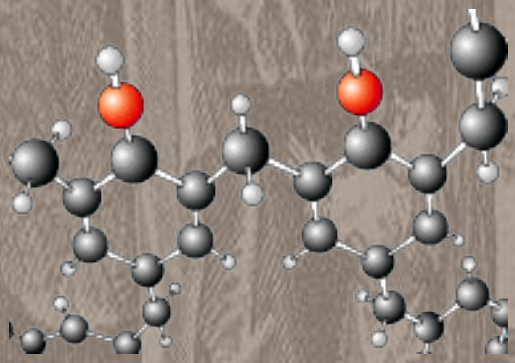
ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ
UNIVERSITY OF PATRAS

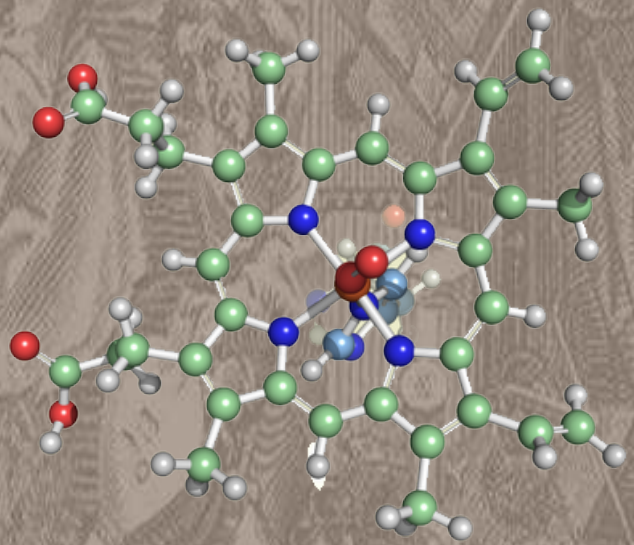
University *of* Patras



Department *of* Chemistry

Curriculum

2019-2020



http://www.chem.upatras.gr
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 33 Academic Staff members, and 9 members of Special Teaching and Technical Personnel. About 700 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-Radiation 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 our 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 our 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 PostGraduate Studies 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
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	Agriculture and Technology, Laboratory of Organic Geochemistry (Tokyo)
Norway	Bergen, Department of Chemistry
Poland	Adam Mickiewicz, Institute of Physics, Nonlinear Optics Division
Spain	Barcelona, Department of Inorganic Chemistry
Sweden	Stockholm, Karolinska Institute
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	Burnet Research Institute, Melbourne
Bulgaria	Catalysis, Bulgarian Academy of Sciences
Germany	Max-Planck, Institut für Polymerforschung TU Braunschweig, Institut für Physikalische und TheoretischeChemie
Hungary	Isotope and Surface Chemistry, Chemical Research Centre, HAS, Budapest
India	National Institute for Interdisciplinary Science & Technology, Biotechnology Division (NIIST)
Slovenia	National Institute of Chemistry, Ljubljana
Spain	Consejo, Superior de Investigaciones Cientificas, Catalysis & Petrochemistry (CSIC)
Sweden	Karolinska Institute (Stockholm)
	Ludwing Institutte for Cancer Research (Uppsala)
	Kungliga Tekniska Högskolan, Stockholm

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, lectures and seminars, or 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 freely 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 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 State. 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 our 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 Project

During their final year, students must carry out a short research project, assigned in Greek as "Experimental Undergraduate Diploma Project", 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) 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 "Experimental 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.

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. 20 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 either a *Postgraduate Diploma of Specialization* (PDS, equivalent to MSc Diploma) or 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 five 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	30
Analytical Chemistry	25
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
Computational Chemistry and Molecular Design	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	19

* *In special cases, the Experimental Diploma Thesis may be replaced by an extended literature review on a chemical topic (in the form of a review article). 6 ECTS Credits are assigned to such a theoretical thesis. The remaining 13 ECTS credits will be then substituted by additional Semi-Optional or Optional Chemical Courses.*

*II.2.4 Optional Chemistry Courses**

COURSE	ECTS CREDITS
Modern Spectroscopy methods (NMR, MS) - Molecular Modelling	4
Food Chemistry and Technology – Oenology I	8
Chemistry of Organometallic Compounds and Mechanisms of Inorganic Reactions	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
Polymer Science	4
Chemical Industries (Inorganic and Organic)	4
Food Chemistry and Technology – Oenology II	4
Bioinorganic Chemistry	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
Economics	3
Business Administration	3
English Chemical Terminology	3
Main European Languages (one from: French, Spanish, German, Italian)	3
Applied statistics	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. 19 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 Diploma Thesis may be replaced by an extended literature review on a topic related to chemistry (in the form of a review article). 6 ECTS Credits are assigned to this theoretical thesis. The remaining 13 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"
XII 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) (applied since 2016-17)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
CHE_MA 102	Mathematics for Chemists	4	1	1	5
CHE_PH 111	Physics for Chemists	4	1	0	5
CHE_XA 127	Introduction to Inorganic Chemistry	3	1	1	5
CHE_XO 101	Structure, Reactivity and Mechanism in Organic Chemistry	3	1	0	5
CHE_XA 131	Chemistry and Informatics	2	0	2	5
CHE_BI 121	General Biology	3	1	0	5
Total (28 CH)		**19**	**5**	**4**	**30**

2nd Semester (II) (applied since 2016-17)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
CHE_XA 222	Inorganic Chemistry-1 (Chemistry of the Representative Elements)	3	1	3	10
CHE_XA 232	Physical Chemistry-1	3	1	0	5
CHE_XE 251	Analytical Chemistry-1	3	1	4	10
CHE_XO 202	Organic Chemistry of Functional Groups-I	3	1	0	5
Total (23 CH)		**12**	**4**	**7**	**30**

3rd Semester (III) (first applied in 2017-18)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
CHE_XE 356	Analytical Chemistry-2	2	0	5	5
CHE_XA 323	Inorganic Chemistry-2 (Chemistry of 1st Row Transition Metals and Coordination Chemistry)	3	1	3	10
CHE_XA339	Physical Chemistry-2	3	1	0	5
CHE_XE 353	Instrumental Chemical Analysis-1	3	1	0	5
CHE_XO 303	Organic Chemistry of Functional Groups-II	3	1	0	5
Total (26 CH)		**14**	**4**	**8**	**30**

4th Semester (IV) (first applied in 2017-18)

Course		Contact Hours (CH)			ECTS credits
Code	**Title**	**Lectures (LC)**	**Seminars (SE)**	**Laboratory (LB)**	
CHE_XO 404	Spectroscopy of Organic Compounds – Experimental Organic Chemistry-1	2	1	3	5
CHE_XO 405	Chemistry of Heterocyclic Compounds and Biomolecules	3	1	0	5
CHE_XE 454	Instrumental Chemical Analysis-2	3	1	3	10
CHE_XA 434	Physical Chemistry-3	3	1	3	10
Total (24 CH)		**11**	**4**	**9**	**30**

5th Semester (V) (first applied in 2018-2019)

Course		Contact Hours (CH)			ECTS credits
Code	**Title**	**Lectures (LC)**	**Seminars (SE)**	**Laboratory (LB)**	
CHE_XO 506	Synthetic Organic Chemistry-Experimental Organic Chemistry-2	2	2	8	10
CHE_XA 538	Physical Chemistry-4	3	1	3	10
CHE_XO 512	Biochemistry-1	3	1	0	5
CHE_XA 527	Inorganic Chemistry-3 (Chemistry of 2nd and 3rd Row Metals and of Lanthanides)	3	1	0	5
Total (27 CH)		**11**	**5**	**11**	**30**

6th Semester (VI) (first applied in 2018-2019)

Course		Contact Hours (CH)			ECTS credits
Code	**Title**	**Lectures (LC)**	**Seminars (SE)**	**Laboratory (LB)**	
CHE_XO 612	Biochemistry-2	3	2	4	10
CHE_XE 681	Principles of Chemical Technology	3	1	4	10
CHE_XE 682	Food Chemistry	2	1	2	5
	Semi-Optional Course-1*	3 or 2	1	1 or 2	5
Total (25-28 CH)		**10 or 11**	**5**	**10 or 12**	**30**

** Selection of 1 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)	
CHE_XE 671	Chemistry and Technology of Materials (Polymers, Nanomaterials, Catalysts)	2	1	2	5
CHE_XE 691	Environmental Chemistry	2	1	2	5
CHE_XE 661	Structural Chemistry	3	1	1	5

7th Semester (VII) (first applied in 2019-20)

Course		Contact Hours (CH)			ECTS credits
Code	Title	Lectures (LC)	Seminars (SE)	Laboratory (LB)	
*	Semi-Optional Course-2	3 or 2	1	1 or 2	5
*	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 702	Experimental Diploma Thesis-1 ** (literature review and initiation of experimental work)	0	0	4	2
EX 703	Experimental Diploma Thesis-2 ** (continuation of experimental work)	0	0	8	5
Total (- CH)		**-**	**-**	**-**	**30**

** Selection of 3 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".

 # 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 EX702 and EX703).*

For Erasmus students, the Experimental Diploma Thesis may take place entirely in one semester (total 19 ECTS credits). It can be replaced by a theoretical thesis (literature review), which corresponds to 6 ECTS credits. Additionally, the students must select 1 Semi-Optional Course (5 ECTS) and 2 Optional Chemistry Courses (2×4=8 ECTS).

Table 2. Optional Courses for 7th Semester

Course		Contact hours (CH)			ECTS credits
Code	**Title**	**LC**	**SE**	**LB**	
Semi-Optional Courses					
CHE_XE 783	Physical Processes of Chemical Technology	2	1	2	5
CHE_XE 784	Chemical Processes of Chemical Technology	2	1	2	5
CHE_XA 742	Principles and Applications of Nuclear Chemistry	3	1	1	5
CHE_XE 737	Computational Chemistry and Molecular Design	3	1	1	5
Optional Chemistry Courses					
CHE_XO 707	Modern Spectroscopy Methods (NMR, MS) - Molecular Modelling	2	1	0	4
CHE_XE 785	Food Chemistry and Technology – Oenology I	4	0	4	8
CHE_XA 726	Chemistry of Organometallic Compounds and Mechanisms of Inorganic Reactions	3	0	0	4
CHE_XA 756	Quality Control in Analytical Chemistry	2	1	0	4
CHE_XO 713	Biochemistry-3 (Gene Expression and Regulation-Gene Engineering)	2	1	0	4
CHE_XO714	Clinical Chemistry	2	0	2	4
CHE_XE 792	Catalysis and Green Chemistry	3	0	0	4
CHE_XO 715	Enzymology	3	0	0	4
CHE_BI 722	Microbiology	2	0	2	4
CHE_ΧΠ 785	Practical Training *				4

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

8th Semester (VII) (first applied in 2019-20)

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 802	Experimental Diploma Thesis-3 ** (continuation and completion of experimental work)	0	0	10	9
EX 803	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 EX802 and EX803).*

For Erasmus students, the Experimental Diploma Thesis may take place entirely in one semester (total 19 ECTS credits). It can be replaced by a theoretical thesis (literature review), which corresponds to 6 ECTS credits. Additionally, the students must select 1 Semi-Optional Course (5 ECTS) and 2 Optional Chemistry Courses (2×4=8 ECTS). There are no Semi-Optional Courses this semester.

Table 3. Optional Courses for 8th Semester

Course					ECTS credits
Code	Title	Contact hours (CH)			
		LC	SE	LB	
Optional Chemistry Courses					
CHE_XO 816	Food Biochemistry	3	0	0	4
CHE_XO 809	Pharmaceutical Chemistry	3	0	0	4
CHE_XO 817	Biotechnology	2	0	2	4
CHE_XE 885	Polymer Science	2	1	0	4
CHE_XE 886	Chemical Industries (Inorganic and Organic)	3	0	0	4
CHE_XE 887	Food Chemistry and Technology – Oenology II	3	0	0	4
CHE_XA 827	Bioinorganic Chemistry	3	0	0	4
CHE_XII 785	Practical Training *				4
Optional non-Chemistry Courses					
CHE_AN 841	Didactics of Natural Sciences	2	0	0	3
CHE_OI 831	Ecomomics	3	0	0	3
CHE_OI 832	Business Administration	3	0	0	3
CHE_AN 842	English Chemical Terminology	2	0	0	3
	Main European Languages (one from):				
CHE_AN 843	French	2	0	0	3
CHE_AN 844	German	2	0	0	3
CHE_AN 845	Italian	2	0	0	3
CHE_AN 846	Spanish	2	0	0	3
CHE_MA 812	Applied Statistics	3	0	0	3
CHE_BI 823	Viticulture	2	0	0	3

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

IV. DESCRIPTION OF UNDERGRADUATE COURSES

1st Semester (I) (applied since 2016-17)

Mathematics for Chemists

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**MA102**	**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		4	5
Seminars		1	
Laboratory work		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*	General background		
PREREQUISITE COURSES:	There are no prerequisite courses. However, the students should already have a satisfactory knowledge of algebra, derivatives and integrals.		
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*

The aim of the course is to give to the student of the Department of 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, probabilities and statistics. 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.

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, differential equations and statistics 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 problems of chemistry which make use of the above mathematical fields.
3. To be able to efficiently use the computer and computer algebra software in mathematics and chemical 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	*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	

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

Autonomous (Independent) work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

3. SYLLABUS

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.
4. Differential calculus of functions of several variables.
5. Integral calculus of functions of several variables.
6. Introduction in differential equations.
7. Introduction to Probability and Statistics.

4. TEACHING and LEARNING METHODS - EVALUATION

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 major part of lectures content is uploaded on the internet, in the form of a series of ppt files, where from the students can freely download them. Tutorials with exemplary mathematical problem solving. Computer laboratory for learning Symbolic Algebra as a tool for solving Mathematical problems.
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 (4 contact hours per week x 13 weeks)	52
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems; techniques and theory associated to each laboratory experiment)	13

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	Laboratory work (1 contact hour per week)	13
	Final examination (3 contact hours)	3
	Hours of Private Study of the Student for the preparation of the Final Examination	44
	Course total	***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. Final written examination (70% of the final grade). 2. Laboratory examination (30% of the final grade). Greek grading scale: 1 to 10. Minimum passing grade: 5.	

5. ATTACHED BIBLIOGRAPHY

1. K.E. Papadakis, "Introduction to Mathematica", 3rdEdition. Tziolas Publications, 2010.
2. V.V. Markellos, "Applied Mathematics, Vol. II: Linear Algebra, Differential Equations". Symmetria Publications, 2000.
3. J. Koutrouvelis, "Statistics methods", Vol. I, Symmetria Publications, 1999.
4. R. E. Walpole, R. H. Myers, S. L. Myers and K. Ye, "Probability and statistics for engineers and scientists" https://drive.google.com/file/d/0B5T4JPIHf-6oSUxtZlBmd0Mxc0E/edit

Physics for Chemists

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**PH111**	**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
Seminars		1	
Laboratory work		-	
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*	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
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
Others

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. SYLLABUS

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 - EVALUATION

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*	Lectures using transparencies, PowerPoint presentations and multimedia.
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 (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
Course total	***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.*	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

5. ATTACHED BIBLIOGRAPHY

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.

Introduction to Inorganic Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA127**	**SEMESTER**	**1st**
COURSE TITLE	INTRODUCTION TO 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Seminars	1	
Laboratory work	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 (Inorganic Chemistry) and Skills Development (Experimental General and Inorganic Chemistry).	
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/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 an ionic formula given the ions, write the name and formula of an anion from the acid, 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.

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	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Working independently	*Criticism and self-criticism*
Team work	*Production of free, creative and inductive thinking*
Working in an international environment	*Others*
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 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. Developing the ability to explain magnetic properties, colour and geometry of complexes and to decide whether isomers are possible. Finally, the student should be able to give some examples of applications of complexes in our daily life.

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. SYLLABUS

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. 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.

4. TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures, seminars and laboratory work face to face.</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 (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 x 13 weeks)</td><td>39</td></tr>
<tr><td>Seminars (1 contact hour per week x 10 weeks) - solving of representative problems; techniques and theory associated to each laboratory experiment)</td><td>10</td></tr>
<tr><td>4 Laboratory Exercises (3 contact hours per 3 weeks)</td><td>12</td></tr>
<tr><td>Hours for private study of the student and preparation of home-works (4 per semester), for Introduction in Inorganic Chemistry, and reports, for the Laboratory, and preparation for the Laboratory (study of techniques and theory)</td><td>16</td></tr>
<tr><td>Final examination (3 contact hours)</td><td>3</td></tr>
<tr><td>Hours of Private Study of the Student for the preparation of the Final Examination</td><td>45</td></tr>
<tr><td>Course total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure</td><td>1. Oral examination during the seminars on problems given as homework in the lectures. The mark of the seminars is added</td></tr>
</table>

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.*	to the final mark only when the student secures the minimum mark of 5 in the final written examination. 2. (Optional)10-min presentation of subjects related to the courses by two-student groups. The mark of the The mark of the seminars is added to the final mark when the student secures the minimum mark of 5 in the final written examination. 3. Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

5. ATTACHED BIBLIOGRAPHY

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", 9thEdition, 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, Reactivity and Mechanism in Organic Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 101**	**SEMESTER**	**1st**
COURSE TITLE	STRUCTURE, REACTIVITY AND MECHANISM 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
Seminars		1	
Laboratory work		0	
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 (Organic Chemistry)		
PREREQUISITE COURSES:	There are not prerequisite courses because this course is the first one of a series of Organic Chemistry undergraduate courses		
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.soclab.chem.upatras.gr (→ Education → Teaching material → Structure, Reactivity and Mechanism in Organic Chemistry)

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:

Structure of organic compounds

Describe the bonds involved in organic compounds with C-C or C-heteroatom single or multiple and conjugated bonds and their influence on the geometry and the reactivity of the system.

Nomenclature of the main classes of organic compounds

Know the correct names (prefixes and suffixes) of the common functional groups. Given a structure or a condensed formula, use the IUPAC nomenclature to name correctly alkanes with a linear or branched chain, monocyclic alkanes, benzene, naphthalene, simple aromatic compounds and their simple substituted derivatives. Given an IUPAC name for any of the above-mentioned compounds, to draw correctly their structure.

Use the priority rules to determine the configuration, to identify and name correctly isomers of compounds with double bonds or rings having the E or the Z configuration or isomers [or isolated stereogenic (chiral) centers] having the R or the S absolute configuration.

Stereochemistry

Recognize a stereogenic (chiral) center in a molecular structure. Identify and distinguish between identical molecules, enantiomers and diastereomers from their structural representations. Recognize a meso-compound from its structure. With or without the use of molecular models, represent the three-dimensional structure of a molecule using «wedge bonds» or the conventions of the Newman and Fischer projections. Describe methods for the analysis of racemic mixtures. Recognize the stereochemical congestion between neighbouring groups in bonds or across rings. Correlate the dynamic energy with the dihedral angle during rotation around bonds and account for the selection of a favourable conformation. Correlate *cis* and *trans* substituents in cyclohexane rings with their axial or equatorial arrangement. Use the known stereochemistry of a reaction to predict the outcome of reactions on saturated centers, double bonds and cyclohexane rings. Use the products of a reaction to identify stereochemical pathways of reactions.

Reactions and Mechanisms

Classify a given chemical transformation as addition, elimination, substitution, condensation, rearrangement, solvolysis, oxidation, reduction as well as subject to base or acid catalysis. Use the principle of the functional group to predict the chemical behaviour of a given molecule. Indicate the polarization caused by the electronegativity of atoms in a given molecule and use it to predict the direction of heterolysis, the basic or acidic properties, and the electrophilic or nucleophilic properties or positions of electrophilic or nucleophilic attack.

Distinguish between a transition state (activation complex) and a reactive intermediate. Under defined reactions conditions, recognize reagents as electrophiles or nucleophiles. Given the starting materials (substrates), reagents and reaction conditions, suggest the outcome of a reaction and given or not the products, suggest a possible mechanism for the progress of the reaction with the use of "curved arrows" to show the electron movements. Explain the different stability of the reactive intermediates involved and the influence of this stability in the reaction progress.

Nucleophilic displacement

Given the reactants (a) identify the nucleophilic and electrophilic center, and the leaving group, (b) decide (if possible) whether $S_N1$or S_N2 reaction will be followed, (c) predict the structure of the products, (d) suggest how changes in the reaction conditions or the reactants would affect the outcome of the reaction, (e) decide whether or not the reaction will take place, and (f) comment on the relative S_N reaction rates. Suggest the best reagents

and reaction conditions to carry out a given transformation. Use curved arrows and diagrams of reaction progress to show the mechanism of S_N1 and S_N2 reactions.

Elimination

Given the substrate, the reagent and the reaction condition, (a) predict the structure of the product(s), indicating the stereochemistry wherever this is necessary, (b) predict which elimination product will be the main wherever more than one may be formed, (c) predict whether substitution or elimination will be the main reaction (d) explain how the conformation and the configuration of a substrate can affect the outcome of an elimination reaction. Use curved arrows and diagrams of reaction progress to show the mechanism of E1 and E2 reactions.

Addition

Given the reactants (a) predict the structure of the product, indicating its stereochemistry and (b) predict which adduct will be the main product, whenever more than one can be formed. Explain why the selection of a reagent can determine the orientation of addition. Specify the reagents and the conditions required for the formation of a given product in an addition reaction.

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	

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 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.
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

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

3. SYLLABUS

1. Organic Chemistry - Organic compounds

- What is Organic Chemistry
- Sources of organic compounds
- Properties of organic compounds and their significance in living organisms
- Organic compounds and Chemical Industry

2. Nomenclature of main homologous series of organic compounds

- Homologous series – Functional groups

- Rules for naming open-chain and cyclic organic compounds and applications
- Naming of organic compounds with many functional groups – Priorities of main functional groups
- Nomenclature of aromatic compounds
- Common or trivial names of very common organic compounds (simple alkenes, alkynes, alcohols, aldehydes and ketones, carboxylic acids and derivatives thereof, and aromatic and heterocyclic compounds)

3. Bonds in Organic Chemistry

- Ionic and covalent bonds
- Periodic Table and the Octet Rule
- Examples of electronic octets with transfer (ionic bonds) and with sharing (covalent bonds) electrons
- Polar covalent bonds - Dipole moment - Inductive effect
- Electron repulsion and shape of molecules
- Lewis structures - Rules - Applications
- Kekulé structures
- Resonance structures
- Conventions for drawing organic compounds - Condensed Kekulé structures
- The Quantum-Mechanical description of atoms - Atomic orbitals (s, p, d) - Electron configurations of atoms - Pauli's Principle - Hund's Rule- Aufbau Principle - Configurations of closed cell or closed layer (configurations of electron duet and octet)
- Bond types
- Localized chemical bond - covalent bond
- Molecular orbitals in diatomic molecules (bonding and antibonding orbitals)
- Molecular orbitals in multi-atom molecules – hybrid orbitals - hybridization (sp, sp^2 and sp^3 hybrid orbitals)
- The molecular structure (lengths, angles and strengths of bonds) of methane, ethane, propane, H_2O, NH_3, methanol, methanamine, ethylene and acetylene
- The relationship of number of bonds and bond length and strength
- The relationship of hybridization of C atom and bond length, angle and strength
- C-C bonds in small rings (three-membered - cyclopropane)
- Multiple bonds C-Heteroatom (Double bonds C=O and C=N and triple bond C≡N
- Delocalized chemical bonds – Resonance effect – Canonical structures (forms) – Resonance hybrid – Conjugated systems – Hyperconjugation effect
- The bonds in the allylic system, 1,3-butadiene and 1,3,5-hexatriene, benzene, and the heteroaromatic systems (pyridine, pyrrole, thiophene and furan) with the Method of Molecular Orbitals
- Electronic effects (Inductive, Resonance) - Methodology for drawing resonance - Stereochemical effect
- Bonds weaker than covalent - van der Waals forces [dipole-dipole, induced or temporary dipole - induced or temporary dipole (London forces)] - Hydrogen bond

4. Structure of Organic Compounds-Stereochemistry

- Stereochemistry - Isomerism - Isomers - Constitutional isomers - Regioisomers - Double bond equivalents - Stereogenic (chiral) centre - Chiral molecule
- Configuration - Stereoisomers - Stereoisomerism - Geometrical isomerism - Optical isomerism - Nomenclature system Cahn-Ingold-Prelog (C-I-P) - Geometrical isomerism (E- and Z-geometrical isomers) and examples of alkene nomeclature - Absolute configuration - Enantiomers - Diastereomers - Meso isomers - Achiral compounds - Examples of determining isomers - Molecular models - Skeletal models - Space-filling models - ball and stick models - Examples of molecular models - Determination of configuration on the basis of C-I-P rules (*R*- and *S*-configuration) - Methodology for determining configurations and examples - Optical isomerism and optical activity - Specific rotation - Optical purity - Enantiomeric excess (ee) - Representation of stereoisomers - Stereochemical structures - Fischer projections - zig-zag structures - Sawhorse representations - Newman projections - Interconversions of the different

structural types - Molecules with one stereogenic centre - Enantiomerically pure compounds - Racemic mixtures (racemates) - Racemization - Analysis of racemates - Molecules with more than one stereogeniccentres - Enantiomers - Relative configuration - Diastereomers (*erythro-*, *threo-*, *syn-*, *anti-*) - Epimers - Meso structures - Molecular asymmetry (allenes, spiranes) - Molecules with heteroatom stereogeniccentres (chiral amines and phosphines and chiral sulfoxides) - Walden inversion

- Conformation - Conformers (or rotamers) - Conformational effects - Conformations of open-chain molecules (ethane, propane, butane) - Eclipsed conformation - Staggered conformation - Tortional angle - Tortional strain - Diagrams depicting dynamic energy variation with tortional angle - Stereochemical congestion - Stereochemical strain - Stereochemical hindrance - Conformation analysis - *syn-periplanar* and *anti-periplanar* conformations - gauche conformation - Conformations of cyclic compounds (cyclopropane, cyclobutane, cyclopentane, cyclohexane) - Angle strain - Tortional strain (or σ-bond opposition strain) - Total ring strain - Puckered conformation - Small, common-medium and large rings - Envelope conformation - Half-chair conformation - Chair conformation - Boat conformation - Twisted-boat conformation - Ring inversion - Transannular strain - Axial and equatorial bonds/substituents - 1,3-Diaxial interactions - Methodology for drawing chair conformations and axial and equatorial bonds - Chiral compounds found in Nature - Natural sources - Chiral pool - α-Amino acids - Alkaloids - Hydroxy acids - Terpenes - Carbohydrates - Asymmetric synthesis - General diagram of stereochemical relationships in organic compounds

5. Reactivity in Organic Chemistry (Reactions - Mechanisms)

- Thermodynamics of organic reactions - Free Energy Gibbs (*G*) - Enthalpy (*H*) - Entropy (*S*) – The equation $\Delta G=\Delta H-T\Delta S$ - Exergonic/Endergonic reaction – Exothermic/Endothermic reaction – Bond formation enthalpies (bond strengths) – Calculation of the ΔH of reactions – Thermodynamically/Entropically favoured/unfavoured reaction- Chemical equilibrium - Equilibrium (chemical) constant (*K*) – The relation between ΔG and *K* – The LeChatellier principle
- Kinetics of organic reactions – Reaction rates – Reaction mechanism – Rate constant *k*- Reaction coordinate – Activation energy – Activation complex or Transition state – Energy barrier – Single- and multi-step reactions – Reaction intermediate – The rate-limiting step - Arrhenius equation – kinetic/thermodynamic stability – Reactions with competing steps – Kinetic versus thermodynamic control Κινητικός – Product from kinetic/thermodynamic control - Overcoming energy barriers - Reaction solvent
- Reaction mechanism – Chemical reactivity – Lewis Acids/Bases – The concept of Filicity – Types of electrophiles/nucleophiles in organic reactions – Polarizability effects – Theory of hard and soft acids and bases – The convention of curved arrows – Classes of reaction mechanisms – Polar mechanisms – Free radical mechanisms – Concerted mechanisms – Metal-mediated mechanisms ((ligand coupling reactions) – The principle of microscopic reversibility – Reaction selectivity - Chemoselective reaction/ chemoselectivity – Protection/deprotection of functional groups – Regioselective reaction/regioselectivity – Diastereoselective reaction/diastereoselectivity – Enantioselective reaction/enantioselectivity - Types of solvents (polar/non-polar/, protic/aprotic)
- Redox reactions - Oxidation number - Oxidation state - When an organic reaction is oxidation/reduction - Which organic reactions are not redox reactions

6. Acidity-Basicity

- Lowry and Brønsted theory of acids and bases - Conjugate base/conjugate acid - Chemical equilibrium constant $K_\alpha$and pK_α-Logarithmic scale of acidity
- Organic acidity - Organic acids - Table of pK_α values for common functional groups - Table of pK_α values for common protonanted functional groups - Acidity of carboxylic acids - Acidity of alcohols and phenols - Acidity of aliphatic and aromatic amines - Acidity of carbonyl compounds - Acidity of hydrocarbon - Organic basicity - Solvation effects
- Organic bases - Strong bases (organolithium compounds, amide and alkoxide anions) - Aliphatic and aromatic amines as bases - Basicity of amides - Amidines and guanidines as bases - Basicity of heterocyclic compounds of nitrogen (pyrrole, pyridine, piperidine)

7. Reactive intermediates in Organic Chemistry

- Tri- and tetravalent reactive intermediates with central C atom - Carbocations - Carbanions - Free radicals - Carbenes

- Carbocations: Structure, factors stabilizing carbocations, generation and reactions, rearrangements
- Carbanions: Structure, carbanions from hydrocarbons, factors stabilizing carbanions, carbanions with covalent character (organometallic compounds)
- Free radicals: Structure, factors stabilizing free radicals, generation and reactions
- Carbenes: Structure, stability, generation, reactions

8. General mechanisms of organic reactions with simple examples

General mechanisms with simple examples for the following classes of organic reactions:

- Nucleophilic substitution on a saturated C atom (S_N2 and S_N1)
- Elimination reactions (E2 and E1)
- Addition reactions on C-C multiple bonds

4. TEACHING and LEARNING METHODS - EVALUATION

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 (http://www.soclab.chem.upatras.gr), from where they can be freely downloaded using a password which is provided to the students at the beginning of the course. Seminars. Problems are solved in an exemplary way summarizing before the theory behind each problem. 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*	

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
Course total	***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, preparation of two home-works involving the solution of a series of organic chemistry problems by groups of two students. 10% of the mean mark of the two home-works will be added to the final mark only when in both home-works the minimum grade 5 has been obtained and in the final exam paper the students secure at least the grade 4. This option will be valid (a) ONLY when the incoming number of students were reduced drastically and (b) for ERASMUS student. 2. Optionally, half-term written examinations, the first one in week 7 of the semester and the second in week 14 (immediately after the end of the semester). 20% of the mean mark X for these two exams will be added to the final mark only when 3,5 <X< 5 and in the final exam the student secures at least the grade 4. 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. 3. Written examination after the end of the semester - final mark, unless the student participated in home-works and/or half-term examinations. In the latter case, the percentage(s) of the marks described above are added). Minimum passing grade: 5. 4. The home-works, 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. 5. 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.

5. ATTACHED BIBLIOGRAPHY

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", VolsI and II, Translation to Greek: G. Kokotos et al, Utopia Publications, 2017.
4. P. Sykes, "Guidbook to Mechanisms in Organic Chemistry", Translation to Greek: D. Gakis, Pneumatikos Publications, 1994.
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	**XA131**	**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*			**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures			2	5
Seminars			-	
Laboratory work			2	
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*	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.
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*

Basic skills in Computational Mathematics, Basic methodology of solving scientific 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*
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	

Use of computer, use of Internet

3. SYLLABUS

A. Computer architecture. Using computers, basic knowledge of the Internet. Seeking and exploring scientific information on the Internet. Data bases. Computer programming with emphasis on problems of significance to Chemistry and Physics.

B. Series. Matrix calculus. Roots of equations. Numerical integration. Langrange interpolation. Solving ordinary differential equations. Length of continuous curves. Fractals.

C. Text processing. Basic software: WinWord, Excel/Office. Introducing ORIGIN. Curve plotting and fitting. Collecting scientific information. Writing a scientific project.

D. Chemical information. Project on a subject of chemical interest (compulsory).

4. TEACHING and LEARNING METHODS - EVALUATION

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 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 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 (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
	Project preparation	40
	Final examination (1 contact hour)	1
	Hours of Private Study of the Student for the preparation of the Final Examination	32
	Course total	***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.*	Final written examination (90% of the final grade). Evaluation of the project (10% of the final grade). Greek grading scale: 1 to 10. Minimum passing grade: 5.	

5. ATTACHED BIBLIOGRAPHY

1. H.G. Hecht, "*Mathematics in Chemistry*", Prentice Hall, 1990.
2. E.Steiner, "*The Chemistry Maths Books*", Oxford, 1996.

General Biology

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**BI121**	**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*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	5
Seminars		1	
Laboratory work		-	
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 (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
Others

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. SYLLABUS

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. Cytoplasmic organelles. Mitochondria and chloroplasts.
8. Cell signalling. Signalling molecules and transduction pathways.
9. Cytoskeleton – cellular motility. Organization of cytoskeleton, microtubules, microfibrils, intermediate fibrils, motility of the cells and organelles.
10. Cell growth – cellular division. Mitosis, cellular division, meiosis.
11. Animal tissues. Origin and characteristics of animal cells and tissues.
12. Animal organs. Organization and functions of animal organs.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *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 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. 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. Minimum passing grade: 5.

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
Course total	***125***

5. ATTACHED BIBLIOGRAPHY

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.

2nd Semester (II) (applied since 2016-17)

Inorganic Chemistry-1 (Chemistry of the Representative Elements)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA222**	**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*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	10
Seminars		1	
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 (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
Others

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. SYLLABUS

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 - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures, seminars and laboratory work face to face.</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 (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 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>Laboratory experiments (3 contact hours per week x 13 weeks)</td><td>39</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 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)</td><td>39</td></tr>
<tr><td>Hours of Private Study of the Student for the preparation of the Final Examination</td><td>117</td></tr>
<tr><td>Course total</td><td>250</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>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.

<u>EXPERIMENTAL INORGANIC CHEMISTRY-1 (EOC-2)</u></td></tr>
</table>

	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. ATTACHED BIBLIOGRAPHY

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*			**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures			3	5
Seminars			1	
Laboratory work			-	
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 (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)				

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	*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	

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. SYLLABUS

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 - EVALUATION

DELIVERY *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 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. Two (2) optional written progress during the Semester 2. 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
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
Course total	***125***

5. ATTACHED BIBLIOGRAPHY

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	**XE251**	**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*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	10
Seminars		1	
Laboratory work		4	
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:	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
Others

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. SYLLABUS

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 - EVALUATION

DELIVERY
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 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 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
Course total	***250***

STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

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 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.

5. ATTACHED BIBLIOGRAPHY

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	**XO202**	**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*			**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures			3	5
Seminars			1	
Laboratory work			-	
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 (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.

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. Utilise the chemo- and stereo-selective nature of the Lindlar catalyst.

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 synthesis. Explain the stability of the benzyl free radical, cation and anion, and show how this determines the chemistry of toluene and its side-chain derivatives.

Explain how reaction conditions determine the position of substitution in naphthalene.

Alkyl halides (haloalkanes and haloaromatic compounds)

Exploit the usefulness of alkyl halides in 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 phenols. Explain the behaviour of crown ethers.

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
Others

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 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.

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. SYLLABUS

Alkanes

Sources, preparation, oxidation, free radical halogenation, combustion. Cycloalkanes - small, medium and large rings, ring strain.

Alkenes

Electronic structure, *cis-trans* isomers, preparation via elimination reactions. Addition reactions - hydrogenation, electrophilic addition of HX, H2O, halogens, orientation of alkene addition reactions, Markovnikov's rule, carbocation structure and stability, addition in the presence of peroxides - anti-Markovnikov. Hydroboration. Oxidation of alkenes by manganate(VII), peroxo-acids, and ozone. Conjugated dienes, resonance, stability of allylic carbocations, 1,2- and 1,4- addition to dienes. Cycloaddition reactions (Diels-Alder).

Alkynes

Structure and preparation. Electrophilic addition of H_2, water, HX and 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, benzyl as a free radical, cation and anion. Naphthalene. Kinetic *vs* thermodynamic control.

Alkyl halides (haloalkanes and haloaromatic compounds)

Preparation from alcohols, nucleophilic substitution reactions, elimination reactions, Grignard reagents. Haloaromatics and haloalkenes, their resistance to nucleophilic attack. Allylic bromination.

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.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	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.
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 x 13 weeks) Tutorials (1 contact hour per week x 13 weeks – Analysis of problem solving strategy and solution of representative problems)	52

	Two (2) progress examinations, one at the middle (mid-term) and one the end of semester (2 contact hours for each exam)	4
	Final examination (3 contact hours)	3
	Hours for private study of the student	66
	Course total	***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, two (2) progress examinations, one at the middle and one the end of semester (mid-term). Minimum passing grade for each: 5. 2. Written examination after the end of the semester. Minimum passing grade: 5.	

5. ATTACHED BIBLIOGRAPHY

1. L. G. Wade JR, "Organic Chemistry", Translation to Greek: D. Komiotis et al, A. Tziolas and Sons Publications, 2010.
2. J. McMurry, "Organic Chemistry", Translation to Greek: A. Varvoglis, M. Orfanopoulos, I. Smonou et al, University of Crete Publications, 2012.
3. Devid Klein, "Organic Chemistry", Translation to Greek: G. Kokotoset al, Utopia Publications, 2015.
4. T. Mavromoustakos, T Tselios, K. Papakonstantinou, "Basic Principles of Organic Chemistry", in Greek language, Symemtria Publications, 2014.

3rd Semester (III) (first applied in 2017-18)

Analytical Chemistry-2

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE356**	**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*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		2	5
Seminars		-	
Laboratory work		5	
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:	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

Respect for difference and multiculturalism

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

- 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 - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures and laboratory work face to face.</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 (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.</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>Half-term evaluations (2, the first in the middle and the second one at the end of the semester, 1 contact hour each)</td><td>2</td></tr>
<tr><td>Laboratory work (5 contact hour per week x 12 weeks)</td><td>60</td></tr>
<tr><td>Final written examination (2 contact hours)</td><td>2</td></tr>
<tr><td>Hours for private study of the student and preparation for the half-term evaluations and/or the final examination.</td><td>35</td></tr>
<tr><td>Course total</td><td>125</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>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.</td></tr>
</table>

5. ATTACHED BIBLIOGRAPHY

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 1st Row Transition Metals and of Coordination Compounds)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA323**	**SEMESTER**	**3rd**
COURSE TITLE	INORGANIC CHEMISTRY-2 (CHEMISTRY OF TRANSITION METALS)		

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	10
Seminars	1	
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 (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/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. 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 analyse the bonding in coordination complexes (valence-bond theory, crystal field theory, molecular orbital theory).
7. Prepare, purify, crystallize and characterize coordination complexes of first-row d-block metal ions.

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 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.

3. SYLLABUS

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. Laboratory exercises

a) Synthesis, purification and crystallization of d-block metal compounds and complexes, such as the double nickel(II)/ammonium/sulfate salt, potassium dichromate, potassium/chromium(III) alum, hexaamminonickel(II) chloride and bromide, bis(dimethylglyoximato) nickel(II), catena-tetra(μ-thiocyanato) cobalt(II) mercury(II), catena-tetrakis(aspirinato)dicopper(II), copper(I)chloride, bis(aquo)tetrakis (acetato) dichromium(II), octahedral cobalt(III) ammino complexes, etc.

b) 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 - EVALUATION

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. 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 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 of the Theory after the end of the semester. The mark consists 50% of the final grade. Minimum passing grade:5. 2) Written examination in the concepts of the Laboratory exercises. The mark consists the other 50% of the final grade. Minimum passing grade: 5.

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 work (3 contact hours per week x 13 weeks)	39
Final examination (3 contact hours for the Theory and 3 contact hours for the Laboratory Exercises)	6
Hours for private study of the student and preparation of home-works	153
Course total	***250***

5. ATTACHED BIBLIOGRAPHY

1. D. Kessissoglou, P. Akrivos, "Biocoordination Chemistry", Vol. I: Theory, Ziti Publishing Company, 2006.
2. D. Kessisoglou, P. Akrivos, P. Aslanidis, P. Karafiloglou, A. Dendrinou-Samara, "Biocoordination Chemistry", Vol. II: Synthesis and Study of Coordination Compounds, Ziti Publishing Company, 2006.

Physical Chemistry-2

1. GENERAL

SCHOOL	NATURAL SCIENCES
ACADEMIC UNIT	CHEMISTRY
LEVEL OF STUDIES	UNDERGRADUATE

COURSE CODE	**XA339**	**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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Seminars	1	
Laboratory work	-	
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 (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)	

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
Others

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.

3. SYLLABUS

- Historical introduction. The discovery of th 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 hamilto-nian operators and the corresponding wavefuctions. Schrödinger's equation for the hydrogen atom. Symmetry of s orbitals. Schrödinger's equation for the helim atom.
- Approximative methods. Perturbation theory. The variational principle.
- Atoms. Atomic units system. Studying the helium atom. Hartree-Fock equations and the self-consistent field method. Antisymmetric wavefunctions. Hartree-Fock calculations and comparison with experimental data.

4. TEACHING and LEARNING METHODS - EVALUATION

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. Seminars. 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 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.*	One written examination at end of Semester 100% of grade. Minimum passing grade: 5.

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 final examination	70
Course total	***125***

5. ATTACHED BIBLIOGRAPHY

1. D. A. McQuarrie, "*Quantum Chemistry*", University Science Books, 1983.
2. C. J. Cramer, "*Computational Chemistry: theories and models*", Wiley, 2004.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Seminars	1	
Laboratory work	-	
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 Qualitative analysis and Quantitative analysis.
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)	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:

Chromatographic Techniques in Chemical Analysis

1. The basic chromatographic parameters: Distribution constant, Retention time, Retention factor and their physical meaning. Ability to use these parameters to calculate from a chromatogram other basic parameters such as the Selectivity Factor and the Resolution.
2. The Plate theory and its basic assumptions. Calculation of the Number of Theoretical Plates from a chromatogram. The Rate Theory and van Deemter equation, with its graphical representations for Gas and Liquid Chromatography- HPLC.
3. Recognize the classes of analytes to be determined by Gas Solid and Gas Liquid Chromatography (with packed and capillary columns). Ability to select the appropriate column and detector for the separation and determination of various analytes by Gas Chromatography.
4. 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 certain separation and the appropriate detector for the determination of various analytes. Understand the role of the solvent in HPLC.

5. Perform Qualitative and Quantitative Analysis by chromatography employing various calibration techniques.

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. 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
Others

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 Chromatography
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.
6. Propose membrane composition for potentiometric determination of various ions or molecules.
7. Predict interferences in potentiometric determinations.
8. Selection of a reference electrode.
9. Ability to develop potentiometric determinations including calibration and calculations.
10. Development of coulometric titrations.

3. SYLLABUS

1. *General Concepts of Chromatography*: Distribution Constants, Retention time, Retention Factor, Selectivity Factor, Plate Theory, Rate Theory, Van Deemter equation for Gas and Liquid Chromatography. Resolution and factors that affect the resolution.
2. *Gas Chromatography*: Instrumentation for Gas Chromatography. Carrier Gas. Solid support. Liquid Stationary Phase. Temperature programming. Capillary columns in Gas Chromatography. Adsorbents. Detectors FID, TCD and ECD.
3. *Liquid Chromatography*: Types of Liquid Chromatography. Instrumentation. Liquid-Solid Chromatography. Adsorbents. Liquid-Liquid Chromatography. Stationary phases of Liquid-Liquid Chromatography for Normal and Reverse Phases. The role of Mobile Phase. Gradient Elution. Detectors: UV/Visible, Diode Array and Refractive Index Detector. Ion Chromatography with chemical suppression. Size Exclusion Chromatography. Gel Permeation and Gel Filtration Chromatography.
4. *Qualitative and Quantitative Analysis*: Kovats Index. Quantitative analysis various calibration techniques.
5. *Electroanalytical Techniques*

6. *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.
7. *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.
8. *Voltammetry*. Principles of voltammetric sensors. Applications.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures
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. Seminars. Problems are solved in an exemplary way summarizing before the theory behind each problem.
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.*	One written examination at end of Semester 100% of grade. Minimum passing grade: 5.

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
Course total	***125***

5. ATTACHED BIBLIOGRAPHY

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*			**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures			3	5
Seminars			1	
Laboratory work			-	
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 (Organic Chemistry)			
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess the knowledge provided through the previously taught theoretical courses: "Structure, Reactivity and Mechanisms 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).

Specifically:

Aldehydes –ketones, Carboxylic acids and derivatives:

1. Present the most important reactions-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	*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	

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 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.

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. SYLLABUS

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.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	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 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 (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)	52
	Two (2) progress examinations, one at the middle (mid-term) and one the end of semester (2 contact hours for each exam)	4
	Final examination (3 contact hours)	3
	Hours for private study of the student	66
	Course total	***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, two (2) progress examinations, one at the middle and one the end of semester (mid-term). Minimum passing grade for each: 5. 2. Written examination after the end of the semester. Minimum passing grade: 5.	

5. ATTACHED BIBLIOGRAPHY

1. L. G. Wade JR, "Organic Chemistry", Translation to Greek: D. Komiotis et al, A. Tziolas and Sons Publications, 2010.
2. J. McMurry, "Organic Chemistry", Translation to Greek: A. Varvoglis, M. Orfanopoulos, I. Smonou et al, University of Crete Publications, 2012.
3. Devid Klein, "Organic Chemistry", Translation to Greek: G. Kokotoset al, Utopia Publications, 2015.
4. T. Mavromoustakos, T Tselios, K. Papakonstantinou, "Basic Pronciples of Organic Chemistry", in Greek language, Symemtria Publications, 2014.
5. Clayden, N. Greeves, S. Warren, P. Wothers, "Organic Chemistry", Oxford University Press, Oxford, 2001.

Spectroscopy of Organic Compounds – Experimental Organic Chemistry-1

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Seminars	1	
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 (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	*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	

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. SYLLABUS

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 - EVALUATION

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. Tutorials with exemplary analysis of problem solving in Spectroscopy. Tutorials where the experimental steps are thoroughly analysed and combined with theory.
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 x 13 weeks)	26
Tutorial (1 contact hour per week x 13 weeks – Analysis of problem solving strategy and solution of representative problems) Tutorial (1 contact hour per week x 13 weeks – Analysis of the laboratory experiments and combination with theory)	26
Laboratory work (4 contact hours per week x 13 weeks)	52
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	18
Course total	***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*	**SPECTROSCOPY OF ORGANIC COMPOUNDS:** Written examination (50% of the final grade). Minimum passing grade: 5. **EXPERIMENTAL ORGANIC CHEMISTRY-1:**

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 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.

5. ATTACHED BIBLIOGRAPHY

1. L. G. Wade,Jr., "Organic Chemistry", Translation to Greek: D. Komiotis et al, A. Tziolas and Sons Publications, 2010.
2. J. McMurry, "Organic Chemistry", Translation to Greek: A. Varvoglis, M. Orfanopoulos, I. Smonou et al, University of Crete Publications, 2012.
3. D. Papaioannou, G. Stavropoulos, T. Tsegenidis, "Spectroscopy of Organic Compounds", in Greek language only, University of Patras Publications Centre, Patras, 2005.
4. 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*			**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures			3	5
Seminars			1	
Laboratory work			-	
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 (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	*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*
	Production of free, creative and inductive thinking

Working in an international environment *Others*
Working in an interdisciplinary environment
Production of new research ideas

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. SYLLABUS

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 - EVALUATION

DELIVERY *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 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 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
Course total	***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, 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. 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. The assessment structure described above focuses on problem solving by combining the concepts and theories taught.

5. ATTACHED BIBLIOGRAPHY

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	**XA 454**	**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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	10
Seminars	1	
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.
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 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 emissions 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, various ion sources (electron impact, chemical ionization, field desorption, etc), Instrumentation for Mass Spectrometry. Mass analysers (magnetic sectors, quadruple, time of flight, etc). MALDI and Electrospray Ionization. Applications of MS to the identification and quantification of a plethora of analytes. Tandem MS. Coupling of chromatography with mass spectrometry. Inductively coupled plasma-mass spectrometry (ICP-MS).
10. 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
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
Others

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 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. SYLLABUS

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. Atomic emission spectroscopy: Atomic emission spectroscopy based on plasma sources. Multielement analysis.
8. Atomic mass spectrometry: Mass spectrometry (general), Inductively coupled plasma/mass spectrometry.
9. Molecular mass spectrometry: mass spectra, various ion sources (electron impact, chemical ionization, field desorption, etc), Instrumentation for Mass Spectrometry. Mass analyzers (magnetic sectors, quadruple, time of flight, etc). MALDI and Electrospray Ionization. Applications of MS to the identification and quantification of a plethora of analytes. Tandem MS. Coupling of chromatography with mass spectrometry. Inductively coupled plasma-mass spectrometry (ICP-MS).

10. Automated methods of analysis. Instrumentation. Flow injection analysis, Discrete automated analyzers. Analysis based on multilayered films.

Laboratory Exercises:

- Potensiometry.
- Electrogravimetric analysis.
- Conductimetry.
- UV/Vis Spectroscopy (quantitative analysis, standard addition method).
- UV/Vis Spectroscopy (binary mixtures).
- Photometric titrations.
- Fluorescence spectroscopy.
- Atomic emission (Flame photometry).
- Gas chromatography.
- HPLC ion exchange.
- HPLC reverse phase.
- Automated titration.
- Kinetic photometric determination of an enzyme.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, tutorials 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 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 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 x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving representative problems	13
Laboratory exercises (3 contact hours per week x 12 weeks)	36
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	158
Course total	***250***

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.*	One written examination at end of Semester 80% of the final grade. One written examination for the Laboratory at end of Semester 20% of the final grade. Minimum passing grade: 5.

5. ATTACHED BIBLIOGRAPHY

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	**XA 434**	**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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	10
Seminars	1	
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 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.

7. Prepare and execute laboratory experiments related to the contents of the course.

8. Prepare technical reports after numerical calculations based on experimental data and carry out scientific conclusions.

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	

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 prepare and execute laboratory experiments related to Physical Chemistry.

5. 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. SYLLABUS

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.
7. *Experimental physical chemistry.*
   Laboratory work dealing with subjects of Chemical Thermodynamics, Chemical Equilibrium, Chemical Kinetics and Electrochemistry.

4. TEACHING and LEARNING METHODS - EVALUATION

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. power point) 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 x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems	13
Laboratory work (4 contact hours per week x 13 weeks)	52
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of technical reports for each laboratory experiment.	143
Course total	***250***

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 course is consisted of theoretical (lecture and seminars) and laboratory sessions. *Theoretical session* 1. Optionally two (2) written examinations during the semester. 2. Written examination after the end of the semester. Minimum passing grade for the theoretical session: 5 *Laboratory session* 1. a. Oral examination at the beginning of each new laboratory period (experiment). The mean mark from these examinations consists the 50% of the final grade of the laboratory session.

	a. Written report for each laboratory experiment. The mean mark of the reports consists the 50% of the final grade of the laboratory session. Minimum passing grade for the experimental session: 5 The final course grade is calculated as follows: Grade of the theoretical session (70%) and grade of the laboratory session (30%). Compulsory passing grade for both theoretical and laboratory sessions.

5. ATTACHED BIBLIOGRAPHY

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*", PartsI&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.
7. A.D. Mc Quarrie, J.D. Simon, ''*Physical Chemistry. A Molecular Approach*''. University Science Book, 1997.

5th Semester (V) (first applied in 2018-2019)

Synthetic Organic Chemistry – Experimental Organic Chemistry-2

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 506**	**SEMESTER**	**5th**
COURSE TITLE	SYNTHETIC ORGANIC CHEMISTRY – 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	10
Seminars	2	
Laboratory work	8	
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*	**Synthetic Organic Chemistry:** Field of Science (Organic Chemistry) **Experimental Organic Chemistry-2:** Skills Development

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)	http://www.soclab.chem.upatras.gr (→ Education → Teaching Material → Synthetic Organic Chemistry)

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:

Synthetic Organic Chemistry

10. 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.
11. 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.
12. Apply antithetic analysis and suggest syntheses of widely known natural products and drugs.
13. Present the basic principles and the most important general methods of asymmetric synthesis.
14. Apply the principles and the methods of asymmetric synthesis in order to suggest syntheses of chiral molecules of medium complexity τις αρχές.

Experimental Organic Chemistry-2

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

4. Collect all the necessary information (substance properties and hazard, synthesis bibliography, etc.) and then organize an organic synthesis/preparation.
5. Explain the role of the various reagents.
6. Construct 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, 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, etc.
7. Use reagents, solvents and laboratory techniques friendly (benign) to the Environment (Green Chemistry).
8. Use spectroscopic methods (UV-Vis, IR, NMR and MS) for identifying the product(s).
9. Edit and present the results of the syntheses he/she carried out, such as yields, mechanisms, improvement of synthetic routes, etc.
10. Analyse and organize complex syntheses in constituent (individual) steps.
11. Edit and calculate in multi-step syntheses the yields of each step and 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	*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, 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. SYLLABUS

Synthetic Organic Chemistry

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. Retrosynthetic (or Antithetic) Analysis

Introduction (Transforms or retro-reactions, Target-molecule, Synthons, Equivalent reagents or reactants, Retrons, Transform types). Antithetic disconnections (disconnections of compounds with one and two functional groups, in positions 1,2-, 1,3- και 1,5-. Illogical disconnections of functional groups in positions 1,2-, 1,4- και 1,6-. Disconnections of the preicyclic type. Disconnections of heteroatomes and heterocyclic rings. Disconnections of small rings). Strategy in synthesis. Applications of antithetic analysis to the synthesis of natural products.

5. Asymmetric Synthesis

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

Experimental Organic Chemistry-2

1. Introductory concepts of the Organic Chemistry Laboratory, description of techniques and introduction to the multi-step syntheses and the Green Chemistry.
2. Preparation of 1,2,3,4-Tetrahydrocarbazole.
3. Reduction of camphor with $NaBH_4$.
4. Synthesis of β-naphthol orange using diazonium salts.
5. Preparation of aniline through the reduction of nitrobenzene.
6. Diels-Alders reaction using microwaves (Green Chemistry).
7. Barbier reaction(Grignard-type) in aqueous solution (Green Chemistry).
8. Multi-step preparation of benzocain from *p*-toluidine:
   a) Transformation 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 - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures, seminars and laboratory work face to face.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Synthetic Organic Chemistry
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.
Experimental Organic Chemistry-2
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.</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 × 13 weeks)</td><td>26</td></tr>
<tr><td>Seminars (1 contact hour per week × 13 weeks) - solving of representative problems
Seminars (1 contact hour per week × 13 weeks)-presentation of laboratory techniques and theory associated to each laboratory experiment</td><td>13
13</td></tr>
<tr><td>Laboratory work (6 contact hours per week × 13 weeks)</td><td>78</td></tr>
<tr><td>Final examination (3 contact hours for Synthetic Organic Chemistry)</td><td>3</td></tr>
</table>
</td></tr>
</table>

	Hours for private study of the student and preparation of home-works (3 per semester), for Synthetic Organic Chemistry, and reports, for the Laboratory, and preparation for the Laboratory (study of techniques and theory)	117
	Course total	**250**

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.*	**Synthetic Organic Chemistry (SOC)** 3. 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. 4. 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. Minimum passing grade: 5. **Experimental Organic Chemistry-2 (EOC-2)** 3. 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}). 4. 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. ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. D. Papaioannou, "Synthetic Organic chemistry", in Greek language only, Papazisis Publications, 1995.
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.
6. L. G. Wade, Jr., "Organic Chemistry", Translation to Greek: D. Komiotis et al, A. Tziolas and Sons Publications, 2010.
7. J. McMurry, "Organic Chemistry", Translation to Greek: A. Varvoglis, M. Orfanopoulos, I. Smonou et al, University of Crete Publications, 2012.
8. D. Papaioannou, G. Stavropoulos, T. Tsegenidis, "Spectroscopy of Organic Compounds", in Greek language only, University of Patras Publications Centre, Patras, 2005.
9. Notes of lecturers in Greek.

Physical Chemistry-4

1.GENERAL

SCHOOL	NATURAL SCIENCES
ACADEMIC UNIT	CHEMISTRY
LEVEL OF STUDIES	UNDERGRADUATE

COURSE CODE	**XA 538**	**SEMESTER**	**5th**
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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	10
Seminars	1	
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 (Physical Chemistry) and Skills Development (Laboratory of Physical Chemistry-4)
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 courses of Physical Chemistry and those of Mathematics during the previous semesters. The same stands also for the laboratory skills obtained through the previously attended laboratory of Physical Chemistry-3.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, both the practice of foreign students in the Lab as well as guidance for the study of the course Physical Chemistry 4 may be done in English or in French.
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*

Course

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.

Laboratory

Concerning the skills which the student is expected to develop through practical work in the Physical Chemistry Laboratory 4, those comprise the ability to:

- Work safely in a chemical lab.
- Carry out scientific experiments aiming to the determination of the values of various physicochemical properties.
- Use standard mathematical analyses to correctly describe the numerical significance of experimental results.
- Communicate successfully in written reports the experimental procedure followed and the obtained results.
- Work harmoniously with others during a collaborative experimental project.

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, 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.SYLLABUS

Course: Physical Chemistry 4

A. Statistical Thermodynamics

A1. Introduction to Statistical Thermodynamics

- The objectives of Thermodynamics, Quantum Chemistry and Statistical Thermodynamics
- Energy distribution among the molecules of a macroscopic (N,V,E) system of localized and independent molecules
- The principle of equal a priori probabilities
- Basic concepts (Instantaneous configurations, Statistical weights, Dominating configuration)

A2. The Boltzmann distribution and the Molecular Partition Function

- Calculation of populations for the Dominating configuration.
- The Boltzmann distribution – Physical meaning
- The Molecular Partition Function – Physical meaning
- Energy states and energy levels. Degenerate states (Molecular Partition Function expressed as a sum over energy levels, Boltzmann distribution relative to energy levels)
- Examples of calculation of Molecular Partition Function (Two levels systems, Harmonic oscillator, Particle-in-a-box, Thermal Wavelength of a molecule, Monatomic molecule in a three dimensional box)

A3. Calculation of Thermodynamic properties from the Molecular Partition Function (q)

- Internal energy (Calculation of the internal energy of a system comprised by one-dimensional harmonic oscillators)
- The constant – volume heat capacity (C_V)
- Einstein's model for an atomic crystal (Calculation of internal energy and heat capacity (C_V) of a crystalline element, Einstein's equation for constant – volume heat capacity (C_V) of atomic crystals)
- Calculation of the Molecular Partition Function (q) by the direct summation of its terms (Examples of calculation of U and C_V. Variation of U and C_V with the temperature)
- Entropy (Boltzmann's equation for the Statistical Entropy. Entropy as a function of the Molecular Partition Function. The approximation Ω=W, Calculation of the entropy of a crystalline element)
- Historical background of the development of the Statistical Thermodynamics

A4. Macroscopic (N,V,T) systems of independent molecules

- The concept of an Ensemble
- Basic kinds of Ensembles (Microcanonical, Canonical and Gand Canonical Ensembles)
- First axiom of Statistical Thermodynamics (The principle of the equal a priori probabilities revisited)
- Second axiom of Statistical Thermodynamics (Ergodic hypothesis)
- The method of ensembles of Gibbs (Application of the Gibbs method in the Canonical ensemble, Instantaneous configurations, Statistical weights and Dominating configuration of the Canonical ensemble)
- The Boltzmann distribution in the Canonical ensemble
- The Canonical Partition Function (Calculation of the Canonical Partition Function (Q) from the Molecular Partition Function (q), Real macroscopic systems of independent and localized (or non-localized) molecules, Examples of calculation of the Canonical Partition Function)
- Calculation of thermodynamic properties for macroscopic (N,V,T) systems from the Canonical Partition Function (Internal energy, Constant-volume heat capacity, Entropy, Helmholtz energy, Pressure, Enthalpy, Gibbs energy)
- Application for Ideal monatomic Gases (Sackur - Tetrode equation for the entropy, Chemical Equilibrium)

B. Electric Properties of Molecules and Intermolecular Forces

B1. Electric Properties of Molecules

- Basic concepts (Electric Dipole, Electric Dipole Moment, Polar molecules, Permanent Electric Dipole Moment, Non-polar molecules, Induced Electric Dipole Moment, Polarization of a sample, Ferroelectric solids, Dielectrics)
- Polar molecules (Diatomic, Polyatomic molecules)
- Electronegativity and Electric Dipole Moment (Pauling and Mulliken scales of Electronegativity, Approximate relations between Electronegativity and Electric Dipole Moment for diatomic molecules)
- Induced Electric Dipole Moment (Polarizability of a molecule, Polarizability volume, Anisotropy of the Polarizability, Electronic Polarizability, Distortion Polarizability and Orientation Polarizability, Debye - Langevin equation)
- Influence of field frequency on Polarization

B2. Dielectric Constant and Electric properties of molecules

- Dielectric Constant (Experimental determination of the Dielectric constant, Relation between Dielectric constant and Polarization of the sample)
- Dielectric Constant and Electric properties of molecules (Low pressure gaseous samples, condensed samples)
- Molar Polarization of a sample
- Debye and Clausius – Mossotti equations
- Experimental determination of Dipole Moment and Polarizabilities from measurements of the Dielectric constant (method description, examples and study cases)

B3. Interactions

- The concept of Interaction
- Kinds of Interactions in nature
- Potential Energy of Interaction and factors on which it depends
- Range of Interaction
- The concept of Force

B4. Intermolecular Forces

- Historical background
- Significance of the Intermolecular Forces
- Influence of the medium
- Ion - Ion Interaction (Potential Energy, Range and Strength of interaction)
- Energy of ionic crystal lattice
- Ion - Polar molecule Interaction (Potential Energy, Range and Strength of interaction)
- Ions in Polar Solvents (Solvation, Solvation number, mean reorientation time, Weakly and strongly Solvate ions, Primary Solvation Shell, Solvation zone)
- Ion – Rotating Polar molecule Interaction (Mean Potential Energy of Interaction, Theorem of Potential Distribution, Range and Strength of interaction)
- Interaction among Non-rotating Polar molecules (Potential Energy, Range and Strength of Interaction)
- Interaction among Rotating Polar molecules - Keesom Interaction (Mean Potential Energy, Range and Strength of Interaction)
- Polar molecule – Non-polar molecule Interaction (Pair of dipole – induced dipole interaction, Potential Energy, Range and Strength of Interaction)
- Non-polar molecule - Non-polar molecule Interaction (Induced dipole – Induced dipole Interaction, London (Dispersion) Interaction, Potential Energy, London formula, Range and Strength of Interaction)
- Hydrogen Bonding

C. Introduction to Colloid Chemistry

- Basic Concepts, The colloidal state, Definitions, Classification of colloidal systems
- Preparation of colloidal systems (Dispersion methods, Aggregation methods)
- Purification of colloidal systems
- Size of colloidal particles
- The number average molecular weight and the weight average molecular weight
- Methods for determining the size of colloidal particles

- Methods for determining the molecular weight of macromolecules
- Electric properties of colloidal particles
- Suspensions
- Emulsions

Laboratory of Physical Chemistry 4

Practice of students on eight out of a collection of laboratory exercises, which are based on the material taught in the four courses of Physical Chemistry. Examples of the exercises offered are:

- Adiabatic Expansion of Gases (Determination of the Heat Capacity C_V και C_P of gases)
- Joule-Thomson Effect (Determination of the Joule-Thomson coefficient of gases)
- Steam Distillation (Determination of the molecular weight of a substance non-soluble in water)
- Surface Tension of Solutions (Determination of the effective cross-sectional area of a molecule)
- Adsorption from Solutions (Determination of the surface coverage of the solid by the adsorbed molecules)
- Intrinsic Viscosity (Determination of the molar mass of a polymer)
- Electric Dipole Moment of Polar molecules in Solution (Determination of the Molar Polarization of dilute solutions of a polar substance in a non-polar solvent from capacitance measurements, Determination of the dipole moment of the solute molecules)
- Influence of Ionic Strength on the Solubility
- Conductance of Solutions (Determination of the ionization constant of a weak electrolyte)
- Temperature dependence of emf (Determination of the changes in Gibbs free energy, entropy and enthalpy)
- Activity Coefficients from Cell Measurements
- Tafel diagram
- Galvanic Cell (Determination of the operation curve of a galvanic cell)
- Atomic Absorption Spectroscopy (Quantitative analysis of calcium in water)
- UV-Vis Spectroscopy (Determination of the energy and probability of a transition)
- IR Spectroscopy (Vibration spectrum of SO_2, Determination of the vibrational contribution to the heat capacity C_V)
- Light Scattering for Monitoring Particle Growth (Kinetics of formation of sulphur colloidal particles)

4.TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, problem-solving 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 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*	

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 (4 contact hours per week × 13 weeks)	52
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of technical reports for each laboratory experiment.	143

	Course total	**250**
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.*	• Optional mid-term assessments (2 written examinations per semester) on the material of the Physical Chemistry 4 course. A student may be exempted from the final course exam if the mean grade in these two mid-term assessments exceeds a predetermined value (usually 6 or 7). Otherwise, this mean grade may be taken into account in the final written examination grade (by 30% - only during the first examination period and only if this increases the student's grade). • Written final examination for the Physical Chemistry 4 course. • The assessment of students in the Laboratory of Physical Chemistry 4 is based on both the in-lab examination prior to each exercise (50%) and the report prepared for each exercise (50%) during the semester. The final Laboratory grade is the mean of the grades for the 8 laboratory exercises. The final grade of the Physical Chemistry 4 is calculated by taking into account the course grade (70%) and the laboratory grade (30%), provided that both these grades are equal or higher to 5 (in a scale of 10).	

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. P.W. Atkins, "Physical Chemistry", 6th edition, Oxford University Press, 1998. *(or any later edition)*
2. D.A. McQuarrie, J.D. Simon, "Physical Chemistry: A Molecular Approach", University Science Books, Sausalito, California, 1997.
3. D.P. Shoemaker, C.W. Garland, J.W. Nibler, "Experiments in Physical Chemistry", 8th edition, McGraw-Hill Education, Europe, 2008.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Seminars	1	
Laboratory work	-	
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 (Biochemistry)
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 '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/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*

1. By the end of this course the student will be able to:
2. Know in general about the chemical composition, structure and function of basic biomolecules (carbohydrates, proteins, lipids, nucleic acids).
3. Know the classification of proteins, and the structure and function of the main members in each class.
4. Know the classification of enzymes, the determination of their kinetic constants, the general mechanisms of enzymatic reactions, and the modes of enzyme activity regulation.
5. Know the structure of cell membranes and the basic concepts of cell signalling.

6. Present the major metabolic processes of carbohydrate metabolism such as glycolysis, glyconeogenesis and glycogen metabolism and their regulation.
7. 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.
8. 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	*Others…*
	…….

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), transduction and storage of energy into fuel molecules, and energy release from them.
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.

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.SYLLABUS

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.
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. Signal transduction. Basic concepts.
7. Metabolism, basic concepts and design. ATP as the universal currency of free energy in biological systems.
8. Glycolysis and glyconeogenesis.
9. Glycogen metabolism.
10. 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.
11. Energy release from reduced coenzymes (respiratory chain) and storage of energy into ATP (oxidative phosphorylation).

4.TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, self-tests of students and problem-solving seminars for the instructive solution of problems in teams of students.
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*	

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
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
Course total	**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.*	5. 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. 6. Written examination after the end of the semester. Minimum passing grade: 5.

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

8. J.M. Berg, J.L. Tymoczko, L. Stryer, "Biochemistry", Volume I and II, Translation: A. Aletras, Th. Valkana, D. Drainas et al., Creta University Press, 2005.

9. D.L. Nelson, M.M. Cox, "Lehninger Basic Principles of Biochemistry", Volume I, II and III, Ed.: A.G. Papavasileiou, Medicinal Publications P.X. Pasxalidis, 2007 &2008.
10. C.A. Demopoulos, S. Antonopoulou, "Basic Biochemistry", 2nd revised edition, C.A. Demopoulos, S. Antonopoulou Publications, 2009.
11. J.G. Georgatsos, "Introduction to Biochemistry", 6th Edition, Giahoudi Publications, 2005.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Seminars	1	
Laboratory work	-	
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 (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	*Others…*
	…….

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.SYLLABUS

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 - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures and seminars face-to-face.</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 (ICTs) (e.g. powerpoint) in teaching.</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>Seminars (1 contact hour per week × 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 and preparation of home-works</td><td>70</td></tr>
<tr><td>Course total</td><td>125</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</td><td>Written examination after the end of the semester. Minimum passing grade: 5</td></tr>
</table>

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

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

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.

6th Semester (VI)

Biochemistry-2

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XO 612**	**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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	10
Seminars	2	
Laboratory work	4	
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 (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/CHEM2085/

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	*Others…*
	…….

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
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

3.SYLLABUS

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.

   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.
4. The degradation of dietary proteins.

   The degradation of intracellular proteins, the ubiquitin-proteasome system. Aminotransferases, their function mechanism. Degradation of glucogenic and ketogenic amino acids. The urea cycle.
5. Nitrogenase, nitrogen fixation, synthesis of ammonia. Essential and non-essential amino acids. Biosynthesis of non-essential amino acids.
6. Nucleotides and deoxynucleotides metabolism. Salvage reactions.
7. The biosynthesis of triacyloglycerols, phospholipids, sphingolipids and cholesterol. The lipoproteins. The LDL receptors. The biosynthesis of steroid hormones.
8. DNA replication in prokaryotes and eukaryotes.

   Prokaryotic and eukaryotic DNA-polymerases. Telomerases and telomeres. Recombination of DNA. DNA mutations and repair mechanisms.
9. RNA synthesis.

   Prokaryotic and eukaryotic RNA-polymerases. Prokaryotic and eukaryotic promoters. Response elements and transcription factors. Splicing of eukaryotic mRNA.
10. Protein synthesis.

The transfer RNA (tRNA). Aminoacyl-tRNA synthetases. The prokaryotic and eukaryotic ribosome. The proteins biosynthesis pathway in prokaryotes and eukaryotes. The Wobble hypothesis.

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 glycin. 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. 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.

4.TEACHING and LEARNING METHODS - EVALUATION

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 (https://eclass.upatras.gr/courses/CHEM2085/), 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 for the instructive solution of problems in teams of 25 students.

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

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	39
Seminars (2 contact hours per week × 13 weeks) - solving of representative problems	26
Laboratory work (4 contact hours per week × 13 weeks)	52
Multiple choice tests for each laboratory exercise	5
Multiple choice tests at the end of each chapter	6
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for mid-term examinations and final examination	119
Course total	**250**

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 of the theory. It includes:

a) Two (2) half-term written examinations (optionally, the first one in week 7 of the semester and the second immediately after the end of the semester). The final mark is the mean mark obtained from the 2 half-time examinations if it is ≥ 6 (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).

b) Written examination after the end of the semester-final mark, unless the student participated in half-term examinations. Minimum passing grade: 5.

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.

2. Practical and written examination of the laboratory courses. It includes:

a) 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 was not obtain a mean mark ≥ 6,5 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%).

b) In order to support the mark in the laboratory courses, each student is subjected to a practical test. At the end of semester he is called to

	carry-out an experiment from those were performed during semester (e.g. the preparation of a buffer solution). The evaluation is "successfully" or " unsuccessfully". The final mark of Biochemistry-2 course results from the mean mark of the two half-term written examinations or the mark from the final written examination at the end of semester (2/3 of the final mark), and the mark from the practical and written examination of laboratory courses (1/3 of the final mark). Both marks should be ≥5. The 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. All the above 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. 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.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. J.M. Berg, J.L. Tymoczko, G.J. Gatto, L. Stryer, "Biochemistry", Crete University Press, 2017.
2. D.L. Nelson, M.M. Cox, "Lehninger-Basic Principles of Biochemistry", New Edition, Publishers Broken Hill, 2018.
3. C.A. Dimopoulos, S. Antonopoulou, Σ. Αντωνοπούλου, "Basic Biochemistry", Publichers C.A. Dimopoulos, 2009.
4 R.A. Harvey, D. Ferrier, "Lippincott Biochemistry", 6th Edition, Parisianos Publishers., 2015.
5. D. Doenecke, J. Koolman, G. Fuchs, W. Gerok, "Karlsons Biochemistry and Pathobiochemistry", 15th Edition, K. & N. Litsas Publishers, 2012.
6. J. G. Georgatsos, "Introduction to Biochemistry", S. Giahoudis Publications, 2005.
7. C. P Tsiganos, N. Papageorgakopoulou, S. Anagnostidis, A.J. Aletras, "Laboratory Practice in Biochemistry", University of Patras Publications Centre, 2008.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Seminars	1	
Laboratory work	2	

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 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*
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 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.SYLLABUS

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 - EVALUATION

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
	Course total	**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. 3. Final written examination. Minimum grade: 5. 4. All the above take place in the Greek language, as well as in English for foreign students (e.g. ERASMUS students).

5.ATTACHED BIBLIOGRAPHY

- 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

Principles of Chemical Technology

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE 681**	**SEMESTER**	**6th**
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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	10
Seminars	1	
Laboratory work	4	
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 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".
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:

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	*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…*
	…….

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.SYLLABUS

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 - EVALUATION

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 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*	*Activity* / *Semester workload* Lectures (3 hours of contact weekly × 13 weeks) — 39 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 (4 hours of contact weekly × 13 weeks) — 52 Final examination (3 hours of contact) — 3 Study hours of the student, laboratory exercises and preparation for progress and/or final examination — 143 **Course total** — **250**
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 ≥ 5.0. 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). 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.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. J. Mikroyiannidis, "Basic Principles and Physical Processes of Chemical Technologies", OEDB.
2. J. Mikroyiannidis, "Problems of Chemical Technology", OEDB.

3. Th. Karapantsios, A. Zoumpoulis, K. Matis, P. Mavros, "Elements of Natural Processes", Tziolas Publications, 2009.
4. W.L. McCabe, J.C. Smith, P. Harriot, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 2004.
5. A. Zoumpoulis, M. Zoumpoulis, N. Kostoglou, K. Lazaridis, "Laboratory Exercises of Chemical Technology", Tziolas Publications, 2009.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Seminars	1	
Laboratory work	2	
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 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	*Others…*
	…….

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.SYLLABUS

<u>*Polymers*</u>

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

<u>*Nanocomposite materials*</u>

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

<u>*Porous Materials*</u>

- 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 - EVALUATION

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*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures (3 hours of contact weekly × 13 weeks)</td><td>39</td></tr><tr><td>Laboratory work (2 hours of contact weekly × 6 weeks)</td><td>12</td></tr><tr><td>Final examination (3 hours contact)</td><td>3</td></tr><tr><td>Study hours of the student, laboratory exercises and preparation for progress and / or final examination</td><td>71</td></tr><tr><td>**Course total**</td><td>**125**</td></tr></table>
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).

5.ATTACHED BIBLIOGRAPHY

- 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Seminars	1	
Laboratory work	2	
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 (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*

1. At the end of this course the student should be able to
2. 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
3. Recognize the differences in wastewater characteristics and the treatment methods required for each type of wastewater.
4. Compare the available analytical methods for measuring wastewater COD and BOD.
5. Describe pollution phenomena for the various water bodies.
6. Describe global air pollution problems.
7. 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 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* …… *Others…* …….

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.SYLLABUS

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 - EVALUATION

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
	Course total	***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.	

5.ATTACHED BIBLIOGRAPHY

- *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*	WEEKLY TEACHING HOURS	CREDITS
Lectures	3	5
Seminars	1	
Laboratory work	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:

5. Have an understanding of the 3D architecture of the different classes of crystalline materials at atomic level.
6. Be aware of the differences in the structure of the various crystalline materials and the effect on their chemical and physicochemical properties.
7. 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.
8. Know the principles and basic steps of the crystal and molecular structure determination.
9. 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*
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 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.SYLLABUS

- 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.

Laboratory training

- 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 - EVALUATION

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

TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	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
Course total	**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.*	6. 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. 7. 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. 8. 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.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

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 (3 courses/15 ECTS credits)

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Seminars	1	
Laboratory work	2	
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 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*
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…*
	…….

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.SYLLABUS

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 - EVALUATION

DELIVERY *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) (PowerPoint) in Teaching and Teaching. Lesson lectures for each

Use of ICT in teaching, laboratory education, communication with students	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 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. 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). 5. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in the English language.

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
Final examination (3 hours of contact)	3
Study hours of the student, laboratory exercises and preparation for progress and / or final examination	57
Course total	**125**

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

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*	WEEKLY TEACHING HOURS	CREDITS
Lectures	2	5
Seminars	1	
Laboratory work	2	
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 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
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	*Others…*
	…….

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.SYLLABUS

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 - EVALUATION

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.*	***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 (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
	Course total	**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 intermediate exams which are exempt for final written examination when the grade in each is ≥7,0. 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). The evaluation language is Greek but for Erasmus students all the above is done in English.

5.ATTACHED BIBLIOGRAPHY

- *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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Seminars	1	
Laboratory work	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 (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	*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, 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.SYLLABUS

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 - EVALUATION

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	44
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
Course total	**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.*	7. 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 8. 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)

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

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.

Computational Chemistry and Molecular Design

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 737**	**SEMESTER**	**7th**
COURSE TITLE	COMPUTATIONAL CHEMISTRY 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Seminars	1	
Laboratory work	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*	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.

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*
	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* …… *Others…* …….

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

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

Production of new research ideas

Production of free, creative and inductive thinking

3.SYLLABUS

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. Dissociation of a monoprotic acid HA.
   - Dissociation of polyprotic acids H_nA.
   - Compute the pH of $Na_mH_{n-m}A + H_nA$
   - Determination of the solubility
   - Titration simulation
   - Maxwell-Boltzmann distribution. Applications.
   - Simple and complex problems of Chemical Kinetics.

C. Chemical Graph Theory.
   - Topological Matrix and Huckel Molecular Orbital Theory.
   - Molecular complexity.
   - Quantitative Structure-Property Relationships (QSPR).
   - Quantitative Structure-Activity Relationships (QSAR).
   - Introduction to Molecular Mechanics (MM).
   - Molecular Design.
   - Applications to Medicinal Chemistry.

Practical/Laboratory courses

Ab initio calculations for small organic and inorganic molecules.

Molecular structure and electronic structure of small molecules.

Peptides and proteins.

Structure and conformation in oligopeptides.

4.TEACHING and LEARNING METHODS - EVALUATION

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 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 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*
Lectures (3 contact hours per week × 13 weeks)	39
Laboratory work (1 contact hours per week x 13 weeks)	13

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*	Tutorials (1 contact hour per week × 13 weeks)	13	
	Possibility of preparing a project	40	
	Final examination (1 contact hours)	1	
	Hours for private study of the student and preparation for the Laboratory and final examinations	45	
	Course total	**151**	
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 evaluation language is Greek but for Erasmus students all the above is done in English.		

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1 K. Ebert, H. Ederer and T.L. Isenhour, "Computer Applications in Chemistry", VCH, 1989.

Optional Chemistry Courses for 7th Semester (2 or 1 courses/8 ECTS credits)

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	4
Seminars	1	
Laboratory work	-	
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 (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 Spectroscopy Methods (NMR-MS)

1. Prepare samples for the NMR Spectroscopy and MS Spectrometry 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	*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, have developed the following skills (general abilities):

(2) 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.

(3) Ability to apply this knowledge in the understanding and resolving problems related to NMR, MS and Molecular Modelling.

(4) Study skills related to NMR, MS and Molecular Modelling needed for continuing professional development.

(5) Ability to interact with others in subjects related to NMR, MS and Molecular Modelling or 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.SYLLABUS

Modern Spectroscopy Methods (NMR-MS)

7. Nuclear Magnetic Resonance Principles and Instrumentation.
8. 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.
9. 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.

10. Nuclear Overhauser Effect (NOE). Principles and interpretation, relation to the distance between nuclei and correlation time τ_c.
11. Mass Spectrometry. Principles and instrumentation. Ion Scan Methods (parent, daughter and neutral loss scans) SRM (Selected Reaction Monitoring). Examples and Applications.

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.

4.TEACHING and LEARNING METHODS - EVALUATION

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. 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*	
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. The exams take place in the Greek language for Greeks and in English for the non-Greek speaking students (e.g. Erasmus students). Students with writing problems can be examined orally at the same day and hour with the written examination.

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
Course total	**100**

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. T. Mavromoystakos, I. Matsoukas, "NMR: Principles and Applications of Nuclear Magnetic Resonance in Medicine, Pharmaceutical Chemistry, Biochemistry and Food Chemistry", in Greek language only, 1st Edition, J.B. Parisanos 2006.

2. T. Mavromoystakos, P.Zoumpoulakis, "Molecular Modelling: Applications in Organic and Pharmaceutical Chemistry", in Greek language only, 1st edition, J.B. Parisanos, 2008.
3. I. Matsoukas, "Modern Spectroscopy Methods", in Greek language only, University of Patras.
4. R.M. Silverstein, F.X. Webster, D.J. Kiemle, "Spectrometric Identification of Organic Compounds", 7th Edition, John Wiley & Sons, 2005.
5. A.R. Leach, "Molecular Modelling: Principles and Applications», 2nd Edition, Prentice Hall, 2001.
6. Notes of lecturers in Greek.

Food Chemistry and Technology – Oenology I

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE785**	**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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	8
Seminars	-	
Laboratory work	4	
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 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	*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 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.SYLLABUS

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 - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	1. Face-to-face lectures 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 *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 × 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
Course total	**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). 3. All the above take place in the Greek language, as well as in English for foreign students (e.g. ERASMUS students).

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. A.A. Koutinas, M. Kanellaki, "Food Chemistry and Technology", University of Patras Publications, 2009-2010. (*in Greek language only*)
2. E. Voudouris, M. Kontominas, "Introduction to Food Chemistry", OEDB Publications, 2006. (*in Greek language only*)
3. H.-D. Belitz, W. Grosch, P. Schieberle, "Food Chemistry", 4th Edition, Springer, Berlin, 2009.
4. O.R. Fennema, "Food Chemistry", 3rd Edition, Marcel Dekker Inc., 1996.
5. R. Jackson, "Wine Science: Principles and Applications", 3rd Edition, Elsevier Inc., 2008.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	4
Seminars	-	
Laboratory work	-	
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 (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	*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…*
	…….

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.SYLLABUS

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 - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and presentation of one bibliographic work by the students
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*	

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
Course total	**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.*	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. Minimum passing grade (in the 0-10 scale) : 5

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	4
Seminars	1	
Laboratory work	-	
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:	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	*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…*
	…….

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.SYLLABUS

- 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 - EVALUATION

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
Course total	**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. Minimum passing grade: 5.

5.ATTACHED BIBLIOGRAPHY

- 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	4
Seminars	1	
Laboratory work	-	
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 (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.

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, 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.SYLLABUS

1. Flow of genetic information.
   a) Rearrangement and replication of genes.
   b) Transcription and processing of RNA.
   c) RNA translation – Protein biosynthesis.
2. Regulation of gene expression, hormonal and epigenetic control, effect of chromatin, histones and protein interactions in gene expression.
3. Post-translational control of gene expression.
4. RNAi.
5. Genetic engineering
6. Restriction enzymes.
7. Recombinant DNA technology.
8. PCR.
9. Manipulation of eukaryotic DNA.
10. Cell transfection.
11. Recombinant proteins.

4.TEACHING and LEARNING METHODS - EVALUATION

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) (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	***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 (2 contact hours per week × 13 weeks)	26
	Seminars (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
	Course total	**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 or oral examination by presentation of a lecture by the students of selected subjects from the subject matter. Minimum predictable grade: 5. This is done in the Greek language and for the foreign students (e.g. ERASMUS students) in English.	

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. J.M. Berg, J.L. Tymoczko, G.J. Gatto, L. Stryer, "Biochemistry", Crete University Press, 2017.
2. B. Lewin, "Genes VIII", Volume I and II, (Greek edition), 8th Edition, Translation: G. Stamatogiannopoulos, Academic Editions I. Basdra, 2004.
3. M. Cooper and R.E. Hausman. "The cell: a molecular approach" 7th Edition, Oxford University Press, 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	4
Seminars	-	
Laboratory work	2	

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 (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:

15. Recognize and apply the basic analytical biochemical and clinical chemistry techniques as well as the methods of evaluation in the clinical chemistry laboratory.
16. 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	*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, 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.SYLLABUS

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 - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures and laboratory work face to face.</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 (ICTs) (e.g. PowerPoint) in teaching.</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 × 13 weeks)</td><td>26</td></tr>
<tr><td>Laboratory work (2 contact hour per week × 13 weeks)</td><td>26</td></tr>
<tr><td>Literature project and presentation (1 contact hour per student x×15 students)</td><td>15</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 final examination</td><td>30</td></tr>
<tr><td>Course total</td><td>100</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure</td><td>9. Optionally, preparation of a literature project that consists 50% of the final grade.
10. Written examination after the end of the semester. Minimum passing grade: 5. For students who have performed the literature</td></tr>
</table>

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.*	project the mark of the final examination consists 50% of the final grade.

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

12. W. Marshall, "Clinical Chemistry", 6th Edition, P.X. Paschalidis Publications, 2011.
13. W.J. Marshall, "Clinical Biochemistry", K. & N. Litsas Publications, 2000.
14. Δ. Βύνιος, Α. Θεοχάρης ΑΣΚΗΣΕΙΣ ΚΛΙΝΙΚΗΣ ΧΗΜΕΙΑΣ, Εκτυπωτικό Κέντρο Παν/μιου Πατρών, 2017
15. A. Skorilas, "Principles of clinical chemistry and molecular diagnostic", Symmetria Publications, 2009.
16. 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	**XE792**	**SEMESTER OF STUDIES**	SEVENTH
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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	4
Seminars	-	
Laboratory work	-	
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 (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	*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, 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.SYLLABUS

1. Principles of Green Chemistry
2. Introduction to Catalysis - Applications Range
   a. Kinds of catalysis and types of catalysts
   b. Comparison of Homogeneous and Heterogeneous Catalysis and Catalysts.
   c. Catalyst operation and ways of accelerating chemical reactions
   d. Catalytic Reaction Mechanisms and Catalytic Circles
   e. Catalytic Activity and Selectivity
3. Homogeneous Catalysis

   Specific and General Acid-Base Catalysis /Lewis Acids as Catalysts

   f. Catalysing Organic Reactions by Lewis Acids - Selectivity

   Organometallic Catalysts

   g. Reactions / Mechanisms taking place in the coordination sphere of catalytic complexes
   h. Shift reactions (ROP, RCM)
   i. Coupling reactions (Suzuki, Sonagashira, Negishi, Heck, Stille, Kumada ..)
   j. Types of ligands
   k. Stereoelectronic and chelating tuning of ligands
   l. Coupling reactions C-O, C-N, C-C of Buchwald-Hartwig type
   m. Catalytic carbonylation
   n. Catalytic Hydrogenation
   o. Catalytic Hydroformylation
   p. The Monsanto Process
   q. The Wacker Process

   Organocatalysis

   r. Nucleophilic Catalysis - General
   s. Organic catalysis by imines and iminates
   t. Carbenium organatalysis
   u. The Stetter reaction
   v. The Morita - Baylis - Hillman reaction
   w. Phase-Transfer Catalysis (Organic Salts and Crown Ethers)
4. Heterogeneous Catalysis
   x. Catalysis by Enzymes
   y. Surface Acid-Base Catalysis-Zeolites.
   z. Partial Oxidation Reactions over the Transition Metal Oxide Surface.
   aa. Catalysis over the Metal Surface.
   bb. Hydrotreatment of Petroleum Fractions on the Surface of Supported Sulphides.
   cc. Photocatalysis.
   dd. Electrocatalysis.

   Solid Catalysts.

   ee. Preparation of non-Supported Catalysts and Carriers.
   ff. Preparation of Supported Catalysts.
   gg. Determination of Geometric Characteristics of Solid Catalysts.
   hh. Determination of Chemical Characteristics of Solid Catalysts.
   ii. Determination of Kinetic Parameters of Heterogeneous Reactions: Laboratory Catalytic Reactors.

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* / *Workload of Semester* Lectures / Seminars (3 contact hours per week × 12 weeks) — 36 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 — 32 **Course Total** — **75**
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 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. Written examination. The evaluation language is Greek but for Erasmus students all of the above is conducted in English

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	4
Seminars	-	
Laboratory work	-	
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*	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	*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, 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.SYLLABUS

1. History of Enzymology. Name and rank of enzymes depending on the reactions that catalyse them.
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.

4.TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures face-to-face.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>PowerPoint type lectures by the teacher, posted on the Internet with free access to the students.</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 and seminars (3 contact hours per week × 13 weeks)</td><td>39</td></tr>
<tr><td>Final examination (3 contact hrs)</td><td>3</td></tr>
<tr><td>Hours for private study of the student and for the final exam</td><td>58</td></tr>
<tr><td>Course total</td><td>100</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure</td><td>1. Written examination at the end of the semester, on the whole of the subject, with a minimum probable grade of 5.
2. All the above are taking place in the Greek language and for the foreign students (eg ERASMUS students) in English.</td></tr>
</table>

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.ATTACHED BIBLIOGRAPHY

- Suggested bibliography: 1. I. Clonis, "Enzymology", Embryo Publications, 2007.

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, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		2	4
Seminars		-	
Laboratory work		2	
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*	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 (eg. bioreactors, production of citric acid and wine).
5. 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	*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…*
	…….

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.SYLLABUS

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 - EVALUATION

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*	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*	

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 for Synthetic Organic Chemistry)	3
Hours for private study of the student and preparation of laboratory reports	58
Course total	**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.*	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. 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. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. G. Aggelis, "Microbiology and Microbial Technology", A. Stamoulis Publications, 2007.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Practical training		4
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*	Skills development
PREREQUISITE COURSES:	Formally there are no prerequisites courses. Students should have successfully completed their obligations in courses corresponding cumulatively to at least 120 ECTS.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	http://www.praktiki.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*

At the end of this course, the student will develop the following skills (general competencies):

1. Use and expand the acquired scientific knowledge, as well as to improve their experience in dealing with problems and scientific data that arise in a real work environment.
2. Connect the professional with the academic environment
3. Acquire job experience and facilitate the entry into the labour market

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
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

Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	……
Production of new research ideas	*Others…*

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.SYLLABUS

Practical Training is realized in chemistry-related companies/public bodies (Industries, Enterprises, Analytical laboratories, Biochemical laboratories, General Chemical State Laboratory, Biochemical Laboratories of Hospitals, Research Centers or Institutes, etc.). The training period is three months.

4.TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face practical training in chemistry-related companies/public bodies.
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 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). Minimum passing grade (in the 0-10 scale): 5.

Optional Chemistry Courses for 8th Semester (3 courses/12 ECTS credits)

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	4
Seminars	-	
Laboratory work	-	
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*	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/modules/document/?course=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	*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…*
	…….

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.

3.SYLLABUS

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).

4.TEACHING and LEARNING METHODS - EVALUATION

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*	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.* *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 at the end of the semester, on the whole of the subject, with a minimum passing grade of 5/10. 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. 3. All 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 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
Course total	**100**

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

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*	**WEEKLY TEACHING HOURS**	**CREDITS**

Lectures	3	4
Seminars	-	
Laboratory work	-	
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 (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 and research activities of R&D departments of pharmaceutical companies
2. Know the categorization of drugs based on administration route and type of molecule.
3. Understands the difference between drug product and drug substance (API)
4. Understands the concepts of solubility, permeability, polarity, lipophilicity and hydrogen bonding
5. Understands the concepts of bioavailability and pharmacokinetics as well as the properties that define them (Absorption, Distribution, Metabolism, Excretion and Toxicity – ADMET)
6. Understands the general strategy of pharmaceutical companies in investing in drug discovery programs, the associated costs and the concept of attrition.
7. Knows the importance of target validation and the data required at the early stages of a drug discovery program. 8. Knows the various pools of compounds and methods for screening for hit identification.
9. Applies the most appropriate methodologies for the design of early lead molecules depending on the available information on target and natural substrate.
10. Understands how potency, selectivity and pharmacokinetics are optimized through SARs and SPRs
11. Knows the basic causes of toxicity and the importance of drug-drug interactions
12. Understands the criteria for candidate selection and the information required for IND submission
13. Be familiar with the importance in investigating the process parameters in a large scale synthesis of a drug candidate and how these impact specifications and technology transfer to manufacturing sites.
14. Understands the importance of salt version, polymorph and habits of crystalline solids and stability tests
15. Understands the BSC system for drug categorization according to solubility and permeability.

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

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 Drug Discovery and Development.
2. Ability to apply this knowledge and understanding to problem-solving in basic drug discovery issues.
3. Study skills needed for continuing academic and professional development.
4. Ability to interact with others in interdisciplinary teams in the pharmaceutical environment.

3.SYLLABUS

1. **General aspects of Medicines**
   - Evolution and current challenges in drug discovery
   - From discovery to approval
   - Activities of the R&D Department in typical pharmaceutical companies.
   - Drug substance and Drug Product
   - Drug categories according to a) administration route and b) type of molecule.
2. **Introduction to pharmacokinetics**
   - Solubility. Definition and measurement of logP
   - Permeability, polarity, lipophilicity and hydrogen bonding
   - The enteric route to drug target
   - Bioavailability
   - Absorption
   - Distribution
   - Metabolism
   - Excretion
3. **Drug Research and Development - Target Validation**
   - Traditional and Contemporary approaches for target selection.
   - Genetic and Chemical Genetics in Target Identification
   - Criteria for target qualification/validation
   - Types of biological targets
   - Druggability
4. **Drug design**
   - Pools of molecules for initial screening
   - Natural Products
   - Fragment Based Design
   - Rational Design
   - Libraries from Combinatorial Chemistry
   - Exploiting older drugs
   - De novo design and conformational analysis. Homology modelling of target
5. **From Hits to Leads**
   - Filtering off rubbish
   - Druglikeness - Lipinski, Veber and other guidelines

- In vivo and in vitro tests
- High Throughput Screening for target binding
- Potency vs selectivity, solubility, stability, enzyme inhibition, permeability
- Bioavailability

6. Lead optimisation

- Determination of the pharmacophore
- Structure Activity Relationships (SARs)
- Structure Property Relationships (SPRs)
- Quantitative Structure Activity Relationships (QSARs)
- Toxicity
- Drug-Drug Interactions

7. Candidate Selection

- IND Submission and prerequisite information
- Necessity of human trials
- Large scale synthesis of the Active Pharmaceutical Ingredient (API)
- Version and polymorph selection
- Stability studies
- BSC classification and formulation strategies

4.TEACHING and LEARNING METHODS - EVALUATION

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 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*	*Activity* / *Semester workload* Lectures and seminars (3 contact hours per week × 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 — 58 **Course total** — **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*	1. Two team assignments on selected topics each contributing 10% towards the final mark. 2. Optional end of term exam for final mark. If grade 6.5 is achieved, contributing 80% towards the final mark, the final examination is waived. 3. Written examination at the end of the semester contributing 80% towards the final mark. 4. Oral examination as appropriate The team assignments and written examination are in the Greek language unless foreign students (for example, ERASMUS students)

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	attend the course, in which case all assessments will be in the English language.

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

5. Notes from the teachers.
6. Graham L. Patrick, "An Introduction to Medicinal Chemistry", 6th Edition, Oxford University Press, 2017. (for foreign students)

Biotechnology

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	4
Seminars	-	
Laboratory work	-	
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*	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/modules/document/?course=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	*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…*
	…….

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.

3.SYLLABUS

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).

4. TEACHING and LEARNING METHODS - EVALUATION

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*	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.* *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*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures and seminars (3 hours of contact weekly × 13 weeks)</td><td>39</td></tr><tr><td>Final examination (3 contact hours for Synthetic Organic Chemistry)</td><td>3</td></tr><tr><td>Hours for private study of the student and preparation of home-works (3 per semester), for the final exam.</td><td>58</td></tr><tr><td>**Course total**</td><td>**100**</td></tr></table>
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 at the end of the semester, on the whole of the subject, with a minimum passing grade of 5/10. 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. 3. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

4.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

3. A. Vafopoulou-Mastrogiannaki, "Food Biochemistry", Ziti Publications, 2003.
4. D. Galanopoulou, J. Zampetakis, M.-Mavri-Vavagianni, A. Siafaka, "Food Biochemistry", Stamoulis Publications, 2007.

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*	WEEKLY TEACHING HOURS	CREDITS
Lectures	2	4
Seminars	1	
Laboratory work	-	
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*	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	*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. 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.SYLLABUS

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 - EVALUATION

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	***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 (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
	Course total	**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.*	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. 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. 4. 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.

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

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*	WEEKLY TEACHING HOURS	CREDITS
Lectures	3	4
Seminars	-	
Laboratory work	-	
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*	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.SYLLABUS

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 - EVALUATION

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*	

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
Course total	**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.*	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. 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. 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.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

2. 'The Petroleum Handbook', Royal Dutch, Shell Group of Companies, Koninklijke Nederlandsche, Petroleum Maatschappij, Elsevier, 1986.

3. 'Industrial Organic Chemicals in perspective' H. A. Wittcoff, B. G. Reuben, J. Wiley & sons, USA, 1980.

4. 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	4
Seminars	-	
Laboratory work	-	
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.	
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	*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 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.SYLLABUS

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 - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures using Information and Communication Technologies (ICTs) (e.g. PowerPoint). Visits to industries.
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*	
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. 2. All the above take place in the Greek language, as well as in English for foreign students (e.g. ERASMUS students).

Activity	*Semester workload*
Lectures (3 contact hours per week × 13 weeks)	39
Final written examination (3 contact hours)	3
Private study time of the student and preparation for the half-term evaluations and final examination	58
Course total	**100**

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. A. A. Koutinas, M. Kanellaki, "Food Chemistry and Technology" University of Patras Publications, 2009-2010. (in Greek language only)
2. J. Jay, "Modern Food Microbiology", 6th Edition, Springer-Verlag, 2000.
3. H.-D. Belitz, W. Grosch, P. Schieberle, "Food Chemistry", 4th Edition, Springer Berlin, 2009.
4. O.R. Fennema, "Food Chemistry", 3rd Edition, Marcel Dekker Inc., New York, 1996.
5. R. Jackson, "Wine Science: Principles and Applications", 3rd Edition, Elsevier Inc, 2008.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	4
Seminars	-	
Laboratory work	-	
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 (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	*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, 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.SYLLABUS

(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.TEACHING and LEARNING METHODS - EVALUATION

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-*	

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

directed study according to the principles of the ECTS	**Course total** | **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.*	4. Written examination (50% of the final mark). 5. An assay comprising the writing of one literature report accompanied by an oral presentation (50% of the final mark).

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

17. S.J. Lippard, J.M. Berg, "Principles of Bioinorganic Chemistry", University Science Books, 1994.
18. R.M. Roat-Malone, "Bioinorganic Chemistry: A Short Course", Wiley-Interscience, 2002.
19. R.W. Hay, "Bioinorganic Chemistry", Translation: E. Manesi-Zoupa, D. Raptis, Papazisis Publications, 1992.

Optional non-Chemistry Courses for 8th Semester (2 courses/6ECTS credits)

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	3
Seminars	-	
Laboratory work	-	
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*	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	*Others…*
	…….

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.SYLLABUS

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 - EVALUATION

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
Course total	**75**

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 at the end of the semester. Minimum passing grade: 5/10. 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). 3. All the above are taking place in the Greek language and for the foreign students (e.g. ERASMUS students) in English.

5.ATTACHED BIBLIOGRAPHY

- *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*

Ecomomics

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**OI 831**	**SEMESTER**	**8th**
COURSE TITLE	ECONOMICS		
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*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	3
Seminars		-	
Laboratory work		-	
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*	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 *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* …… *Others…* …….
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.SYLLABUS

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 - EVALUATION

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
Course total	**75**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive,*	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.

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.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

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

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**OI 832**	**SEMESTER**	**8th**
COURSE TITLE	BUSINESS ADMINISTRATION		

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	3
Seminars	-	
Laboratory work	-	
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*	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	*Others…*
	…….

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.SYLLABUS

1. Introduction to Management.
2. Programming.
3. Organization.
4. Management.
5. Control.

4.TEACHING and LEARNING METHODS - EVALUATION

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	***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 (2 contact hours per week × 13 weeks) — 26 Final examination (3 contact hours) — 3 Hours for private study of the student and preparation for the final examination. — 46 **Course total** — **75**
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.

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

4. L. Chitiris, "Management - Principles of Business Administration", Faidimos ed., 2013. (*in Greek language only*)
5. 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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	3
Seminars	-	
Laboratory work	-	
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*	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	*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…*
	…….

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.SYLLABUS

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 - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures fate-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.
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 x 13 weeks) — 26 Final examination (3 contact hours) — 3 Hours for private study of the student and preparation for the final examination. — 46 **Course total** — **75**
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.*	Assessment is performed through written examinations at the end of the semester and includes: • Multiple choice test • Short answers to questions • Report Minimum passing grade: 5/10.

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

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.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	3
Seminars	-	
Laboratory work	-	
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*	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	*Others…*
	…….
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.SYLLABUS

Basics of reading, writing, listening and speaking in French language.

4.TEACHING and LEARNING METHODS - EVALUATION

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
Course total	**75**

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*	Final examination. Minimum passing grade: 5/10.

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.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	3
Seminars	-	
Laboratory work	-	
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*	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

5. write simple texts in German
6. understand simple texts in German
7. 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	*Others…*
	…….

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.SYLLABUS

Basics of reading, writing, listening and speaking in German language.

4.TEACHING and LEARNING METHODS - EVALUATION

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
Course total	**75**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure*	Final examination. Minimum passing grade: 5/q0.

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.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Main European Languages (Italian)

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	3
Seminars	-	
Laboratory work	-	
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*	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	*Others…*
	…….

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.SYLLABUS

Basics of reading, writing, listening and speaking in Italian language.

4.TEACHING and LEARNING METHODS - EVALUATION

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-*	

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

directed study according to the principles of the ECTS	Hours for private study of the student and preparation for the final examination.	28
	Course total	**75**
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 examination. Minimum passing grade: 5/q0.	

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Main European Languages (Spanish)

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	3
Seminars	-	
Laboratory work	-	
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*	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 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 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.SYLLABUS

Basics of reading, writing, listening and speaking in Spanish language.

3.TEACHING and LEARNING METHODS - EVALUATION

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,*	

Activity	*Semester workload*
Lectures (2 contact hours per week × 13 weeks)	26

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*	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
	Course total	**75**
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 examination. Minimum passing grade: 5/q0.	

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Applied Statistics

1.GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**MA 812**	**SEMESTER**	**8th**
COURSE TITLE	APPLIED STATISTICS		

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	3
Seminars	-	
Laboratory work	-	
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*	Specialised general knowledge, skills development

PREREQUISITE COURSES:	The course "Mathematics for Chemists" is prerequisite.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/MECH1175/

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 at providing the students of the Chemistry Department basic knowledge on applied statistics. This knowledge is necessary for Chemists, in order to be able to analyze experimental data in the best possible way and it is useful in many courses of the Department of Chemistry, as well as during the "undergraduate diploma thesis".

At the end of the course the student will have acquired the following skills, abilities:

1. Will be able to effectively use key statistical tools to analyze and process experimental data and draw the appropriate conclusions
2. Will be able to effectively use the SPSS 24.0 statistical package to calculate basic statistical terms and to implement the statistical techniques taught in the theory of the 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	*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 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.SYLLABUS

1. Multivariate statistical analysis
2. Linear regression
3. Distribution analysis
4. Criterion X^2

5. Non-parametric methods

4.TEACHING and LEARNING METHODS - EVALUATION

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. 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. Use of P.C. for learning the SPSS 24.0 statistical package.
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. Solving exercises after the completion of basic chapters of the course (60 of the final grade). 2. Development and presentation of a subject related to the course (final examination, 40% of the final grade).

Activity	*Semester workload*
Lectures (1 contact hours per week × 13 weeks)	13
Seminars (1 contact hours per week × 13 weeks)	13
Laboratory work (1 contact hours per week × 13 weeks)	13
Final examination (3 contact hours)	3
Hours for private study of the student and preparation for the final examination.	33
Course total	**75**

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. E. Manatakis E., "Applied Statistics", Volume 2, Symmetria Publications, 2006. (*in Greek language only*)
2. Ph. Koliva-Mahaira, E. Bora-Senta, "Statistics", Zitis Publications, 2012. (*in Greek language only*)
3. P. Oikonomou, Ch. Karoni, "Statistical regression models", Symeon Publications, 2010. (*in Greek language only*)
4. R.E. Walpole, R.H. Myers, S.L. Myers, K. Ye, "Probability and statistics for engineers and scientists", 9th Edition, Pearson, 2014.

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	3
Seminars	-	
Laboratory work	-	
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*	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	*Others…*
	…….

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.SYLLABUS

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 - EVALUATION

<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), and presentation of the theoretical background of the laboratory exercises.</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 × 13 weeks)</td><td>26</td></tr>
<tr><td>Laboratory work (2 contact hours per week × 13 weeks)</td><td>26</td></tr>
<tr><td>Final written examination of the lab (1 contact hour)</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>20</td></tr>
<tr><td>Course total</td><td>75</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>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. Minimum passing grade: 5.
3. All the above take place in the Greek language, as well as in English for foreign students (e.g. ERASMUS students).</td></tr>
</table>

5.ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. K. Kousoulas, "Viticulture", 2nd Edition, Ekdotiki Agrotehniki, SA. 2002. (*in Greek language only*)
2. N.A. Nikolaou, "Viticulture", Syghroni Paideia Publications, 2008. (*in Greek language only*)
3. U. Hofmann, P. Kopfer, A. Werner, "Organic Viticulture", transl. Korkas Ilias 2003. Psyhalos Publications, (*in Greek language only*)
4. M. Keller, "The Science of Grapevines: Anatomy and Physiology", Elsevier, 2010.
5. G. Zarmpoutis, M. Tsiveriotou, "Principles of viticulture and enology", ION Publications, 2003. (*in Greek language only*)
6. I. Vagianos, "Practical Viticulture-Oenology", Psyhalos Publications, 1986. (*in Greek language only*)

V. POSTGRADUATE STUDIES

The PhD Diploma offered by the Department of Chemistry is described as: "PhD in Chemistry". The Program of Post Graduate 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 a prerequisite for the application for a PhD Diploma. 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	A. Aletras D. Vynios N. Karamanos Th. Tsegenidis	Autumn
Advanced Biochemistry	A. Aletras N. Karamanos S. Skandalis	Autumn
Molecular Pharmacology – Immunology	A. Aletras N. Karamanos E. Papadimitriou	Spring
Molecular Biology – Molecular Biotechnology	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 P. Ioannou N. Klouras 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 G. Karaiskakis A. Koliadima	Spring
Properties and Applications of Functional and Nanostructured Materials	J. Kallitsis G. Bokias Ch. Deimede S. Perlepes	Spring

Course	Teaching Staff	Semester
	E. Dalas	
Development, Characterization and Evaluation of Solid Catalysts	Ch. Kordulis A. Lycourghiotis Ch. Papadopoulou	Autumn
Air Pollution Control	Ch. Matralis H. Papaefthymiou	Autumn
Water and Soil Pollution Control	Ch. Matralis H. Karapanagioti B. Symeopoulos M. Soupioni	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	V. Nastopoulos 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 M. Kornaros S. Bogosian C. Poulos	Autumn
Renewable Sources for Energy and Chemicals Production	C. Poulos 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	K. Barlos C. Athanassopoulos	Autumn
Peptide and Combinational Chemistry	K. Barlos D. Gatos	Autumn
NMR Spectroscopy and Molecular Design	J. Matsoukas 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

Course	Teaching Staff	Semester
Spectroscopy of Organic Compounds	Th. Tsegenidis 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 C. Stathopoulos I. Zarkadis M. Klapa	Autumn
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. Kaamanos V. Nastopoulos 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 D. Kalogianni F. Lamari M. Fousteris C. Stathopoulos	Spring
Advanced Food Chemistry	M. Kanellaki	*Spring*

Course	Teaching Staff	Semester
	A. Bekatorou A. A. Koutinas M. Soupioni	
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).

- 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).

2. Interdepartmental MSc Program "Medicinal Chemistry and Chemical Biology"

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: Assoc. Prof. C. Athanassopoulos, Assist. Prof. G. Rassias.

Medicinal Chemistry

Faculty Members: Assoc. Prof. Th. Tselios, Assoc. Prof. G. Tsivgoulis, Assist. Prof. G. Rassias.

Peptide Chemistry

Faculty Members: Prof. D. Gatos.

Biomolecules: isolation, characterization, synthesis and development of analytical methods

Faculty Members: Prof. Th. Tsegenidis.

Supramolecular Chemistry

Faculty Members: Prof. G. Tsivgoulis.

Biochemistry, Biochemical Analysis and Matrix Pathobiology

Faculty Members: Prof. N. Karamanos, Prof. D. Vynios, Prof. A. Aletras, Prof. A. Theocharis, Assist. Prof. A. Vlamis, Assist. Prof. S. Skandalis.

Inorganic-Bioinorganic-Organometallic Chemistry

Faculty Members: Prof. Sp. Perlepes, Assoc. Prof. V. Tangoulis, Assoc. Prof. Th. Stamatatos

Physical Chemistry

Physical Chemistry of Interfaces

Faculty Members: Assoc. Prof. A. Koliadima.

Physical, Aquatic & Colloidal Chemistry

Faculty Members: Prof. E. Dalas.

Quantum Chemistry

Faculty Members: Prof. G. Maroulis.

Radiochemistry

Faculty Members: Assoc. Prof. H. Papaefthymiou, Assoc. Prof. M. Soupioni, Assist. Prof. B. Symeopoulos.

Catalysis and Interfacial Chemistry for Environmental Applications – Environmental Chemistry

Faculty Members: Prof. Ch. Kordulis, Assist. Prof. Ch. Matralis, Assist. Prof. Ch. Papadopoulou, Assoc. Prof. H. Karapanagioti.

Food Chemistry and BioTechnology

Faculty Members: Prof. M. Kanellaki, Assoc. Prof. A. Bekatorou, Assoc. Prof. M. Soupioni.

Polymer Science and Technology

Advanced Polymers and Hybrid Nanomaterials

Faculty Members: Prof. J. Kallitsis, Assoc. Prof. Ch. Deimede.

Stimuli-Responsive Polymers

Faculty Members: Prof. G. Bokias.

Analytical and Structural Chemistry

Analytical Chemistry

Faculty Members: Prof. Th. Christopoulos, Assist. Prof. D. Kalogianni.

X-ray Crystallography

Faculty Members: Prof. V. Nastopoulos.

Useful Department links/contacts

Department web page: http://www.chem.upatras.gr

Research Activities: www.chem.upatras.gr/ResearhGroups/

Head of Department:	head@chemistry.upatras.gr	996007
Secretary:	secretary@chemistry.upatras.gr	997101, 996006, 996012, 996013
Library:	library@chemistry.upatras.gr	997900
Computer centre:	ccdoc@chemistry.upatras.gr	997902

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!