of Analytical Chemistry for applications to a variety of samples (biological, environmental, food, medical, materials, works of art).

Table 2. Structure of the MSc in "*Analytical Chemistry and Nanotechnology*" curriculum (compulsory courses), including ECTS credits.

Code	ECTS	Course title
Semester A		
AXN-101	10	Micro/nanotechnology – Chemical Sensors
AXN-102	10	Investigating the Micro/Nano-world: Microscopic Techniques
AXN-103	10	Literature review and research methodology of the Postgraduate Diploma Thesis
Total	30	
Semester B		
AXN-201	10	Investigating the Micro/Nano-world: Spectroscopic Techniques
AXN-202	10	Special Applications of Analytical Chemistry
AXN-203	10	Design of the Postgraduate Diploma Thesis and Initiation of Research Activities
Total	30	
Semester C		
AXN-301	30	Postgraduate Diploma Thesis (completion of the research activities, writing and presentation of the thesis)

Other Joint MSc courses

1. Interdepartmental MSc Program "Applied Biochemistry: Clinical Chemistry, Biotechnology and Evaluation of Pharmaceutical Products"

General Description

The Joint MSc Programme "Applied Biochemistry: Clinical Chemistry, Biotechnology, Evaluation of Pharmaceutical Products" is launched by the Decision 1364/20835/28.06.2018 of the Rector of the University of Patras (FEK 2969B/24.07.2018), approved by the Senate of the University of Patras (133/30.03.2018), the General Assembly of the Department of Chemistry (8/27.02.2018), the Advice of the Board of NCSR "Demokritos", in accordance to the cooperation protocol between the partners. It is governed by the provisions of the law 4485/2017, as well as of the Rules for the Postgraduate Studies of the University of Patras (http://www.msc.biochemistry.chem.upatras.gr/el/operation-el/20-kanonismos-spoudon-dpms.html).

Aim

The Joint MSc Programme has as its subject-matter Biochemistry and its applications, covering this subject both in its theoretical dimension and in its practice.

The main objectives of the programme are:

a. the education on advanced topics of biochemistry and their applications as well as modern quantitative and qualitative methods of biological samples analysis, familiarity with the use of modern technologies, promotion of scientific excellence and research, cultivation and development of leadership capabilities,

b. the widening and promotion of theoretical and applied knowledge in the individual subjects of the Joint MSc Programme,

c. the investigation of problems related to human, animal or plant pathological conditions,

d. the development of scientists able to undertake PhD studies in relevant scientific areas,

e. the creation of executives with strong theoretical background and upgraded analytical skills in modern Health, Care and Sustainable Development policies capable of addressing the challenges of the modern environment,

f. providing students with knowledge and analytical research tools that will enable them to work as professional executives in positions of increased responsibility in Health Units, Pharmaceutical Companies, Food Industries, development companies with the objective of developing and promoting new therapeutic approaches, or even the central government, regional and local authorities.

More information regarding the objectives of the Joint MSc Programme are found in the web page: **http://www.msc.biochemistry.chem.upatras.gr/en/.**

The Joint MSc Programme awards exclusively Master of Sciences (MSc) in «Applied Biochemistry: Clinical Chemistry, Biotechnology, Evaluation of Pharmaceutical Products».

Admission of post-graduate students

New posts for Postgraduate Students are announced by the end of July of each year with the closing date for submission of the application and supporting documents by September of the same year. The announcement of the Call for Proposals is made by the University of Patras under the

responsibility of the Department of Chemistry. A notice of admission is issued following the advice of coordinating committee (CC) and approval of the Inter-Institutional committee (IIC). The CC advices and the IIC approves the Candidates Evaluation Committee (CEC). The CEC is a three-member committee and consists of the Director of Postgraduate Studies, a member of the faculty of the Department of Chemistry and a Researcher of the NCSR "Democritus", with their respective alternates. It has a two-year term, which can be renewed. The selection is completed by the first week of October at the latest. Application forms and information on the required qualifications and supporting documents are obtained by the Secretariat of the Department of Chemistry. These are also found on the web site of the programme.

The programme accepts graduates of Schools of Natural Sciences, Health Sciences, Geotechnical Sciences and Agronomic Sciences, of Technical Universities, and of relevant Departments of Open Universities. Applications may also be submitted by undergraduate students of the above listed Schools and Departments, provided that they have presented a Certificate of Completion of their studies no later than one day before the Inter-Institutional meeting date of the JPGP to validate the list of selected candidates. In this case, the diploma is submitted before the start date of the programme. In any case, the selected candidates will have to provide all the necessary supporting documents until the end of the entries.

The number of admissions is set at a maximum of twenty (20).

The selection is based on the following criteria: the final grade of the bachelor or diploma degree of the candidate, the grades in undergraduate courses relative to the subject of JPGP, the grade in diploma thesis where this is envisaged in undergraduate level, and the potential research or professional activity of the candidate.

In particular, account shall be taken of:

i. The general grade of the degree.

ii. The grades in three undergraduate courses, relative to the subject of JPGP, such as Biochemistry, Biology, Biotechnology, Clinical Chemistry, Pharmacology, Bioinformation, Biophysics, among others.

In case candidates have not been taught three courses whose content is relevant to that of courses described above, the selection committee will determine the ones to be examined in order to complete their assessment.

iii. The grade in experimental diploma thesis, where this is envisaged in undergraduate level, with an assessment commensurate with its duration. The basis is 20 points for a one-year duration of an experimental thesis.

iv. Good knowledge of English language, at least in a basic level (First certificate in English). If a candidate does not hold an English language degree, he/she will be examined by the selection committee for his/her Biochemical English Skills.

v. Interview with the candidate, including: (i) assessing his/her personality; (ii) assessing his/her possible research activity; (iii) assessing the quality of the required two recommendation letters.

The CEC shall draw up a scoreboard of the successful candidates, who (with the agreement of the Coordinating Committee) shall be validated by the IIC, considering the following selection criteria, with the following weightings:

Performance in the selection criteria will be graded from 0 (zero) to 10 (ten) and the points will be multiplied by corresponding coefficients as follows:

i. General Grade of the Degree (GG)	coefficient: 4	{GG×4}
ii. Undergraduate Courses (UC)	coefficient: 2	$\{[(UC_1+UC_2+UC_3)/3]\times 2\}$
iii. Diploma Thesis (DT)	coefficient: 2	{DT×2}
iv. Interview (IN)	coefficient: 2	{IN× 2}

Candidates are ranked according to their scores. Of those candidates who will score at least a total score of 70 or more, those who will collect the highest total of units will be selected. The rest are designated as runners-up and can be admitted in the programme, if one or more of the selected ones withdraw their applications.

In the event of a tie, if the positions are covered, those with a higher degree will be awarded. If the positions are not filled, all the tiered players are accepted.

For those candidates who have not completed an experimental diploma thesis, the total score will be reduced to 80 instead of 100, i.e., no students with less than 56 marks will be ranked. In case the experimental thesis has a weight different from the 20 Credit Units (higher or lower), the multiplier 2 (see above, iii) and the selection score are adjusted accordingly.

For the selection, the knowledge of computer use is additionally considered, certified by ECDL or the certificate of graduation.

Registration - Updates

Registration of the admitted Post-graduate Students (PS) is from October 15 to November 15, within deadlines set by the IIC of the programme. Registration is done online at https://matrix.upatras.gr/sap/bc/webdynpro/sap/zups_pg_adm.

It is possible to register within one month of the deadline by decision of the IIC, following a reasoned request from the interested PS.

The PSs are required to renew their registration every six months. The renewal is done on request within the deadlines set by the IIC. The renewal will take place two (2) times a year at the beginning of each academic semester. PS who did not renew their enrolment and did not attend courses or did not conduct research for two consecutive semesters, loses the status of PS and is deleted from the records of the programme, following a decision by the IIC.

Suspension of studies may be suspended for a certain period, which may not exceed twelve months, for duly substantiated reasons, following a decision by the IIC, which is taken at the request of the PS concerned. During the suspension, all benefits are removed, which are recovered at the request of the person concerned. Student suspension semesters do not count towards the expected maximum period of normal attendance.

It is only in exceptional cases (e.g., illness, workload, serious family reasons, armed forces, force majeure) to extend the studies and up to one year, following a reasoned decision of the IIC. The maximum duration of study is defined to 6 semesters (3 years).

The terms of study included in the Study Regulation of the programme shall be accepted by each candidate upon his/her enrolment. The candidate, before registering, is aware of this Regulation from the Secretariat of the Department of Chemistry and the websites:

http://www.chem.upatras.gr/el/Postgraduate,

http://www.demokritos.gr/

http://www.msc.biochemistry.chem.upatras.gr/en/.

Curriculum

The total number of ECTS credits required to acquire the MSc amounts to ninety (90). The courses of the programme are biannual. Teaching will be in Greek and/or English. To take a MSc, students are required to attend and be considered successfully in all compulsory courses during the two semesters (1st and 2nd semesters) and to successfully complete diploma theses during the 2nd and 3rd semesters. The curriculum is set up as follows:

1ST SEMESTER		
COMPULSORY COURSES		
CN	**CREDITS**	**TITLE**
BIO-101	10	Biochemical Analysis – Clinical Biochemistry
BIO-102	10	Advanced Biochemistry
BIO-103	10	Literature Review and Research Methodology
TOTAL	**30**	
2ND SEMESTER		
COMPULSORY COURSES		
CN	**CREDITS**	**TITLE**
BIO-201	10	Molecular Pharmacology - Immunology
BIO-202	10	Molecular & Cellular Biology – Molecular Biotechnology
BIO-203	10	MSc Thesis I: Launch of Research Activities for MSc Thesis (Post-Graduate Diploma Work)
TOTAL	**30**	
3RD SEMESTER		
CN	**CREDITS**	**TITLE**
BIO-301	30	MSc Thesis II: Completion of the research project, Writing and Defence of the Thesis

The programme provides for the running of study fees, the amount of which is set at €1,500. Payment of the tuition fees is made in three equal instalments, the first with the registration of each Postgraduate student and the next with each renewal of the registration.

Courses

Biochemical Analysis – Clinical Biochemistry

- Liquid chromatography (gel, ion-exchange, affinity). Theory, applications.
- HPLC: Theory, techniques, applications. GC: Applications. SFC: Theory, applications.
- Electrophoresis: Theory and techniques. Capillary electrophoresis: Applications.
- Enzyme in analysis: Chemistry and applications of enzymes, biosensors.
- Radionuclides in analysis.
- Immunoenzymatic analytical methods: Theory, techniques, applications.
- Automatization in analysis, Modern auto-analysers,
- Methods selection criteria - Development of analytical methods.
- Selection of methods for the analysis of biological fluids.
- Biochemistry of the main organs and endocrine glands.
- Control of organs and endocrine glands functions.
- Evaluation of results.
- Analysis of metabolites, drugs and toxic substances.

Advanced Biochemistry

- Membranes – signal transduction.
  - cAMP pathway, protein kinase A.
  - cAMP receptors (Epac), activation protein kinase B (Akt).
  - Phosphoinisitide pathway, protein kinase C.
  - Ca^{2+} signalling.
  - Tyrosine kinases, small G proteins, PI-3 kinase.

- MAP kinases (ERK1,2, JNKs, p38).
- NO signaling pathways, cGMP, protein kinase G.
- Transcription factors (CREB, CREM, NF-kB, AP-1, STAT) and their activation.
- Prostaglandins.
- Steroid hormones.
- Signaling pathways of main cytokines and growth factors, IL-1, TNF-α, TGF-β (SMAD proteins), PDGF, EGF, FGF.

- Interaction of ECM and cells.
- Integration of metabolism in prokaryotes and eukaryotes. Control mechanisms of metabolism of carbohydrates, proteins and fats.
- Basic Physiology (nervous system, liver, gallbladder, pancreas).

Molecular Pharmacology - Immunology

- Effect of drugs to enzymes (binding interactions, competitive and non-competitive inhibitors, allosteric inhibitors), the catalytic role of enzymes, enzyme regulation, isoenzymes, pharmaceutical applications of inhibitors (inhibitors for enzymes, microbes, viruses and body enzymes).
- Effect of drug to receptors (the role of receptor, neurotransmitters and hormones, design of agonists and antagonists, partial and reverse agonists, desensitization and sensitization, tolerance and dependence, cytoplasmic receptors, types and subtypes of receptors).
- Structure and functions of nucleic acids (DNA structure, DNA-acting drugs, RNA structure, RNA-acting drugs, drugs related to nucleic acids and their structural units, molecular biology and genetic engineering).
- Adrenergic nervous system (adrenergic system, adrenergic receptors and transducers, biosynthesis and metabolism of cateholamines, neurotransmission, drug targets, adrenergic site of binding, structure – biological activity relations, adrenergic agonists, antagonists of agrenergic receptor, drugs acting to adrenergic transduction).
- Opium-related analgetics (morphine, morphine analogues development, analgetic receptors, agonists and antagonists, encephalines and endorphines, receptors mechanisms)
- Innate immunity-Complement.
- Acquired immunity (humoral immunity, cellular immunity).
  - Antibodies, antibodies classes, structure, production (B-lymphocytes, clone selection theory), immune system memory, vaccines, monoclonal antibody production, antibodies biosynthesis.
  - Immunogens, antigens, antigen determinants, epitopes.
  - Antigen-antibody complex. Antigen presenting cells.
  - Proteins of the major innumohistocompatibility complex (MHC-I, MHC-II).
  - T-lymphocytes (Th1 and Th2 help cells, cytotoxic Tc cells), T-cells receptors.
  - MHC-I / Tc and MHC-II / Th complexes.
  - Biosynthesis of T-cells receptors and MHC proteins.

Molecular Biology – Molecular Biotechnology

- DNA organisation.
- Annealing and hybridisation.
- Eukaryotic genome transcription and translation.
- DNA mapping.
- Gene structure and function.

- DNA replication in viruses, eukaryotic and prokaryotic cells.
- Strain selection, genetic recombination.
- Protoplasts fusion, techniques for isolation of DNA sequences (restriction enzymes).
- cDNA, gene libraries.
- DNA vectors (plasmids, cosmids, phages).
- Advanced Studies in 3D Cell Platforms for Cancer Targeting
- Cloning vectors, sequences vectors, expression vectors.
- Methods of integration, transport and recombination of genetic information.
- Analysis and isolation of recombinant clones.
- Cloning systems and applications in Biotechnology.
- Enzymes technology (immobilization of enzymes, kinetics of immobilized enzymes, reactions and kinetics in biphasic systems, reverse enzyme reactions, artificial enzymes).
- Industrial applications (Manufacture of dairy products, alcoholic beverages, fruit juices, single-cell protein, industrial fermentations: alcohol, organic acids and aminoacids, pharmaceuticals, baking, syrups, processing of wastes: biofertilizers, methane).

General Description

Chemical Biology is a contemporary scientific discipline, engaging the Sciences of Chemistry and Biology, which includes the application of chemical techniques and tools, often molecules which are produced by synthetic chemistry, to study and affect the biological systems. Chemical Biology finds special application in Medicinal Chemistry, a relative scientific discipline, in which the molecules are designed in such a way as to interact with biological processes and treat particular diseases. Therefore, the aim this Postgraduate program is:

1) To carry out novel research on important and hot biomedical projects towards new medicines and methods.

2) To train the student in independent research work, information retrieval skills, the critical assessment of sources and research results, and written communication.

Also, the program is focused on:

3) The application of techniques (analytical, spectroscopic, biochemical) and of synthetic molecules (or molecules obtained from natural sources) to the study of biological systems involved in particular diseases, and to the development, based on this study, of pharmaceutical substances for the clinical treatment of a variety of diseases.

For more information on Scope, Curriculum, and Operation Regulations please link in:

http://www.msc.medchembiol.chem.upatras.gr/el/

VII. RESEARCH ACTIVITIES OF THE FACULTY MEMBERS

Research in the Department of Chemistry is at the forefront of modern science, both in the core chemical discipline (Inorganic, Organic, Physical and Analytical chemistry) and as a key element of life, environmental and materials sciences (biochemistry and biochemical analysis, synthetic organic and medicinal chemistry, bioinorganic chemistry, catalysis and interfacial chemistry, food chemistry and biotechnology, polymer science, structural and environmental chemistry).

The faculty members are active in all aspects of the chemical sciences and in constant collaboration with Universities, Research Institutes and Industry in Europe, Asia and USA. Senior academics of the Department are internationally recognised scientists in their fields and through the Postgraduate programs they are joined by young promising fellows who will be the leaders of tomorrow.

State-of-the-art facilities for synthesis, analysis, cell molecular biology and drug preclinical evaluation, biotechnology, interfacial and environmental chemistry within the Department, as well as the NMR and DNA-sequence facilities of the "Laboratory of Instrumental Analysis" enable the high-quality research of the Faculty members. Facilities for technical, computing and analytical support are excellent. Access to transmittance and scanning electron microscopes equipped with EDS & WDS instruments are also provided by a link to the "Laboratory of Electron Microscopy".

The Chemistry buildings house two well-equipped Multimedia Laboratories used for Seminars and Workshops, a fully equipped Seminars Room with audio and video facilities and a library with a collection of approximately 3,200 book titles.

As a department, we are strongly committed to innovation and improvement in our undergraduate and graduate programs.

Organic Chemistry

Synthetic Organic Chemistry

Faculty Members: Prof. C. Athanassopoulos, Assoc. Prof. G. Rassias, Assist. Prof. Sp. Mourtas.

Medicinal Chemistry

Faculty Members: Prof. Th. Tselios, Prof. G. Tsivgoulis, Assoc. Prof. G. Rassias, Assist. Prof. C. F. Simal.

Peptide Chemistry

Faculty Members: Prof. D. Gatos, Assist. Prof. Sp. Mourtas.

Biomolecules: isolation, characterization, synthesis and development

Faculty Members: Assist. Prof. C. F. Simal.

Supramolecular Chemistry

Faculty Members: Prof. G. Tsivgoulis.

Biochemistry, Biochemical Analysis and Matrix Pathobiology

Faculty Members: Prof. N. Karamanos, Prof. D. Vynios, Prof. A. Theocharis, Assoc. Prof. S.

Skandalis, Assist. Prof. A. Vlamis, Assist. Prof. Z. Piperigkou.

Inorganic – Bioinorganic - Organometallic Chemistry

Faculty Members: Prof. Th. Stamatatos, Assoc. Prof. V. Tangoulis, Assist. Prof. N. Lalioti, Assist. Prof. D. Alexandropoulos.

Physical Chemistry

Physical Chemistry of Interfaces

Faculty Members: Assoc. Prof. A. Koliadima, Prof. S. N. Yannopoulos.

Physical, Aquatic & Colloidal Chemistry

Faculty Members: Prof. E. Dalas.

Quantum Chemistry

Faculty Members: Assoc. Prof. S. Marinakis, Assist. Prof. A. Chrissanthopoulos.

Catalysis and Interfacial Chemistry for Environmental Applications – Environmental Chemistry

Faculty Members: Prof. Ch. Kordulis, Prof. H. Karapanagioti, Assist. Prof. Ch. Papadopoulou.

Food Chemistry and BioTechnology

Faculty Members: Prof. A. Bekatorou.

Polymer Science and Technology

Advanced Polymers and Hybrid Nanomaterials

Faculty Members: Prof. J. Kallitsis, Assoc. Prof. Ch. Deimede, Assist. Prof. K. Andreopoulou.

Stimuli-Responsive Polymers

Faculty Members: Prof. G. Bokias.

Analytical and Structural Chemistry

Analytical Chemistry

Faculty Members: Prof. Th. Christopoulos, Assoc. Prof. D. Kalogianni.

Useful Department links/contacts

Department web page: https://www.chem.upatras.gr/en/

Head of Department:	head@chemistry.upatras.gr	2610 996007
Secretary:	chemsecr@upatras.gr	2610 996202, -203, -204, -205, 206
Library:	https://library.upatras.gr/english/	2610 969621
IT upatras:	helpdesk.upnet.gr	2610 962600

Emergency numbers

Emergency University number:	**11771**	(mobiles: 6978 188881, 6978 188882)
National emergency number:	**112**	
Fire Department:	**199**	
Ambulance:	**166**	
Police:	**100**	
Traffic police:	**10400**	
Hospital (University):	**2613 603000**	
Hospital (Ag. Andreas):	**2613 601000**	
Bus station	**2610 623888**	

Greece Useful Numbers link: https://www.greecewebtravel.com/greece-useful-numbers.html

Welcome to Patras!