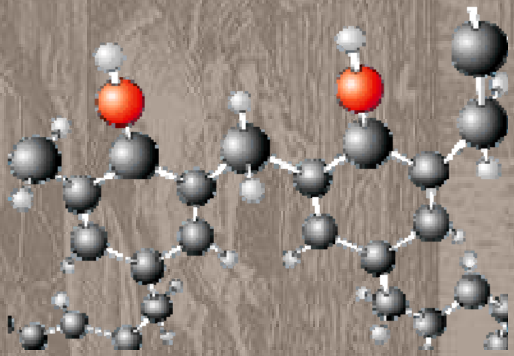
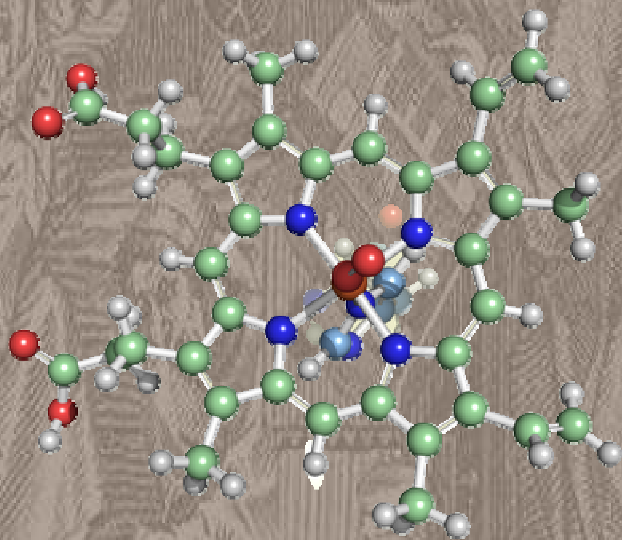


DEPARTMENTAL CURRICULUM
ERASMUS

2010-2011



http://www.chem.upatras.gr

PATRAS 2010

UNIVERSITY OF PATRAS
DEPARTMENT OF CHEMISTRY
PATRAS – GREECE

I. GENERAL INFORMATION-STRUCTURE OF THE DEPARTMENT

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 concentrated in three separate buildings (North, South and New Chemistry Buildings). It includes of student and research laboratories, two computational centres and a library.

The Department has 40 academic staff members, 6 technical assistants and 3 special technical academic assistants. There are about 700 undergraduate currently enrolled and over 200 post-graduate students. There are about 700 undergraduate and over 200 postgraduate students currently enrolled.

At the undergraduate and postgraduate levels the Department collaborates with a large number of other European Universities through the Erasmus student and academic staff exchange program (http://www.upatras.gr/index/page/id/52/lang/en). Moreover, the majority of faculty members participate in joint research projects with scientists from other academic and research institutions and chemical companies in Greece and around the world.

The Department is organized into the three following Divisions. Each one has its own 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.

UNDERGRADUATE STUDIES

The Chemistry Department provides students with a full education in the whole range of subjects and skills associated with chemistry, including biochemistry, chemical technology and food and environmental science. The four-year degree qualifies our graduates for careers in public or private sectors, such as the chemical industry, commercial research, analytical laboratories, secondary education.

POSTGRADUATE STUDIES

Postgraduate studies enable our students to pursue academic careers and further their industrial career. The Postgraduate Studies Program of the Department of Chemistry offers the following possibilities:

MSc in the areas:

- ⇨ Applied Biochemistry: Clinical Chemistry, Biotechnology and Evaluation of Pharmaceutical Products.
- ⇨ Advanced Polymeric and Nanostructured Materials.
- ⇨ Catalysis for Environmental Protection and Clean Energy Production.
- ⇨ Environmental Analysis.
- ⇨ Analytical Chemistry and Nanotechnology.

Ph.D.: Students following the program approach research areas and activities pursued in the Department related to chemistry. Candidates are accepted with degrees from the Departments of Chemistry, Biology, Geology, Physics and Agriculture, Faculty (Department) of Medicine, Pharmacology and Chemical Engineering.

Other MSc Programs

- ⇨ Transnational and Transistitutional MSc Program of Studies in **Food Biotechnology**. The Chemistry Departments of the Universities of Patras and Ioannina and the Biotechnology Group of Biomedical Sciences School of the University of Ulster (Northern Ireland, Great Britain) participate in the program.
- ⇨ Interdepartmental MSc Program of Studies: "**Medicinal Chemistry: Drug Discovery and Design**". The Departments of Chemistry and Pharmacy of the University of Patras participate in the program.
- ⇨ Interdepartmental MSc Program of Studies in **Environment Sciences**. The Departments of Biology, Geology, Mathematics, Physics and Chemistry of the University of Patras participate in the program.
- ⇨ Interdepartmental MSc Studies in the **Science and Technology of Polymers**. The Departments of Materials Science, Physics, Chemistry and Chemical Engineering of the University of Patras participate in the program.

Main Collaborators with Universities / Research Institutions

Country	University
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 Resonance Center 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

Country	Institute
Australia	Burnet Research Institute, Melbourne
Bulgaria	Catalysis, Bulgarian Academy of Sciences
Germany	Max-Planck, Institut für Polymerforschung TU Braunschweig, Institut für Physikalische und Theoretische Chemie
Hungary	Isotope and Surface Chemistry, Chemical Research Centre, HAS, Budapest
India	National Institute for Interdisciplinary Science and Technology, Biotechnology Division
Slovenia	National Institute of Chemistry, Ljubljana
Spain	Consejo, Superior de Investigaciones Cientifıcas, Catalysis and Petrochemistry (CSIC)
Sweden	Karolinska Institute (Stockholm) Ludwing Institutte for Cancer Research (Uppsala) Kungliga Tekniska Högskolan, Stockholm

II. UNDERGRADUATE STUDY PROGRAM

General information

The education system in Greece is based on semesters. There are two semesters per academic year. The first (autumn) semester begins in October 1st and ends in January 31st. The exact dates are announced in the departmental website: www.chem.upatras.gr. Classes for the second (spring) semester, resume the 16th of February and last until the 10th of June. In the Department Chemistry, a student formally needs 8 semesters (4 years) of studying in order to graduate, that is to obtain the Diploma in (Ptychio, in Greek) Chemistry. During each semester a student has to follow 3-5 courses with a total of around 23-28 conduct hours per week.

A course can be consisted of only lectures or lectures and seminars or lectures, seminars and practical work (laboratory). The courses offered in our Department are grouped in semesters (autumn and spring semesters). This is however indicative for the students who can actually choose at will any courses from any of the autumn or spring semesters. However the way these courses appear in the Course Table indicate the sequence of courses (model study plan) a student should follow in order to avoid choosing courses whose background material has not been studied before. That way, knowledge is built up in logical succession and failures in the related exams can be minimised.

The curriculum is consisted of absolutely necessary courses (compulsory courses) which every one student must take and courses (freely optional chemical on non-chemical courses and semi optional courses) which can be chosen by the students according to their special interests. These last mentioned courses are designated in the Course Table as Optional (Elective) or Semi Optional and the minimum number of courses each student should opt for is also indicated therein. These optional and semi optional courses are then treated as the compulsory ones in relation to attendance and exams matters. There is no quota of students for the optional and semi optional courses, although in some cases where less than three students for a particular course this course for the particular semester might be suspended and students advised to apply for a different course. The number of students usually participating in optional courses is in the order of 10-20 students. Although, this number can be higher. These courses can provide some short of specialization, which is in turn considered important in the job market and are related to Foodstuffs-Wine Chemistry, Environmental Chemistry, Polymer Chemistry and Clinical Chemistry. Lectures and seminars can be followed by students at will whereas attendance of laboratories is mandatory.

In most taught courses there is not any formal assessment throughout the semester. In some cases, lecturers offer partial exams within the semester and the grades obtained at these exams are taken into account in the final mark. However in the labs, the students are constantly examined, usually orally, on the theory and practice behind each experiment they are to perform, before or during their lab work, and finally have to present written account of their results after the end of each exercise. All these are taken into account in the final mark together with the results of the final written examination, which is associated with each particular laboratory. Courses are only offered in the Greek language. Lecturers teach the related material based on Greek textbooks, which are often written by themselves. The, Greek students study from these textbooks, which are offered free by the Greek State. These textbooks are usually based on the corresponding most broadly used English books. Thus the content and the level of these Greek textbooks are similar to the corresponding English ones. For 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, an english textbook with similar content to that his/her fellow greek students use can always be easily found. These textbooks are offered on loan by our departmental or institutional (central) library. During their final year, in addition to the courses they follow, the students have to carry out a short research project, assigned in Greek as "Undergraduate Diploma Work", under the supervision of a member of the academic staff. Following the end this work students have to provide a written report of their results and present them orally. 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 for a successfully completed "Undergraduate Diploma Work". At the moment, no industrial placements can be secured by our Department in co-operation with the Greek Chemical Industry. However, there is a possibility of offering such placements in replacement of the required "Undergraduate Diploma Work". A course is considered as being successfully passed only when the student has acquired at least the grade 5 out of 10 in the associated exams. However, a course associated with lab work requires in addition also successful completion of the lab work and for the final mark both the grade in the exam and the lab performance are considered with factors which vary according to the lab. Exams are offered to the students after the end of each semester and repeat exams in September. However students who have failed in these exams, or not participated at all, can sit for these exams as many times as they wish in the following exams periods. A student is considered as having completed his/her studies in our Department only when he/she has passed all the exams associated with all courses described-in the curriculum.

The number of Greek credits we assign to each course is dictated by a regulation of Greek Law for Higher Education (1268/82) which states that 1 Greek credit corresponds to 1 hr lecture per week per semester whereas to the rest of educational work (e.g. seminars and labs) 1 credit corresponds to 1-3 hr per week per semester. Then, each Department through its General Assembly, defines the number of credits assigned to this other educational work. Thus, in our Department, 1 credit corresponds to 1 hr per seminar per week per semester and 2 hrs lab work per week per semester. To the Undergraduate Diploma Work, 20 Greek credits are assigned. According to this definition, ca. 20 Greek credits are associated to each semester. The credits collected by the students during their study period in the Greek Universities, and the associated grades, are taken into account for the calculation of their final mark. For this calculation another factor has been introduced by Law which is called "weighing" factor. 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 2.0. Thus, the final grade with which a student is graduated is the mean value of grades obtained for each course multiplied by the associated weighing factor. Thus, taking into account our higher education system as it was briefly described above, the basic requirement of the ECTS system for 30 credits for each semester was met in our Department by initially assigning for each 1 hr of lecture, seminar and lab work per week and per semester, 1 ECTS credit. Additional ECTS credits were then added to those of the courses which are considered as the most hard to be passed by the students, that is those requiring higher student workload. These courses actually form the basis of our curriculum and are associated with Inorganic Chemistry, Organic Chemistry, Analytical Chemistry, Physical Chemistry and Industrial Chemistry (Chemical Technology).

An ERASMUS student, who have studied for at least a year in our institution can be considered as candidate to obtain the Diploma (Ptychion) in Chemistry offered by our Department for undergraduate studies. The ERASMUS Committee of our Department dealing with the recognition of studies carried out abroad will consider the student's transcript of records and his performance at our Department. Courses successfully completed abroad will then be correlated to those in Patras. If there is no need for additional courses to be taken by the student in Patras in order to fulfil the requirements imposed by our curriculum, this committee will propose the General Assembly of the Department to offer our Diploma (Ptychion) to that particular student. Otherwise, the student will have to attend and successfully pass all those courses which are needed 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 a MSc degree) or a doctorate degree (DD, that is a Ph.D. degree). The PDS involves 1,5 years of studies. During the first year the candidate follows ca.4 courses in total (2 courses each semester) and has to pass the exams associated with these courses. Exams take place at the end of each semester. The minimum passing grade is 5 out of 10. Repeat exams for both semesters take place in September. In addition, the student has to prepare and deliver two talks, of one hour duration (at the end of each semester), related to the specialization courses. During the second year the student carries out a short, novel, research project and presents the results both written and orally. There are currently five specializations available.

Types of Courses and Associated Ects Credits

1. CORE (COMPULSORY) COURSES

COURSE	ECTS CREDITS
General Chemistry	10
Inorganic Chemistry	25
Organic Chemistry	30
Physical Chemistry	30
Analytical Chemistry	30
Biochemistry	15

Physics for Chemists	5
Mathematics for Chemists	5
Chemistry and Informatics	5
Chemical Technology-I (principles, physical and chemical processes)	10
Food Chemistry	5
Total number of ECTS credits	***170***

2. SEMI-OPTIONAL COURSES[&]

COURSE	ECTS CREDITS
Chemical Technology-II (special topics of physical and chemical processes)	5
Chemistry and Technology of Materials (polymers, nanomaterials, catalysts)	5
Environmental Chemistry	5
Computational Chemistry	5
Structural Chemistry	5
Principles and Applications of Nuclear Chemistry	5
Chemistry of Heterocyclic Compounds and of Natural Products	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 ones, can be selected as Elective Chemical Courses.

3. EXPERIMENTAL DIMPLOMA (BACHELOR) THESIS [$]

COURSE	ECTS CREDITS
Experimental Diploma Thesis	20

[$] In special cases, the Bachelor Thesis may be replaced by writing an extended review on a chemical theme (in the form of a review article. To such a thesis, 5 ECTS Credits are assigned. The remaining 15 ECTS credits will then be replaced by semi-optional or elective chemical modules.

4. OPTIONAL (ELECTIVE) CHEMICAL COURSES[@]

COURSE	ECTS CREDITS
NMR Spectroscopy, Molecular Modeling and Design	5
Synthetic Organic Chemistry	5
Organic Industrial Products and Green Chemistry	5
Chemistry of Organometallic Compounds and Mechanism in	5

Inorganic Reactions	
Bioinorganic Chemistry	5
Introduction to Molecular Design	5
Special Topics of Physical Chemistry	5
Quality Control in Analytical Chemistry	5
Catalysis	5
Food Biochemistry	5
Clinical Chemistry	5
Biochemistry-III (gene expression and regulation-gene engineering)	5
Polymer Science	5
Special Topics of Environmental Chemistry	5
Food Chemistry and Technology – Oenology I	10
Chemical Industries (Inorganic and Organic)	5
Food Chemistry and Technology – Oenology II	5
Renewable Energy Sources and Chemical Storage	5
Biotechnology	5
@ ***2-3 courses to be selected with a total number of ECTS credits***	***15***

5. OPTIONAL (ELECTIVE) NON-CHEMICHAL COURSES@

COURSE	ECTS CREDITS
Microbiology	5
Didactics of Natural Sciences	5
Main European Languages (one from: French, Spanish, German, Italian)	5
Viticulture	5
Economics	5
Business Administration	5
Elements of General Biology	5
English Chemical Terminology	5
@ ***2 courses to be selected with a total number of ECTS credits***	**10**

III. PROGRAM PLAN

OLD CHEMISTRY CURRICULUM-APPLICABLE UP TO SEPTEMBER 2013

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 have to carry out a short research project (VII and VIII semesters) and finally submit a Diploma Thesis. To this research work (Diploma Work, in greek), which is done under the supervision of a faculty member, 20 ECTS credit units are assigned. In special cases, the Bachelor Thesis may be replaced by writing an extended review on a chemical theme (in the form of a review article. To such a thesis, 5 ECTS Credits are assigned. The remaining 15 ECTS credits will then be replaced by semi-optional or elective chemical modules.

NEW CHEMISTRY CURRICULUM – APPLIED SEPT 2010

1o Semester

COURSE		CONDUCT HOURS (CH)			ECTS credits
Code	**Title**	**Lectures (LH)**	**Tutorials (TH)**	**Laboratory (PH)**	
Math101	Mathematics for Chemists	3	1	1	5
Phys110	Physics for Chemists	4	1	0	5
GeCh121	General Chemistry	4	1	3	10
ChIn131	Chemistry and Informatics	2	0	2	5
	Non-Chemical Elective Course-I#	4	0	0	5
Total (26 CH)		17	3	6	30

2o Semester

COURSE		CONDUCT HOURS (CH)			ECTS credits
Code	**Title**	**Lectures (LH)**	**Tutorials (TH)**	**Laboratory (PH)**	
InCh222	Inorganic Chemistry-I (Chemistry of the Representative Elements)	3	1	3	10
PhCh232	Physical Chemistry-I	3	1	0	5
AnCh251	Analytical Chemistry-I	3	1	4	10
OrCh201	Structure, Reactivity and Mechanism in Organic Chemistry	3	1	0	5
Total (23 CH)		12	4	7	30

3o Semester

COURSE		CONDUCT HOURS (CH)			ECTS credits
Code	**Title**	**Lectures (LH)**	**Tutorials (TH)**	**Laboratory (PH)**	
AnCh352	Analytical Chemistry-II	2	0	5	5
InCh323	Inorganic Chemistry-II (Chemistry of 1st Row Transition Metals and of Complex Compounds)	3	1	3	10
PhCh333	Physical Chemistry-II	4	1	0	5
AnCh353	Instrumental Chemical Analysis-I	3	1	0	5
	Non-Chemical Elective Course-II#	2	0	2	5
Total (27 CH)		14	3	10	30

Indicative distribution of CH. For the actual distribution of CH to LH, TH and PH for each course see Table C.

4o Semester

COURSE		CONDUCT HOURS (CH)			ECTS credits
Code	Title	Lectures (LH)	Tutorials (TH)	Laboratory (PH)	
OrCh402	Organic Chemistry of Functional Groups-I	3	2	6	10
AnCh454	Instrumental Chemical Analysis-II	3	1	3	10
PhCh434	Physical Chemistry-III	3	1	4	10
Total (26 CH)		9	4	13	30

5o Semester

COURSE		CONDUCT HOURS (CH)			ECTS credits
Code	Title	Lectures (LH)	Tutorials (TH)	Laboratory (PH)	
OrCh503	Organic Chemistry of Functional Groups-II	2	2	6	10
PhCh535	Physical Chemistry-IV	3	1	4	10
BiCh510	Biochemistry-I	3	1	0	5
InCh524	Inorganic Chemistry-III (Chemistry of 2nd and 3rd Row Metals and of Lanthanides)	3	1	0	5
Total (26 CH)		11	5	10	30

6o Semester

COURSE		CONDUCT HOURS (CH)			ECTS credits
Code	Title	Lectures (LH)	Tutorials (TH)	Laboratory (PH)	
OrCh604	Special Topics of Organic Chemistry	3	1	0	5
BiCh511	Biochemistry-II	3	1	4	10
FoCh670	Food Chemistry	2	1	2	5
ChTe680	Chemical Technology-I (Principles-Physical and Chemical Processes)	3	3	2	10
Total (25 CH)		11	6	8	30

7o Semester

COURSE		CONDUCT HOURS (CH)			ECTS credits
Code	Title	Lectures (LH)	Tutorials (TH)	Laboratory (PH)	
	Semi-Optional Course-I#	3	1	0	5
	Semi-Optional Course-I#	3	1	0	5
	Elective Chemical Course-I#	3	1	0	5
	Elective Chemical Course-II#	3	1	0	5
DiTh700	Experimental Diploma Thesis-I (literature search-beginning of laboratory work)@	0	0	12	10
Total (28 CH)		12	4	12	30

Indicative distribution of CH. For the actual distribution of CH to LH, TH and PH for each course see Table C.

@ The experimental work of the thesis is usually committed in one of the research laboratories of the Chemistry Department of the University of Patras. It can also take place in part or totally in other co-operating Chemistry Departments or Research Institutes or the Chemical Industry or other bodies employing chemists (e.g. Hospitals, General State Laboratory etc) in the form of an 'Industrial Placement'. In that latter case, the relative Chemistry Department regulations must be followed. The Experimental Diploma Thesis is always supervised by a member of the academic staff of the Chemistry Department of the University of Patras who is responsible for assigning the final mark to the thesis (one combined mark for the course DiTh700 and DiTh800).

For Erasmus students, the Experimental Diploma Thesis may take place wholy in one semester (24 PH per week, 20 ECTS credits). The remaining 10 ECTS credits can be obtained by freely selecting one or two courses from those taught in that particular semester (winter or autumn), following the successful pass in the associated exams.

8o Semester

COURSE		CONDUCT HOURS (CH)			ECTS credits
Code	Title	Lectures (LH)	Tutorials (TH)	Laboratory (PH)	
	Semi-Optional Course-III#	3	1	0	5
	Semi-Optional Course-IV#	3	1	0	5
	Semi-Optional Course-V#	3	1	0	5
	Elective Chemical Course-III#	3	1	0	5
DiTh800	Experimental Diploma Thesis-II (continuation and completion of laboratory work–writing-up of thesis and presentation of results in public)@	0	0	12	10
Total (28 CH)		12	4	12	30

Indicative distribution of CH. For the actual distribution of CH to LH, TH and PH for each course see Table C.

@ The experimental work of the thesis is usually committed in one of the research laboratories of the Chemistry Department of the University of Patras. It can also take place in part or totally in other co-operating Chemistry Departments or Research Institutes or the Chemical Industry or other bodies employing chemists (e.g. Hospitals, General State Laboratory etc) in the form of an 'Industrial Placement'. In that latter case, the relative Chemistry Department regulations must be followed. The Experimental Diploma Thesis is always supervised by a member of the academic staff of the Chemistry Department of the University of Patras who is responsible for assigning the final mark to the thesis (one combined mark for the course DiTh700 and DiTh800).

For Erasmus students, the Experimental Diploma Thesis may take place entirely in one semester (24 PH per week, 20 ECTS credits). The remaining 10 ECTS credits can be then obtained by freely selecting one or two courses from those taught in that particular semester (winter or autumn), following the successful pass in the associated exams.

GROUPING OF OPTIONAL COURSES OF ALL TYPES

Autumn Semester

COURSE					ECTS credits
Code	Title	Conduct hours (CH)			
		LH	TH	PH	
SEMI-OPTIONAL COURSES (7th Semester)					
CtMa781	Chemistry and Technology of Materials (polymers, nanomaterials, catalysts)	2	0	2	5
EnCh790	Environmental Chemistry	2	0	2	5
NuCh741	Principles and Applications of Nuclear Chemistry	3	0	1	5
OPTIONAL CHEMICAL COURSE (7th Semester)					
NsMd705	NMR Spectroscopy, Molecular Modeling and Design	3	1	0	5
SoCh706	Synthetic Organic Chemistry	3	1	0	5
FcTo771	Food Chemistry and Technology – Oenology I	4	0	4	10
CoMi725	Chemistry of Organometallic Compounds and Mechanism in Inorganic Reactions	4	0	0	5
StPc736	Special Topics of Physical Chemistry	3	1	0	5
QcAc755	Quality Control in Analytical Chemistry	3	1	0	5
CaTa791	Catalysis	4	0	0	5
GeRe712	Biochemistry-III (gene expression and regulation-gene engineering)	3	1	0	5
ClCh713	Clinical Chemistry	2	0	2	5
OPTIONAL NON-CHEMICAL COURSES (1st and 3rd Semester)					
GeBi120	Elements of General Biology≠	3	0	1	5
MiBi321	Microbiology¥	2	0	2	5
ViTi322	Viticulture¥	2	0	2	5
EcOn130	Economics≠	4	0	0	5
DiNs340	Didactics of Natural Sciences¥	4	0	0	5
EnCt141	English Chemical Terminology≠	3	1	0	5
EuLa142-145	Main European Languages (one of the following: French, German, Italian, Spanish ≠	3	1	0	5
BuAd331	Business Administration¥	4	0	0	5

≠ It is recommended for the 1º semester.
¥ It is recommended for the 3º semester.

Spring Semester

COURSE					ECTS credits
Code	Title	Conduct hours (CH)			
		LH	TH	PH	
SEMI-OPTIONAL COURSES (8th Semester)					
ChTe882	Chemical Technology-II (Special Topics of Physical and Chemical Processes)	3	1	0	5
ChNp807	Chemistry of Heterocyclic Compounds and of Natural Products	3	1	0	5
CoCh837	Computational Chemistry	2	0	3	5
StCh861	Structural Chemistry	4	0	0	5
OPTIONAL CHEMICAL COURSE (8th Semester)					
FoBi814	Food Biochemistry	3	1	0	5
InMd838	Introduction to Molecular Design	3	1	0	5
BiNc826	Bioinorganic Chemistry	4	0	0	5
BiTe815	Biotechnology	2	0	2	5
OpGc808	Organic Industrial Products and Green Chemistry	4	0	0	5
PoSc883	Polymer Science	3	1	0	5
StEc892	Special Topics of Environmental Chemistry	2	0	2	5
ChIn884	Chemical Industries (Inorganic and Organic)	4	0	0	5
FcTo872	Food Chemistry and Technology – Oenology II	4	0	0	5
ReCs893	Renewable Energy Sources and Chemical Storage	4	0	0	5

IV. DESCRIPTION OF UNDERGRADUATE COURSES

1st Semester

Course title	**Mathematics for Chemists**
Course code	Math101
Type of course	Compulsory
Level of course	Undergraduate
Year of study	1st
Semester	1st
ECTS credits	5
Name of lecturer(s)	Lectures and laboratory: Dr. S. Malefaki, Dr. K. Papadakis
Learning outcomes	To give the student in Chemistry the knowledge of advanced applied mathematics that he/she needs in his/her science in the areas of differential and integral calculus of one variable and of several variables, of linear algebra, differential equations, probabilities and statistics. This knowledge is necessary and is used in many subsequent specialization courses in chemistry.
Competences	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 areas. 3. To be able to efficiently use the computer and computer algebra software in mathematics and chemical applications. 4. To be able to efficiently use the statistical package Minitab.
Prerequisites	There are no prerequisite courses. However the students should already have a satisfactory knowledge of algebra, derivatives and integrals.
Course contents	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. Statistics. 8. Teaching of a computer algebra system in the computing centre. 9. Teaching the statistical package Minitab.
Recommended reading	1. V.V. Markellos, "Applied Mathematics, Vol. II: Linear Algebra, Differential Equations ". Symmetria Publications, 2000. 2. P.M. Hatzikonstantinou, "Mathematical Methods for Engineers and Scientists: Calculus of Functions of Several Variables and Vector Analysis", Symmetria Publications, 2009. 3. J. Koutrouvelis, "Statistics methods", Vol. I, Symmetria Publications, 1999. 4. K.E. Papadakis, "Introduction to Mathematica", 3rd Edition. Tziolas Publications, 2010.

Teaching and learning methods	1. Teaching (4 hours/week): lectures using the blackboard concerning the theory, exercises and applications. 2. Laboratory (1 hour/week in the computing center): practice in the course contents through applications by using the computer mainly in symbolic computations. 3. Solution of exercises (by hand and by using the computer) individually by each student.
Assessment ang grading methods	1. Final written examination. 2. Laboratory examination.
Language of instruction	Greek

Course title	**Physics for Chemists**
Course code	Phys110
Type of course	Compulsory
Level of course	Undergraduate
Year of study	1st
Semester	1st
ECTS credits	5
Name of lecturer(s)	Dr V. Giannetas
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 on which he deals. 3. Comprehend the operation of optical and electric/electronic instruments that he uses.
Competences	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.
Prerequisites	There are no prerequisite courses. The required knowledge of Advance Mathematics (Vectors-Derivatives-Integrals) will be developed during the courses <u>in the case where they have not been covered (temporally)</u> by the corresponding course of Mathematics, that is taught also in the first semester.
Course contents	*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.
Recommended reading	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.
Teaching and learning methods	Lectures using transparencies, powerpoint presentations and multimedia.
Assessment ang grading methods	Written examination
Language of instruction	Greek

Course title	**General Chemistry**
Course code	GeCh 121
Type of course	Compulsory
Level of course	Undergraduate
Year of study	1^{st}
Semester	1^{st}
ECTS credits	10
Name of lecturer(s)	Dr N. Klouras
Learning outcomes	At the end of this course the student should 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 H_3O^+ 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.
Competences	At the end of the course the student will have further developed the following skills/competences: 1. Ability to solve cumulative-skills theoretical and practical problems. These problems require two or more operational skills learnt 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, color 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.
Prerequisites	There are no prerequisite courses.
Course contents	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. 9. Acids and Bases Arrhenius concept of acids and bases. Brønsted–Lowry concept of acids and bases. Lewis concept of acids and bases. Relative strengths of acids and bases. Molecular structure and acid strength. Self ionization of water. Solutions of a strong acid or base. The pH of a solution. 10. Coordination Compounds Werner's coordination theory. Ligands. Naming coordination compounds. Isomerism in coordination compounds. The bonding in coordination compounds (valence bond theory and crystal field theory). The role of coordination compounds.
Recommended reading	1. N. Klouras, "General Chemistry", 3rd Edition, translation of the D.D. Ebbing και S.D. Gammon "General Chemistry", 6th Edition 1999, P. Travlos Publications, 2007. 2. N. Klouras, "Basic Inorganic Chemistry", 6th Edition, P. Travlos Publications, 2003. 3. G. Pnevmatikakis, X. Mitsopoulou, K. Methenitis, "Inorganic Chemistry-Basic Principles", A. Stamoulis Publications, 2005. 4. D.D. Ebbing and S. D. Gammon, "General Chemistry", 9th Edition, Houghton Mifflin Company, 2009. 5. R.H. Petrucci, W.S. Hawood, G.E Herring and J. Madura, "General Chemistry: Principles and Modern Applications", 9th Edition, Prentice Hall, 2006. 6. R. Chang, "General Chemistry: The Essential Concepts", McGraw-Hill Science Engineering, 2007. 7. T.E. Brown, E.H. LeMay and B.E. Bursten, "Chemistry: The Central Science", 10th Edition, Prentice Hall, 2006. 8. J. McMurry, R.C. Fay and L. McCarty, "Chemistry", 4th Edition, Prentice Hall, 2003. 9. S.S. Zumdahl, "Chemistry", 7th Edition, Houghton Mifflin College Div., 2007.

Teaching and learning methods	Lectures using power-point presentations and personal website. Problem-solving seminars for the instructive solution of typical problems for each new concept, emphasizing the Problem Strategy and the Answer Check.
Assessment and grading methods	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.
Language of instruction	Greek

Course title	**Chemistry and Informatics**
Course code	ChIn131
Type of course	Compulsory
Level of course	Undergraduate
Year of study	1st
Semester	1st
ECTS credits	5
Name of lecturer(s)	Lectures and laboratory: Dr. G. Maroulis
Learning outcomes	Basic skills in Computational Mathematics, Basic methodology of solving scientific problems.
Competences	Computer applications in Science, development of Internet skills
Prerequisites	There are no prerequisite courses.
Course contents	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).
Recommended reading	H.G.Hecht, “Mathematics in Chemistry”, Prentice Hall, 1990.
Teaching and learning methods	Lectures and laboratory.
Assessment and grading methods	Written examination.
Language of instruction	Greek.

2nd Semester

Course title	**Inorganic Chemistry I (Chemistry of the Representative Elements)**
Course code	InCh222
Type of course	Compulsory
Level of course	Undergraduate
Year of study	1st
Semester	2nd
ECTS credits	10
Name of lecturer(s)	Dr. P.V. Ioannou
Learning outcomes	It is expected that the student will be taught the Descriptive Chemistry (not only Inorganic) of the s and p group elements using an up to date book (literature citations up to 1995).
Competences	It is expected that through lectures students will be able to judge what is basic and what is necessary for their expansion of chemical awareness.
Prerequisites	There is no prerequisite knowledge because the course starts from zero i.e. how atoms and molecules were created in the Universe.
Course contents	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.
Recommended reading	This is given in the reference Sections [books and papers published till the end of 1995]. 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.
Teaching and learning methods	Use of blackboard without using the power point system. The teaching of a subject is based on the question posed and how one can arrive at a logical (not necessarily chemically correct) answer. This way there can be an immediate problem-solving response.
Assessment ang grading methods	Written examinations (about 50 questions which do not require memoralization).

Language of instruction	Greek and English (terminology).

Course title	**Physical Chemistry I**
Course code	PhCh232
Type of course	Compulsory
Level of course	Undergraduate
Year of study	1^{st}
Semester	2^{nd}
ECTS credits	5
Name of lecturer	Dr. E. Dalas
Learning outcomes	At the end of this course the student should be able to solve problems concerning physical processes and thermodynamic engines.
Competences	At the end of this course the student will have further developed the following skills/competences: Ability to follow up the experiments in Physical Chemistry Lab. IV as well as physical and thermodynamic processes.
Prerequisites	There are no prerequisite courses.
Course contents	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 μ_T, C_p-C_V=α(p+π_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 engine, heat pumps, Carnot cycle in p-V plot, the Clausius inequality and the definition of the Enthaly, 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: $[\partial(G/T)/\partial(1/T)]_P = H$ και $[\partial(A/T)/\partial(1/T)]_V = U$, 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 thermodynamics 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.
Recommended reading	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.
Teaching and learning methods	Lectures using slides for overhead projector and/or computer presentation. Problem-solving seminars. A set of 50 problems.
Assessment and grading methods	Three partial examinations during the semester and one final.
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Analytical Chemistry I**
Course code	AnCh251
Type of course	Compulsory
Level of course	Undergraduate
Year of study	1st
Semester	2nd
ECTS credits	10
Name of lecturer(s)	Lectures: Dr. T. Christopoulos, Dr. C. Papadopoulou Laboratory: Dr. T. Christopoulos, Dr. V. Nastopoulos, Dr. C. Papadopoulou
Learning outcomes	At the end of this course the student will be able to: 1. Define basic concepts like: solutions and their characteristics, expressions of the concentration of solutions (molarity, normality, formality, 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. Derive equations and perform calculations in equilibria involving sparingly soluble salts. Importance of solubility product. Selective precipitation of ions. 8. Derive equations and perform calculations in equilibria involving complex formation. 9. Derive equations to describe equilibria in oxidation-reduction systems. Galvanic cells. Electrochemical potentials. Applications of potentials in chemical analysis. 10. Extraction. 11. Chromatography. 12. Describe the methodology for a correct chemical analysis (best practice). 13. Describe fundamental laboratory techniques as well as their advantages and their limitations, e.g. solid–liquid separations methods. 14. Choose the pathways for the separation and identification of chemical substances, combining analytical methods to resolve complex problems. 15. 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. 16. Describe all the safety rules to be applied in a chemical laboratory and recognize what one must not do.
Competences	In addition to the above, at the end of the 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.
Prerequisites	There are no prerequisite courses. The students should have at least knowledge of the basic concept of Chemistry.
Course contents	1. Importance of Analytical Chemistry for Science and every day 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 Exercises and solutions to problems in the above chapters. 11. 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.
Recommended reading	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. V. Nastopoulos and X. Papadopoulou, "Laboratory exercices in Analytical Chemistry, Publications of University of Patras, 2010.
Teaching and learning methods	1. Lectures using power-point presentations. The students are asked to find information in their documents. Educational software snd 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.
Assessment and grading methods	1. Evaluation of the result of analysis of unknown solutions. Written tests during the laboratory practice through the whole semester. Questions on the theory and problem solving of the same type with those practiced in the tutorials. In order to consider that the student has succeeded in the laboratory practice, the mean value of the marks obtained for the results of the analysis of the unknown solutions and the corresponding test must be at least 5 (pass in 0-10 scale). This consists the 40 % of the final mark. 2. 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. 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
Language of instruction	Greek. The faculty is able to provide lectures and labs in English.

Course title	**Structure, reactivity and mechanism in Organic Chemistry**
Course code	OrCh201
Type of course	Compulsory (Core Chemistry Course)
Level of course	Undergraduate
Year of study	2nd
Semester	3nd
ECTS credits	5
Name of lecturer(s)	Dr K. Barlos, Dr D. Papaioannou
Learning outcomes	At the end of this course the student should be able to *The structure of organic compounds* Describe the bonds involved in organic compounds with C-C or C-heteroatom single or multiple bonds and conjugated bonds and their effect on the geometry and the reactivity of the system. *Nomenclature of main classes of organic compounds* Know the correct names (both prefix and suffix forms) of common functional groups. Given a structure or abbreviated formula use IUPAC nomenclature to name correctly straight and branched chain hydrocarbons, monocyclic cycloalkanes, benzene and naphthalene, simple aromatic heterocyclic compounds, and their simple substituted derivatives. Given an IUPAC name for any of the above correctly draw its structure. Use the sequence rules for specification of configuration to identify and name correctly isomers of doubly-bonded or cyclic compounds having either E or Z configurations, or isomers (or individual stereogenic (chiral) centres) having R or S absolute configurations. *Stereochemistry* Recognise a stereogenic (chiral) centre in a molecular structure. Identify and distinguish between identical molecules, enantiomers and diastereomers from structural representations. Recognise a meso compound from its structure. With or without the aid of molecular models, represent the three-dimensional nature of a molecule using "flying wedge" or Newman projection conventions. Describe methods for separating a racemic mixture. Account for steric hindrance between neighbouring groups on bonds and across rings. Relate potential energy to dihedral angle during bond rotation, and justify the selection of a preferred conformation. Calculate a specific rotation and an enantiomeric excess from appropriate data. Correlate *cis* and *trans* substituents on cyclohexane rings with axial and equatorial disposition. Use known stereochemistry of reaction to predict the outcome of reactions at saturated centres, double bonds, cyclohexane rings, and co-ordinated metal ions. Use the products of reaction to identify stereospecific reaction paths. *Reactions and mechanism* Classify a given chemical transformation as addition, elimination, substitution, condensation, rearrangement, solvolysis, oxidation, reduction, and as subject to acid or base catalysis. Use the functional group principle to predict the chemical behaviour of a given molecule. Indicate *sigma* and *pi* bond polarisation caused by the electronegativity of atoms in a given molecule, and use it to predict direction of heterolysis, acid or base properties, and electrophilic or nucleophilic behaviour or sites of electrophilic or nucleophilic attack.

	Distinguish between a transition state (activated complex) and a reactive intermediate. Under specified reaction conditions, recognise reagents as electrophiles or nucleophiles. Given starting materials (substrates), reagents, and reaction conditions, propose the outcome of a reaction; and whether given products or not, propose a possible mechanism for the course of the reaction, using "curly arrows" to indicate electron movements. Explain the differing stability of related reactive intermediates, and the influence of this stability on the course of a reaction. Illustrate acid-base catalysed reactions; and show how acids (H+) and bases may be incorporated into the mechanism of a reaction. *Nucleophilic substitution* Given the reactants (a) identify nucleophile, electrophilic centre and leaving group; (b) decide (if possible) whether an SN1, SN2 or other mechanism will operate; (c) predict the structure of the products; (d) indicate how changes in reaction conditions, or the reactants could influence the outcome to the reaction; (e) decide whether or not a reaction will go; and (f) comment on the relative rates of the SN reactions. Suggest the best reagents and reaction conditions for carrying out a given transformation. Use curly arrows and reaction co-ordinate diagrams to show the mechanism of SN1, SN2 and SNAr reactions. *Elimination* Given the substrate, reagent and reaction conditions (a) predict the structure of the product(s), indicating the stereochemistry where necessary; b) predict which elimination product will predominate where more than one product can be formed; (c) predict whether substitution or elimination will predominate; and (d) explain how the conformation and configuration of a substrate can affect the outcome of an elimination reaction. Use curly arrows and reaction co-ordinate diagrams to show the mechanisms of El and E2 reactions. *Addition* Given the reactants (a) predict the structure of the product, indicating its stereochemistry; and (b) predict which addition product will predominate, where more than one product can be formed. Explain how the selection of the reagent can determine the orientation of addition. Specify the reagents and conditions needed to form a given product by an addition reaction. *Electrophilic aromatic substitution* Use curly arrows and reaction co-ordinate diagrams to show the mechanisms of electrophilic aromatic substitution. Predict and explain the position of entry of a second substituent, and the rate of substitution, into a monosubstituted benzene. Explain the different reactivity, and the positions of substitution, of aromatic heterocycles. *Carbonyl compounds* Illustrate with curly arrows the mechanisms by which nucleophiles and electrophiles react with carbonyl compounds. Recognise the common tetrahedral intermediate in mechanistic explanations of the reactions of both aldehydes and ketones and carboxylic acids and their derivatives with nucleophiles. Use curly arrows to show the mechanisms of these reactions. Explain the mechanism of Grignard reactions. Alkylation and acylation of enols and enolates: Explain the acidity of C-H bonds adjacent to a carbonyl or other electron-withdrawing group, and show how this leads to valuable

	intermediates for the formation of carbon-carbon bonds through alkylation and acylation. Utilise ethyl acetoacetate and malonic ester in the synthesis of ketones and carboxylic acid derivatives. Differentiate between tautomers and resonance forms. Explain the ease of decarboxylation of beta-ketocarboxylic acids. Describe the role of acid and base catalysis in carbonyl condensation reactions. Recognise limitations in the use of condensation reactions in synthesis. *Rearrangement reactions* Using curly arrows outline the general mechanism for carbocation rearrangements (carbon to carbon migration), and rearrangements involving electron deficient nitrogen or oxygen (carbon to nitrogen, carbon to oxygen migration). Predict the products and give a mechanism for a rearrangement reaction given substrate and reaction conditions, or provide a mechanism for a reaction where substrate and product are given. *Pericyclic reactions* Demonstrate how the geometry of the frontier orbitals of conjugated reactant(s) determines the viability of a reaction under thermal or photochemical conditions and the stereochemistry of the product. Explain the stereochemical course of reactions like S_N2, E2 and addition of Br_2 or BH_3 to alkenes, using the Frontier Orbital approach.
Competences	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, theories and applications relating to Organic Chemistry. 2. Ability to apply such knowledge and understanding to the solution of problems related to Organic Chemistry 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.
Prerequisites	There are no prerequisite courses. It is, however, recommended that students should have at least a basic knowledge of General Chemistry.
Course contents	*The structure of organic compounds* The Periodic Table, atomic orbitals, hybridization, bonding in carbon compounds (single, double and triple C-C bonds, C-O and C-N multiple bonds, conjugated bonds, benzene and aromaticity) *Nomenclature of main classes of organic compounds* IUPAC nomenclature for straight and branched chain hydrocarbons, monocyclic cycloalkanes, benzene and naphthalene, simple aromatic heterocyclic compounds, and their derivatives having any of the main functional groups. Sequence rules for specification of ligand priority, the E/Z designation, R/S to specify absolute configuration (Cahn, Ingold, Prelog). *Stereochemistry* Tetrahedral carbon, stereogenic (chiral) centres, chirality in molecules, geometrical and optical isomerism, optical activity, specific rotation, enantiomers, diastereomers, meso compounds, racemic mixtures and their separation. Conventions for

	representing three-dimensional chemical structures, conformations of ethane and butane, steric hindrance and preferred conformation. Conformation and *cis-trans* isomerism in cycloalkanes, axial and equatorial bonds in cyclohexane, conformational mobility of cyclohexane. The stereochemical requirements of substitution, addition, and elimination reactions. *Reactions and Mechanism* Types of organic reaction, reaction mechanisms, rates and equilibria, reaction co-ordinate energy diagrams, intermediates and transition states. Basic ideas of mechanism-electronegativity, polarisation, curly arrows, electrophiles and nucleophiles, reactive intermediates-carbocations, carbanions, free radicals. Acid-base catalysis. *Substitution, addition and elimination reactions* General mechanisms for SN1, SN2, SNAr, E1, E2 and electrophilic aromatic substitution reactions, the influence of reagents and reaction conditions, the competition between nucleophilic substitution and elimination. Addition to carbon-carbon multiple bonds. Addition and addition-elimination reactions at carbonyl, imino and nitrile groups; esterification, hydrolysis and analogues *Alkylation and acylation of enols and enolates* Acidity of hydrogen atoms alpha to carbonyl, nitrile and nitro groups, keto-enol tautomerism, reactivity of enols, alpha halogenation of carbonyl compounds. Enolate ion formation and reactivity, alkylation of enolate ions, decarboxylation, the use of ethyl acetoacetate and malonic esters in synthesis. Enolate acylation, carbonyl condensation reactions, aldol reaction and analogues, the Claisen condensation and related reactions. The Cannizzaro reaction. *Rearrangement reactions* Carbocation rearrangements (Wagner-Meerwein, pinacol), Rearrangements involving electron-deficient N and O atoms (Beckmann, Baeyer-Villiger, Hofmann and Curtius rearrangements). *Pericyclic reactions* Molecular Orbitals, π-Electron distribution in conjugated systems according to Huckel's method, Chemical reactions and molecular orbital symmetry, Frontier Orbitals Method, Classification, the thermal and photochemical closure of hexa-2,4-diene, the Diels-Alder reaction, the 1,3-dipolar cycloaddition, the photochemical isomerization of alkenes, 1,2-alkyl metathesis, [3,3]-sigmatropic reactions (Claisen metathesis), reverse ene-reactions (decarboxylation of β-ketoacids). Application of the Frontier Orbitals approach to explain the stereochemistry of classical organic reactions like substitutions (S_N2), eliminations (E2), additions (Br_2 addition, hydroboration).
Recommended reading	1. J. McMurry, "Organic Chemistry", Volumes I and II, translation in greek of the original english text, Creta University Press, 1999. 2. P. Sykes, "A guidebook to mechanism in organic chemistry", Translation: D. Gakis, Pnevmatikos Publications, 1994. 3. D.E. Levy, "Arrow pushing in Organic Chemistry: an easy approach to understanding reaction mechanisms", Wiley, 2008.
Teaching and learning methods	Lectures using slides for overhead projector or powerpoint presentations. Problem-solving seminars for the instructive solution of problems related to the organic chemistry.

	Collaborative problem-solving work by the students working in teams of two.
Assessment ang grading methods	1. Optionally, three assays with organic chemistry related problems solved by groups of two students (the 30% of the mean mark for the three assays is added to the final exams mark, taken however into account only when the student secures the minimum mark of 5 for each one of the assays and of 4 in the final written examination) 2. Written examination, final mark, unless the student participated in the preparation of the afore mentioned all three assays during the semester, in which case the final mark is calculated as described above). 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 holds: 5 (or 5.5) ⇔ E, 6 (or 6.5) ⇔ D, 7 (or 7.5) ⇔ C, 8 (or 8.5) ⇔ B and ≥9 - 10 ⇔ A
Language of instruction	Greek. Instruction may be given in English in case foreign students attended the course.

3rd Semester

Course title	**Analytical Chemistry II**
Course code	AnCh352
Type of course	Compulsory
Level of course	Undergraduate
Year of study	2nd
Semester	3nd
ECTS credits	5
Name of lecturer(s)	Lectures: Dr. V. Nastopoulos Laboratory: Dr T. Christopoulos, Dr C. Papadopoulou, Dr V. Nastopoulos
Learning outcomes	At the end of this course the student should: Be aware of the possibilities provided by the various techniques of quantitative analytical chemistry and be able to make comparison between them. Have a comprehension of modern analytical techniques that have a wide application in a variety of samples (e.g. biological samples, environmental samples, foods, medicines, materials, work of art). Have flexibility in the combination of analytical techniques for the resolution of complex problems. Have the faculty to combine and apply the knowledge acquired also in other fields of Chemistry (e.g. Inorganic, Organic, Biochemistry etc) in which certain notions and principles of the course in question are necessary and useful.
Competences	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 concepts and principles relating to Quantitative Analysis. 2. Ability to apply the acquired knowledge to the solution of problems in other fields of Chemistry. 3. Study skills needed for continuing professional development. 4. Adaptability in the continuously evolving Analytical Laboratory. 5. Work in a chemical lab following all the standard safety rules.
Prerequisites	Basic knowledge of General and Inorganic Chemistry.
Course contents	Classification of methods of quantitative analysis. Sampling, sample treatment, laboratory techniques and chemicals. Statistical treatment of analytical data (accuracy, precision), errors in chemical analysis, significant figures, methods for reporting analytical data. Classification of gravimetric methods, precipitation, homogeneous precipitation, crystal growth, colloids, impurities, digestion, errors. 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. Buffer solutions, titration curves for strong/weak acids and bases, mass/charge balance equations, errors. Evaluation and comparison of gravimetric and titrimetric methods of analysis. Exercises and solutions to problems in the above chapters.

	Laboratory exercises: Determination of nickel with dimethylglyoximate (gravimetric titration). Determination of sodium carbonate (neutralization titration). Determination of calcium and of the total hardness of water with EDTA (complexometric titration). Determination of copper and ascorbic acid [iodo(i)metry]. Determination of nicotine in tobacco (non-aqueous acid-base titration).
Recommended reading	T.P. Hadjiioannou, A.K. Kalokerinos, M. Timotheou-Potamia, “Quantitative Analysis”, Mavromatis Publications, 2006. D.C. Harris, “Quantitative Chemical Analysis”, 7th Edition, W.H. Freeman & Co., 2007. V. Nastopoulos, X. Papadopoulou, “Laboratory exercises in Analytical Chemistry, Publications of University of Patras, 2010.
Teaching and learning methods	1. Lectures using power-point presentations, educational software, problem solving, use of the Internet facilities for information retrieval from data bases. 2. Tutorials focused on problem solving and exercises of various types (e.g. multiple choice, right/ wrong, filling the gaps). 3. Laboratory exercises of quantitative analysis.
Assessment and grading methods	1. Problem-solving by the students. Evaluation of the result of analysis of unknown solutions and written tests during the laboratory practice. This consists the 40 % of the final mark (provided that it is at least 5). 2. Written examination at the end of the semester. The mark obtained will be the 60% of the final mark (provided that it is at least 5). 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
Language of instruction	Greek. The faculty is able to provide lectures and labs in English.

Course title	**Inorganic Chemistry II**
Course code	XA323
Type of course	Compulsory
Level of course	Undergraduate
Year of study	2nd
Semester	3nd
ECTS credits	10
Name of lecturer(s)	Lectures: Dr. Th. Zafiropoulos, Laboratory: Dr Th. Zafiropoulos, Dr. Sp. Perlepes
Learning outcomes	At the end of this course the student should be able to: 1. Recognize d-block elements and write their ground-state electronic configurations. 2. Discuss the oxidation states of d-block elements. 3. Explain the variation of radii, ionization energies and other physical properties of d-block elements both horizontally and vertically within the Periodic Table. 4. Describe occurrence, metallurgy, chemical properties and uses

	of representative first row d-block metals. 5. Know the basic features of coordination chemistry(definition of the coordination complex, terminology, ligands, coordination numbers, stereochemistry, colours, magnetic properties, stability, isomerism, and applications of the metal complexes). 6. Discuss and analyze the bonding in coordination complexes (valence-bond theory, crystal field theory, molecular orbital theory). 7. Prepare, purify, crystallize and characterize coordination complexes of first-row d-block metal ions.
Competences	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 excercises of unfamiliar nature. 4. Ability to interact with others on interdisciplinary problems. 5. Skills enabling the student to synthesize and study coordination complexes.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a good knowledge of General Chemistry and an elementary knowledge of Analytical Chemistry.
Course contents	*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 backround . 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 isomerism, linkage isomerism, polymerization isomerism, 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.
Recommended reading	1. D. Kessissoglou, P. Akrivos, "Biocoordination Chemistry", Volume I: Theory, Ziti Publishing Company, 2006. 2. D. Kessisoglou, P. Akrivos, P. Aslanidis, P. Karafiloglou, A. Dendrinou -Samara, "Biocoordination Chemistry", Volume II: Synthesis and Study of Coordination Compounds, Ziti Publishing Company, 2006.
Teaching and learning methods	Lecturers using slides for overhead projector or/and power-point presentations. Seminar for the instructive solution of problems.
Assessment and grading methods	1) Written examination of the Theory (50% of the final mark). 2) Written examination in the concepts Laboratory Exercises (50% of the final mark). Greek grading scale: 1 to 10. Minimum passing grade: 5 (for both topics).
Language of instruction	Greek

Course title	**Physical Chemistry II**
Course code	PhCh333
Type of course	Compulsory
Level of course	Undergraduate
Year of study	2nd
Semester	3nd
ECTS credits	5
Name of lecturer(s)	Dr. G. Maroulis
Learning outcomes	Basic knowledge for the interpretation of spectroscopic observations and measurements.
Competences	Using advanced specialized software in applications in Chemistry: Spectroscopy, Molecular Modelling in Organic and Inorganic Chemistry.
Prerequisites	None.
Course contents	• 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 hamiltonian 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.
Recommended reading	D.A. McQuarrie, "Quantum Chemistry", University Science Books, 1983.
Teaching and learning methods	Lectures and laboratory practice.
Assessment and grading methods	Written examination.
Language of instruction	Greek.

Course title	**Instrumental Chemical Analysis I**
Course code	AnCh353
Type of course	Compulsory
Level of course	Undergraduate
Year of study	2nd
Semester	3rd
ECTS credits	3
Name of lecturer(s)	Dr. S.D. Glavas, Dr T. Christopoulos
Learning outcomes	At the end of this course the student will know: Techniques in Chromatography Analysis (S. Glavas) 1. The basic chromatographic parameters: Distribution constant, Retention time, Retention factor and their physical meaning. He will be able to use these parameters to calculate from a chromatogram other also basic parameters like the Selectivity Factor and the Resolution. 2. The Plate theory and its basic assumptions and calculate from a chromatogram the Number of Theoretical Plates. The Rate Theory and van Deemter equation, with its graphical representations. for Gas and Liquid Chromatography- HPLC. 3. Recognize the classes of analytes to be determined with Gas

	Solid and Gas Liquid Chromatography (with packed and capillary columns). Choose the appropriate column and detector for the separation and determination of certain analytes with Gas Chromatography. 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 cterain separation and the appropriate Detector for the determination of a certain analyte. Understand the role of the solvent in HPLC. 5. Perform in a Chromatogram Qualitative and Quantitative Analysis, with simple Normalization and also based on Response Factors. Electroanalytical Techniques (Th. Christopoulos) 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.
Competences	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
Prerequisites	There are no prerequisite courses. It is however recommended that students have basic knowledge of Physics, Organic chemistry, Qualitative analysis and Quantitative analysis.
Course contents	1. *General Concepts of Chromatography*: Distribution Constants, Retention time, Retention Factor, Selectivity Factor. Plate Theory, Rate Theory.Equation Van Deemter for Gas and Liquid Chromatography. Resolution and factors that affect it.

	2. *Gas Chromatography*: Instrumentation of Gas Chromatography. Carrier Gas. Solid support. Liquid Stationary Phase. Temperature programming. Cappilary 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 Chrmatography of Normal and Reverse Phases. The role of Mobile Phase. Gradient Elution. Detectros of UV/Visible, Diode Array Detectors 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 with simple Normalizations and Response factors Normalization. 5. *Electroanalytical Techniques*: *Potentiometry*. Indicator electrodes. Development of electrical potentials. Development of membrane potentials. Reference electrodes. The liquid junction potential. Electrodes selective to molecules. Principle and architecture of potentiometric gas sensors. Principle and architecture of biocatalytic membrane electrodes. Quantitative analysis by potentiometry. Direct potentiometric methods. Calibration methods. Errors in potentiometry. Potentiometric titrations. *Coulometry*. Principle of coulometric titrations. Advantages of coulometric titrations. Various types of coulometric titrations: Acid-base titrations; precipitation titrations; complex-formation titrations; oxidation reduction titrations. Electrochemical cells for coulometry. Problems. *Voltammetry*. Principles of voltammetric sensors.
Recommended textbooks	1. D.A. Skoog, F.J. Holler, T.A. Nieman, "Principles of Instrumental Analysis", 5th Edition, Translation: M.I. Karagiannis, K.H. Efstathiou, N. Haniotakis, Kostarakis Publications, 2002. 2. Th. Hatjiioannou and M.A. Kouppari, "Instrumental Analysis, Mavrommatis Publications, 2003.
Teaching and learning methods	Lectures using with power-point presentations.
Assessment ang grading methods	One written examination at end of Semester 100% of grade. 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
Language of instruction	Greek. Lectures may also be given in English.

4th Semester

Course title	**Organic Chemistry of Functional Groups I**
Course code	OrCh 402
Type of course	Compulsory
Level of course	Undergraduate
Year of study	2nd
Semester	4th
ECTS credits	10
Name of lecturer(s)	Lectures: Profs of Organic Chemistry Laboratory Course: Dr G. Tsivgoulis Laboratory: Drs D. Gatos, G. Tsivgoulis, T. Tselios, K. Athanassopoulos
Learning outcomes	At the end of this course the student should 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, amines and other nitrogen functions, benzene and its derivatives. In addition, for the following classes of organic compounds: *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. *Amines and other nitrogen functions* Distinguish between the behaviour of amines as nucleophiles and bases, and between nitrogen in sp3, sp2 and sp hybridisation. Account for the basicity of amines, and the reduced basicity of amides. Exploit the usefulness of diazonium compounds in the synthesis of substituted benzene derivatives. At the end of this course the student should be able to organize and perform the synthesis of simple organic molecules. In

	particular, he should be able to: *At the end of this laboratory course the student should be able to organize and perform the synthesis of simple organic molecules. In particular, he should be able to:* Collect all the necessary information (hazards, properties of compounds, bibliography of synthesis e.t.c.) and analyze the procedure in simple experimental steps. Explain the role of all the reagents. Assembly all type of equipments necessary in classical organic synthesis and perform successfully the synthesis as well as the isolation and purification of the products. To accomplish these tasks he should know the various techniques used usually in organic synthesis like extraction, filtration, distillation, recrystalization e.t.c. Processing the data and presenting the results of his experiments (yields, notes, improvements e.t.c.).
Competences	At the end of the course and laboratory the student will have further developed the following skills/competences: 1. Ability to demonstrate knowledge and understanding of essential facts, concepts, theories and applications relating to Organic Chemistry. 2. Ability to apply such knowledge and understanding to the solution of problems related to Organic Chemistry of an unfamiliar nature. 3. Ability to adopt and apply methodology to the solution of unfamiliar problems. 4. Ability to interact with others on inter or multidisciplinary problems. 5. Ability to understand essential facts, concepts, and techniques relating to the Synthesis of Simple Organic Molecules. 6. Ability to apply such knowledge for the synthesis of new molecules. 7. Study skills needed for continuing professional development.
Prerequisites	There are no prerequisite courses. It is, however, recommended that students should have at least a basic knowledge of Organic Chemistry.
Course contents	*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 (including the Lindlar catalyst), 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 H2, water, HX and X2, 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. *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, ureas. *Laboratory exercises* 1. Introductory concepts for a Laboratory and description of the various techniques. 2. Synthesis of tert-butylchloride. 3. Synthesis of acetanilide. 4. Synthesis of ojime of cyclohexanone. 5. The cannizzaro reaction. 6. Nitration of acetanilide. 7. Thin Layer Chromatography (aminoacids separation). 8. Reactions in microscale (Synthesis of Benzoin).
Recommended reading	1. J. McMurry, “Organic Chemistry”, Volumes I and II, translation in greek of the original english text, Creta University Press, 1999. 2. D. Papaioannou, G. Stayropoulos, T. Tsegenidis, “Notes on experimental organic chemistry”, Publications of University of Patras.
Teaching and learning methods	Lectures using slides for overhead projector and/or power-point. Problem-solving seminars.
Assessment and grading methods	Written examination (100% of the final mark) Laboratory: 1 Test before any experiment (30% of the final mark). 2 Performance of the student during the experiments and yield of the reactions (30% of the final mark). 3 Written examination (40% of the final mark) 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
Language of instruction	Greek

Course title	**Instrumental Chemical Analysis II**
Course code	AnCh434
Type of course	Compulsory
Level of course	Undergraduate
Year of study	2^{nd}
Semester	4^{th}
ECTS credits	10
Name of lecturer(s)	Lectures: Th. Christopoulos Laboratory: Th. Christopoulos, Ch. Papadopoulou
Learning outcomes	At the end of this course the student will know: - Properties of electromagnetic radiation. Parts of optical instruments. - UV/Vis molecular spectroscopy: Transmittance and absorbance measurements. Beer's Law. Instrumentation. - Applications of UV/Vis molecular spectroscopy: Requirements for absorption at the UV/Vis range. Applications in qualitative and quantitative analysis. Photometric titrations. - Molecular luminescence spectroscopy: Theory of fluorescence and phosphorescence. Instrumentation. Applications and luminescence methods. Chemiluminescence. - Infrared absorption spectroscopy: Theory, instrumentation and applications. - Atomic absorption and atomic fluorescence spectroscopy: Atomization techniques, instrumentation for atomic absorption, interferences, analytical techniques in atomic absorption spectroscopy, atomic fluorescence spectroscopy. - Atomic emission spectroscopy: Atomic emission spectroscopy based on plasma sources. - Atomic mass spectrometry: Mass spectrometry (general), Inductively coupled plasma/mass spectrometry. - Molecular mass spectrometry: Mass spectra, ion sources, Instrumentation. Applications. - Automated methods of analysis. Principles, Instrumentation and Applications.
Competences	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..
Prerequisites	There are no prerequisite courses. It is however recommended

	that students have basic knowledge of Physics, Qualitative analysis and Quantitative analysis.
Course contents	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. 8. Atomic mass spectrometry: Mass spectrometry (general), Inductively coupled plasma/mass spectrometry. 9. Molecular mass spectrometry: Mass spectra, ion sources, Instrumentation. Applications. 10. Automated methods of analysis. 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.
Recommended textbooks	1. D.A. Skoog, F.J. Holler, T.A. Nieman, "Principles of Instrumental Analysis ", 5th Edition, Translation: M.I. Karagiannis, K.H. Efstathiou, N. Haniotakis, Kostarakis Publications, 2002. 2. Th. Hatjiioannou and M.A. Kouppari, "Instrumental Analysis, Mavrommatis Publications, 2003.
Teaching and learning methods	Lectures using transparencies and/or power-point presentations.
Assessment ang grading methods	One written examination at end of Semester 80% of grade. The Laboratory contributes to 20% of the final grade. 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
Language of instruction	Greek. Lectures & Labs may also be given in English.

Course title	**Physical Chemistry III**
Course code	PhCh434
Type of course	Compulsory
Level of course	Undergraduate
Year of study	2nd
Semester	4th
ECTS credits	10
Name of lecturer(s)	Dr. G. Karaiskakis
Learning outcomes	At the end of this course the student should be able to: 1. Define the thermodynamic equilibrium constant and study its variation with temperature and pressure. 2. Answer to the following questions: a) How quickly a reaction mixture approaches equilibrium? b) Which factors affect the rate of reactions? c) Which is the mechanism of a reaction? 3. Know the factors which affect the rate of enzyme reactions. 4. Define the activity, the activity coefficient, the mean activity coefficient and the mean activity of ions, and describe the interactions between ions in electrolytes. 5. a) Describe the interface between electrodes and electrolytes. b) Explain the way by which the electrodes and the electrochemical cells are denoted. c) Anticipate when an electrochemical reaction is spontaneous. d) Describe the situation of electrochemical equilibrium. 6. Define the rate of the electrochemical reactions and explain its relation with the standard potentials of electrodes and cells. 7. Execute laboratory experiments related to Physical Chemistry. 8. Report all the experimental data and observations, execute the numerical calculations and extract the relevant conclusions.
Competences	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 principles, concepts and theories relating to Physical Chemistry and especially to chemical equilibrium, to chemical kinetics and to electrochemistry. 2. Ability to apply such knowledge to the solution of problems relating with the Sciences of Materials, Environment and Food, as well as to the Sciences of Biology, Pharmacy and Medicine. 3. Study skills needed for continuing professional development. 4. Laboratory skills necessary for the execution of experiments related to Physical Chemistry.
Prerequisites	The students should have at least a basic knowledge of Physical Chemistry I.
Course contents	***1. Chemical Equilibrium*** Equilibrium constant and its variation with temperature and pressure, Examples of chemical equilibrium, Coupling of biological reactions.

	2. ***Chemical Kinetics*** Reaction rate and factors that affect it, Rate laws, Order of reactions, Molecularity, Parallel, Opposing and Consecutive reactions, The steady state approximation, The Arrhenius law, The collision theory and the theory of absolute reaction rates, Catalysis. 3. ***Kinetics of Enzyme Reactions*** Influence of concentration, pH and temperature on the rate of enzyme reactions. 4. ***Conductivity and Ionic Equilibria*** Electrolytic conductivity, Transport numbers, Molar activity and electric mobility of ions, Ionic equilibria, Buffer solutions, Indicators. ***5. Electrochemical cells*** Potentials of electrodes and electrochemical cells, Electrochemical reactions, Thermodynamics of electrode and electrochemical cell potentials, Classification of electrodes and electrochemical cells, The junction potentials, Potentiometric determination of pH, Potentiometric titrations. 6. ***Electrochemical Kinetics*** The electrochemical double layer, Rate of electrochemical reactions, Overpotential, Polarography, Corrosion 7. ***Laboratory Experiments*** Twelve (12) experiments related to : Chemical Thermodynamics, Chemical Equilibrium, Chemical Kinetics and Electrochemistry.
Recommended textbooks	1. G. Karaiskakis, "Physical Chemistry", P. Travlos Publications, 1998. 2. P. Atkins, J. De Paula, "Atkins' Physical Chemistry», 8th Edition, Oxford University Press, 2006. 3. N. Katsanos, "Physical Chemistry: ", 3rd completed edition, Papazisis Publication, 1999. 4. N. Katsanos, "Experiments in Physical Chemistry", Volume I and II, Publications of University of Patras, 2006. 5. G. Karaiskakis, N. Klouras, E. Manesi-Zoupa, "Experiments in Chemistry", Publications of Hellenic Open University, 2003. 6. R.J. Sime, "Physical Chemistry: Methods-Techniques-Experiments", (Saunders Golden Sunburst Series), Saunders College Publishing, 1998.
Teaching and learning methods	Problem-solving seminars for the easier and more complete understanding of the course contents. Oral examination in questions and problems related to experiments during the execution of the laboratory experiments.
Assessment ang grading methods	1. Three optional tests. 2. Written final examination. 3. a) Oral examination for the laboratory experiments b) Grading of the written report for each laboratory experiment.The final mark for the experiments results as an average of the oral examination and the written report. The final mark of the course results from the contribution of the final examination, of the optional tests and of the final mark for the experiments, but with different weightiness. 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
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

5^{th} Semester

Course title	**Organic Chemistry of functional groups II**
Course code	OrCh503
Type of course	Compulsory
Level of course	Undergraduate
Year of study	3^{rd}
Semester	5^{th}
ECTS credits	10
Name of lecturer(s)	Lectures: Drs T. Tsegenidis, J. Matsoukas, G. Tsivgoulis, T. Tselios Laboratory Course : Dr C. Poulos Laboratory: Drs C. Poulos, D. Gatos, G. Tsivgoulis, T. Tselios, K. Athanassopoulos
Learning outcomes	At the end of this course the student should be able to: *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 presence of carbonyl compounds. 2) Evaluate chemical methods and propose-apply methods for the synthesis and inter-conversion of carbonyl compounds or their conversion to other organic compounds. 3) Presents the applications and use of carbonyl compounds. *Heterocyclic compounds:* 1) Compare the aromaticity of pyrrole, furan, thiophen and pyridine with that of benzene, showing similarities and differences. Explain the different effect that nitrogen has on the chemistry of pyrrole and pyridine and rationalise their contrasting chemical behaviour. 2) Predict the products of reactions of monosaccharides and disaccharides. 3) Relate the different chemistry of pyrrole, furan and thiophen to the influence of the heteroatom. *Biomolecules:* Carbohydrates After studying this chapter the student should be able to: 1) Classify carbohydrates as aldoses, ketoses, D or L sugars, monosaccharides or polysaccharides. 2) Draw monosaccharides in the following projections: a) Fischer projection. b) Haworth projection. c) Chair conformation. 3) Predict the products of reactions of monosaccharides and disaccharides. 4) Deduce the structure of monosaccharides and disaccharides. *Amino Acids, Peptides and Proteins:* After studying this chapter, the student should be able to: 1) Identify the common amino acids and draw them with correct stereochemistry and dipolar form. 2) Understand the acid-base behavior of amino acids. 3) Synthesize amino acids. 4) Draw the structure of simple peptides.

	5) Determine the structure of peptides and proteins. 6) Outline the synthesis of peptides. 7) Draw the structures of reaction products of amino acids and peptides. *Lipids:* After studying this chapter, the student should be able to: 1) Draw the structure of fats, oils, steroids, and other lipids. 2) Determine the structure of a fat. 3) Predict the products of reactions of fats and steroids. 4) Locate the isoprene units in a terpene. 5) Draw the structures and conformations of steroids and other fused-ring systems. *Heterocycles and Nucleic Acids:* After studying this chapter, the student should be able to: 1) Draw orbital pictures of heterocycles and explain their acid-base properties. 2) Explain orientation and reactivity in aromatic heterocycle reactions. 3) Predict the products of reactions of heterocycles. 4) Formulate mechanisms of reactions of heterocycles. 5) Draw purines, pyrimidines, nucleosides, nucleotides, and representative segments of DNA. 6) Given a DNA or RNA strand, draw is complimentary strand. At the end of this laboratory course the student should be able to organize and perform the synthesis of simple organic molecules. In particular, he should be able to: 1) Collect all the necessary information (hazards, properties of compounds, bibliography of synthesis e.t.c.) and analyze the procedure in simple experimental steps. 2) Explain the role of all the reagents. 3) Assembly all type of equipments necessary in classical organic synthesis and perform successfully the synthesis as well as the isolation and purification of the products. To accomplish these tasks he should know the various techniques used usually in organic synthesis like extraction, filtration, distillation, recrystalization etc. 4) Processing the data and presenting the results of his experiments (yields, notes, improvements etc.). 5) Use environmentally friendly reagents, solvents and experimental techniques (Green Chemistry).
Competences	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 carbonyl compounds. 2) Ability to understand essential facts, concepts, principles and theories relating to Heterocycle Chemistry and Chemistry of Natrural Products. 3) Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems of an unfamiliar nature. 4) Ability to adopt and apply methodology to the solution of unfamiliar problems. 5) Study skills needed for continuing professional development. 6) Ability to interact with others on inter or multidisciplinary problems.

	7) Ability to understand essential facts, concepts, and techniques relating to the Synthesis of Simple Organic Molecules. 8) Ability to apply such knowledge for the synthesis of new molecules.
Prerequisites	There are no prerequisite courses**.** It is however recommended that students should have at least a basic knowledge of Organic Chemistry.
Course contents	*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 *Heterocyclic compounds* Pyrrole, furan, thiophen, pyridine, aromaticity in monocyclic heterocyclic compounds, electrophilic and nucleophilic attack, acid/base properties. *Biomolecules* Aminoacids and peptides: structures of common amino acids, dipolar (zwitterionic) nature, isoelectric points, syntheses of amino acids, the peptide bond, synthesis of peptids, structures of proteins, structure determination of peptids and proteins. Carbohydrates: structures of common carbohydrates, chemical reactions, deduce of structure of monosacharides and disacharides, polysacharides Lipids: structures of the major classes of lipids (fats, phosphatids, terpenoids, steroids, alkaloids), chemical reactions of the triesters of glycerol and of steroids. Nucleic acids: structure of purines and pyrimidines, nucleosides, nucleotides and polynucleotides. *Laboratory exercises* 1. Introductory concepts for a Laboratory and description of the various techniques and introduction to Green Chemistry. 2. Synthesis of 1,2,3,4 tetrahydrocarbazole. 3. Reduction of camphor. 4. Synthesis of aniline from the reduction of nitrobenzole. 5. Synthesis of orange color of b-naphthol. 6. Diels-Alders reaction with microwaves (Green Chemistry). 7. Barbier reaction (type Grignard) in water solution (Green Chemistry). 8. Synthesis of benzocaine.
Recommended reading	1. J. McMurry, "Organic Chemistry", Volumes I and II, translation in greek of the original english text, Creta University Press, 1999. 2. D. Papaioannou, G. Stayropoulos, T. Tsegenidis, "Notes on experimental organic chemistry", Publications of University of Patras. 3. C. Poulos, "Notes of Experimental Green Chemistry", Publications of University of Patras, 2010.
Teaching and learning methods	Lectures using slides for overhead projector and/or power-point. Problem-solving seminars.
Assessment and grading methods	1) Written examination (100% of the final mark) 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
Language of instruction	Greek

Course title	**Physical Chemistry IV**
Course code	PhCh535
Type of course	Compulsory
Level of course	Undergraduate
Year of study	3rd
Semester	5th
ECTS credits	5
Name of lecturer(s)	Lectures: Dr X. Matralis Laboratory: Dr. X. Matralis, Dr. A. Koliadima, Dr. E. Papaeftymiou
Learning outcomes	In brief, at the end of this course the student should be able to: • Define basic concepts in the fields of Statistical Thermodynamics, Electric properties of molecules, Intermolecular Forces, and Colloid Chemistry. • State the two axioms of Statistical Thermodynamics and discuss the objectives of this branch of Physical Chemistry • Explain the physical meaning of the Boltzmann distribution and the partition functions. • Describe the genesis of the induced dipole moment. • Explain the influence of the electric field frequency on the polarizibility. • Describe and discuss experimental procedures for the determination of the permanent dipole moment and polarizibility. • 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.
Competences	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. Concerning the skills which the student is expected to develop through practical work in the Physical Chemistry Laboratory IV, 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.
Prerequisites	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.
Course contents	*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 dimentional 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). - First 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. *Γ. 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 IV* 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).
Recommended reading	1. P.W. Atkins, "Physical Chemistry", 6th Edition, Oxford University Press, 1999. 2. D.A. McQuarrie, J.D. Simon, "Physical Chemistry: A Molecular Approach", University Science Books, 1997. 3. E. Dalas, A. Crisanthopoulos, "Experiments in Physical Chemistry IV", Publications of University of Patras. 4. D.P. Shoemaker, C.W. Garland, J.W. Nibler, "Experiments in Physical Chemistry", 8th edition, McGraw-Hill, 2008.
Teaching and learning methods	Lectures, team work during the problem-solving seminars and laboratory exercises.
Assessment ang grading methods	1. Optional Assessment Tests (2 or 3 written tests of 2h duration per semester on the material of the course Physical Chemistry IV). A student may be exempted from the final exam if his/her grade, in all the optional assessment tests, is equal to or higher than a predefined grade (usually 6 or 7). In this case the student's mean in the grade of the optional assessment tests is taken as his/her grade for the final written examination. Otherwise, his/her mean grade in these tests is 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). 2. The assessment of students in the Lab is based, for each laboratory exercise, on the examination preceding the exercise (50%) and on the written report (50%) for the exercise. The

	final grade in the Lab is the mean of the student's grades in 8 exercises. 3. Final written examination on the material of the course Physical Chemistry IV. 4. The final grade for the course Physical Chemistry IV is calculated by the final grade in the Lab (30%) and the grade of the final written examination (70%). The student must have secured a minimum grade of 5 in both the Lab and the final written examination.
Language of instruction	Greek. Both, the practice of foreign students in the Lab as well as guidance for the study of the course Physical Chemistry IV may be done in English or French.

Course title	**Biochemistry I: Structure and function of bio-molecules, Transduction and storage of energy, Cellular Signaling**.
Course code	BiCh510
Type of course	Compulsory
Level of course	Undergraduate
Year of study	3rd
Semester	5th
ECTS credits	5
Name of lecturer(s)	Dr N. Karamanos
Learning outcomes	At the end of this course the student should be able to: 1. Know in general about the chemical composition, structure and function of basic biomolecules (carbohydrates, proteins, lipids, nucleic acids). 2. Know the classification of proteins, and the structure and function of the main members in each class. 3. Know the classification of enzymes, the determination of their kinetic constants, the general mechanisms of enzymatic reactions, and the modes of enzyme activity regulation. 4. Know the basic concepts of cellular signaling. 5. Present the pathway of light energy (solar energy) conversion into chemical energy in the form of various biomolecules. 6. 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. 7. Describe the pathway of energy release from reduced coenzymes through respiratory chain and storage of energy into ATP through oxidative phosphorylation.
Competences	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 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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry and General Biology.
Course contents	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) Stuctural 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. Photosynthesis. The light reactions of photosynthesis. Photosystems I and II. The dark reactions-The Calvin cycle. C3 and C4 plants. 9. Oxidative release of energy from fuel molecules and its storage into reduced coenzymes. The central role of acetyl-coenzyme A. Citric acid cycle (Krebs cycle) and glyoxylate cycle. 10. Energy release from reduced coenzymes (respiratory chain) and storage of energy into ATP (oxidative phosphorylation).
Recommended reading	1. 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. 2. 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. 3. C.A. Demopoulos, S. Antonopoulou, "Basic Biochemistry", 2nd revised edition, C.A. Demopoulos, S. Antonopoulou Publications, 2009. 4. J.G. Georgatsos, "Introduction to Biochemistry", 6th Edition, Giahoudi Publications, 2005.
Teaching and learning methods	Lectures using power-point presentations and/or slides for overhead projector. Self-test of students with multiple-choice

	questions. Problem-solving seminars for the instructive solution of problems in teams of 25 students.
Assessment ang grading methods	Written examination. 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
Language of instruction	Greek

Course title	**Inorganic Chemistry III (Chemistry of 2nd and 3rd Row Metals and of Lanthanides)**
Course code	InCh524
Type of course	Compulsory
Level of course	Undergraduate
Year of study	3rd
Semester	5th
ECTS credits	5
Name of lecturer(s)	Dr Sp. Perlepes
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.
Competences	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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a good knowledge of General Chemistry, a basic knowledge of Inorganic Chemistry and an elementary knowledge of Physical Chemistry.
Course contents	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) Stereochemical aspects. b) Electronic effects. Jahn-Teller distortions. 6. *Thermodynamic stability of metal complexes* a) The Irving-Williams trends. 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-Orbital and oxidation states. c) Atom and ion sizes. d) Occurrence and separation of the lanthanides. e) Inorganic compounds and coordination complexes of the lanthanides.
Recommended reading	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.
Teaching and learning methods	Lectures using slides for overhead projector. Problem-solving seminars for the instructive solution of problems. Collaborative problem-solving work by the students working in teams of 3.
Assessment ang grading methods	1. An assay comprising of one synthetic problem solved and presented (15 min, power-point presentation) by groups of 3 students (30% of the final mark, taken into account only when the student secures the minimum mark of 5 in the final written examination). 2. Written examination (70% of the final mark). 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.
Language of instruction	Greek

6^{th} Semester

Course title	**Special Topics in Organic Chemistry**
Course code	OrCh604
Type of course	Compulsory (Core Chemistry Course)
Level of course	Undergraduate
Year of study	3^{rd}
Semester	6^{th}
ECTS credits	5
Name of lecturer(s)	Drs G. Tsivgoulis, D. Papaioannou
Learning outcomes	At the end of this course the student should be able to: 1. 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. 2. Relate the organic chemistry of silicon, phosphorous and sulphur to that of carbon, nitrogen and oxygen, showing similarities and differences. Outline mechanisms for the Wittig Peterson reactions and show how the Wittig και Horner-Emmons reactions can be used in synthesis.. 3. Recognize a given molecular structure as (a) an initiator, (b) an addition polymer, (c) a condensation polymer, (d) a monomer for addition polymerisation and (e) a monomer for condensation polymerisation. Outline the sequence of reactions involved in (a) radical-initiated addition polymerisation and (b) condensation polymerisation. Predict the polymer that would result from a given monomer(s) or deduce the monomer(s) that would give rise to a given polymer. 4. Devise a synthetic sequence by working back from a target molecule of moderate complexity using reactions and reagents encountered previously or by proposing analogous reactions and reagents. 5. Utilize the chemistry of the various functional groups already studied to introduce or modify (interconvert) functional groups. Recognize the need for the introduction and removal of a protecting group. Depict the four possible synthons generated by a bond disconnection, and select the more suitable pair by relating each synthon to a viable reagent. Identify sites where a functional group interconversion is necessary before a useful disconnection can be made.
Competences	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, theories and strategics relating to Spectroscopy and Synthetic Organic Chemistry 2. Ability to apply such knowledge and understanding to the solution of spectroscopic and synthetic 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.
Prerequisites	There are no prerequisite courses. It is, however, recommended that students should have at least a basic knowledge of General Chemistry, Organic Chemistry and Physics.
Course contents	*1. Spectroscopy of Organic Compounds (36 hours)* Matter and Electromagnetic Irradiation. UV-Vis Spectroscopy (theory– applications) IR and Raman Spectroscopy (theory– applications) MS Spectrometry: a) Description of the principle and the basic parts of a Mass spectrometer as well as the various ionization techniques (EI, CI, MALDI, ES, e.t.c.) b) Fragmentation pathways of the various categories of organic compounds c) Examples – Applications. 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. Combinatorial use of the above spectroscopic/spectrometric techniques for the identification of 'unknown' organic compounds. *2. Organic Chemistry of elements of the third row of the periodic table (sulfur, phosphorus and silicon (5 hours)* Similarities and differences in the chemical behaviour of couples of organic compounds with central atoms O and S, N and P and C and Si. Thiols and sulfides, sulfoxides and sulfones. Structure, nomenclature and reactions of simple organophosphorus and organosilicon compounds. Compounds of S and of P as nucleophiles and as electrophiles. The reactions Wittig and Horner-Emmons. Stabilization of β-carbonium ions and α-carbanions (Petersen olefination) by Si, Si in the protection or activation of functional groups, silanes as reducing agents. *3. Polymers (2 hours)* Free radical or ionic polymerization of alkenes (addition or chain-growth), Step-growth (condensation) polymerization. *4. Synthetic methodology (9 hours)* Systematic approaches to the design of syntheses, utilization of functional group reactions for synthesis, interconversion of functional groups and the formation of C-C και C-heteroatom bonds, application and removal of protecting groups, analysis and modification of synthetic sequences. Analysis and modification of synthetic sequences. Use of retrosynthetic (antithetic) analysis and the disconnection approach, synthons and corresponding reagents.
Recommended reading	1. A. Valavanidis, "Basic Principles of Molecular Spectroscopy and Applications in Organic Chemistry", Current Topics Publications, 2008. 2. J. McMurry, "Organic Chemistry", Volumes I and II, translation in greek of the original english text, Creta University Press, 1999. 3. D. Papaioannou, "Synthetic Organic Chemistry", Papazisis

	Publications, 1995. 4. J.R. Hanson, "Organic Synthetic Methods" Tutorial Chemistry Texts No. 12, Royal Society of Chemistry, 2002. 5. Personal notes of the lectures for the modules 1, 2 and 4.
Teaching and learning methods	Lectures using slides for overhead projector or powerpoint presentations. Problem-solving seminars for the instructive solution of spectroscopic and synthetic problems. Collaborative problem-solving work by the students working in teams.
Assessment and grading methods	1. Optionally, three assays with spectroscopic (two) and synthetic (one) problems solved by groups of two students (the 30% of the mean mark for the three assays is added to the final exams mark, taken however into account only when the student secures the minimum mark of 4 in the final written examination). 2. Written examination (2 questions on spectroscopy and 1 question from the other units, final mark, unless the student participated in the preparation of the afore mentioned all three assays during the semester, in which case the final mark is calculated as described above). 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 holds: 5 (or 5.5) ⇔ E, 6 (or 6.5) ⇔ D, 7 (or 7.5) ⇔ C, 8 (or 8.5) ⇔ B and ≥9 - 10 ⇔ A
Language of instruction	Greek. Instruction may be given in English in case foreign students attended the course.

Course title	**Biochemistry II: Metabolism of micro- and macro-biomolecules. Genetic information flow and regulation**.
Course code	BiCh511
Type of course	Compulsory
Level of course	Undergraduate
Year of study	3rd
Semester	6th
ECTS credits	10
Name of lecturer(s)	Dr A. J. Aletras
Learning outcomes	At the end of this course the student should be able to: 1. Describe the main biosynthetic pathways of micro- and macrobiomolecules (carbohydrates, fatty acids and other lipids, amino acids and proteins, nucleotides and nucleic acids). 2. Describe the main pathways of micro- and macrobiomolecules (carbohydrates, lipids, amino acids, proteins and nucleic acids) breakdown to meet the energy needs of a cell or organism. 3. 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. 4. Know the main steps of the genetic information flow and regulation (DNA replication, transcription-RNA biosynthesis, translation-protein biosynthesis, operon theory). 5. Apply various spectrophotometric methods for the determination of several biomolecules. 6. Isolate and study simple proteins abundant in various natural

	products. 7. Carry out the kinetic study of an enzyme.
Competences	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 metabolism of micro- and macrobiomolecules (carbohydrates, lipids, proteins, nucleic acids) and genetic information flow and regulation. 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.
Prerequisites	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 I, particularly of the chapters referring to respiratory chain and oxidative phosphorylation, and citric acid cycle (Krebs cycle).
Course contents	*Theory* 1. Carbohydrates metabolism. Glycolysis, gluconeogenesis, pentose phosphate pathway. Glycogen metabolism. 2. 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. 3. 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. 4. Nitrogenase, nitrogen fixation, synthesis of ammonia. Essential and non-essential amino acids. Biosynthesis of non-essential amino acids. 5. Nucleotides and deoxynucleotides metabolism. Salvage reactions. 6. The biosynthesis of triacyloglycerols, phospholipids, sphingolipids and cholesterol. The lipoproteins. The LDL receptors. The biosynthesis of steroid hormones. 7. DNA replication in prokaryotes and eukaryotes. Prokaryotic and eukaryotic DNA-polymerases. Telomerases and telomeres. Recombination of DNA. DNA mutations and repair mechanisms. 8. RNA synthesis. Prokaryotic and eukaryotic RNA-polymerases. Prokaryotic and eukaryotic promoters. Response elements and transcription factors. Splicing of eukaryotic mRNA. 9. 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. 10. Regulation of gene expression. Operon theory.

	Laboratory exercises 1. Spectophotometric methods for protein determination a) Biuret method b) Lowry method c) Bradford method 2. Preparation of buffer solutions. 3. Titration of glycin. Determination of pK1, pK2 and 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. SDS-polyacrylamide gel electrophoresis of proteins. Determination of proteins molecular weight. 7. Immunochemical methods for protein detection and determination. Dot-blot analysis and ELISA, using antibodies against ovalbumin. 8. Enzymes kinetic. Study of acid phosphatase. Effect of temperature and pH on the rate of enzymatic reaction Determination of acid phosphatase Km and Vmax values. 9. Protein denaturation. Effect of high temperature and high urea concentration on enzyme activity. Reverse and non-reverse denaturation. 10. Oxidoreductases. Study of succinate dehydrogenase and glutamate dehydrogenase in liver extract. 11. Glycogen breakdown. Comparative study in liver and muscle extracts.
Recommended reading	1. 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. 2. 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. 3. C.A. Demopoulos, S. Antonopoulou, "Basic Biochemistry", 2nd revised edition, C.A. Demopoulos, S. Antonopoulou Publications, 2009. 4. J.G. Georgatsos, "Introduction to Biochemistry", 6th Edition, Giahoudi Publications, 2005. 5. C.P. Tsiganos, N. Papageorgakopoulou, S. Anagnostidis, A.J. Aletras, "Laboratory practice in Biochemistry", Publications of University of Patras.
Teaching and learning methods	Lectures using power-point presentations and/or slides for overhead projector. Self-test of each student with multiple-choice questions. Problem-solving seminars for the instructive solution of problems in teams of 25 students.
Assessment and grading methods	1. Written examination of the theory (2/3 of the final mark) 2. Practical and written examination of the laboratory courses (1/3 of the final mark). Both marks should be ≥5. 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
Language of instruction	Greek

Course title	**Food Chemistry**
Course code	FoCh670
Type of course	Compulsory
Level of course	Undergraduate
Year of study	3rd
Semester	6th
ECTS credits	5
Name of lecturer(s)	Drs A. A. Koutinas, M. Kanellaki and A. Bekatorou
Learning outcomes	At the end of this course the student will: 1. Acquire deeper knowledge on the chemistry and role of the major food constituents (water, carbohydrates, proteins, fats and vitamins). 2. Acquire knowledge relevant to the new trends in food production (novel food with health benefits, probiotics, genetically modified food, functional food etc.) 3. Acquire knowledge relevant to the nutritional value of packaged industrial food (composition, concentration of chemical additives, possibility of contamination with toxic substances).
Competences	At the end of the course the student will have further developed the following skills/competences: 1. Ability to recognize the role and nutritional value of food components and be able to adapt his dairy diet in order to obtain health benefits and face food associated problems (obesity, diabetes, anaemia, etc.) and to inform other people accordingly. 2. Ability to evaluate the nutritional value and safety of industrialized food. 3. Ability to consult food production, processing or analysis enterprises, in which he can also seek employment.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry and Biochemistry.
Course contents	1. Water in food: Free and bound. Water activity (a_w). Significance in food nutrition. 2. Chemistry of carbohydrates: Reactions in food. Carbohydrate containing foods. 3. Chemistry of fruit and other plant foods. 4. Chemistry of cereals and their products. 5. Chemistry of proteins and amino acids: Protein containing foods. Effect of processing on food proteins. 6. Chemistry of meat and its products. 7. Chemistry of milk and dairy products. 8. Chemistry of edible fats and oils. 9. Vitamins: Changes during food processing. Significance to human nutrition. 10. Inorganic constituents: Significance to human nutrition. 11. Food flavours and pigments. 12. Food additives. 13. Toxic substances in food. 14. New trends in food production:

	• Imitation foods • Genetically modified foods. • Functional foods.
Recommended reading	1. Food Chemistry. Book in progress by the authors. 2. D. Boskou, "Food chemistry", 5th Edition, Gartaganis Publications, 2004. 3. H.-D. Belitz, W. Grosch, P. Schieberle, "Food Chemistry", 3rd Edition, Έκδοση, Ed.: S. Rafailidis, Translation: M.D. Papageorgiou, A.I. Varnalis, Publications Tziola, 2007. 4. O.R. Fennema (editor), "Food Chemistry", 3rd edition, Marcel Dekker Inc., 1996.
Teaching and learning methods	Power point presentations or transparencies.
Assessment and grading methods	Final written course examinations
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Chemical Technology I (Principles-Physical and Chemical Processes)**
Course code	ChTe680
Type of course	Compulsory
Level of course	Undergraduate
Year of study	3rd
Semester	6th
ECTS credits	10
Name of lecturer(s)	Drs J. Mikrogiannidis, J. Kallitsis, Ch. Kordulis
Learning outcomes	At the end of this course the student should be able to 1. Apply the Chemical Technology Principles for solving problems related to fluids flow and transfer as well as to the heat transfer taking place in Physical and Chemical Processes. 2. Choose the best conditions for carrying out effectively physical processes such as distillation, drying, washing and evaporation. 3. Choose the right kind of reactor for performing homogeneous chemical reaction. 4. Calculate the volume and determine the suitable performance conditions of homogeneous chemical reactor for the production of certain quantity of a chemical. 5. Determine the rate equation of homogeneous reactions.
Competences	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 productive performance of physical processes and homogeneous chemical processes. 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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Physical Chemistry.
Course contents	Units and Dimensions. Basic Aspects Mass Balance Energy Balance Fluids Flow Measurement of Fluids Flow Fluids Transfer Heat Transfer. Heat Exchangers Distillation (mainly Re-distillation) Humidification and Drying Leaching Evaporation(fundamental aspects) Overview of Chemical Reaction Engineering Interpretation of Batch Reactor Data Introduction to Reactor Design Ideal Reactors for a Single Reaction Design for Single Reactions Design for Parallel Reactions Potpourri of Multiple Reactions Choosing the Right Kind of Reactor
Recommended reading	1. J. Mikrogiannidis, "Fundamental Aspects and Physical Processes of Chemical Technology", Teaching Books Publishing Organization. 2. J. Mikrogiannidis, "Chemical Technology Problems", Teaching Books Publishing Organization. 3. Th. Karapantsios, A. Zoumpoulis, K. Matis, P. Mavros, "Elements of Physical Processes", Tziolas Publications, 2009. 4. O. Levenspiel, "Chemical Reaction Engineering", Translation: F. Pomonis, K. Matis, et al., Kostarakis Publications, 2004. 5. J. Smith, "Chemical Reaction Engineering", Tziolas Publications, 1997. 6. P. Mavros, K. Matis, K. Triantafyllides, "Elements of Chemical Processes", P. Mavros, K. Matis, K. Triantafyllides, Tziolas Publications, 2009. 7. Zoumpoulis, M. Zoumpoulis, N. Kostoglou, K. Lazarides, "Laboratory Exercises of Chemical Dechnology", Tziolas Publications, 2009. 8. N. Kalfoglou, J. Mikrogiannides, J. Kallitsis, C. Gravalos, "Exercises of Physical Processes of Chemical Technology", Publications of University of Patras. 9. Ch. Kordulis, Ch. Fountzoula, K. Goudani, "Laboratory Notes for Chemical Processes", Publications of University of Patras.
Teaching and learning methods	Power-point presentations. Problem-solving seminars. Laboratory exercises performed by the students working in teams of four.
Assessment and grading methods	1. Two written examinations (one in the middle of the semester and one at the end), which substitute the final written one when the student secures the minimum mark of 7.0 in each one of them. 2. Problems given during the corresponding seminars solved by each student (20% addition of the mark of final written examination, taken into account only when the student secures the minimum mark of 5 in the final written examination).

	3. 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). 4. Written examination (80% of the final mark). 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
Language of instruction	Greek

7^{th} Semester

Semi-optional Courses
(two courses/10 ECTS credits)

Course title	**Chemistry and Technology of Materials (Polymers, nanomaterials, catalysts)**
Course code	CtMa781
Type of course	Semi optional
Level of course	Undergraduate
Year of study	4^{th}
Semester	7^{th}
ECTS credits	5
Name of lecturer(s)	Lectures: Dr. J. Kallitsis, Dr. J. Mikrogiannidis Laboratory: Dr. G. Mpokias, Dr. Ch. Papadopoulou, Dr. A. Lycourghiotis, Dr. Ch. Kordulis
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.
Competences	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.
Prerequisites	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.
Course contents	*Polymers* ▪ Introduction-Applications. ▪ Polymer synthesis. ▪ MW characterization. ▪ Physical chemistry of polymer solutions. ▪ Amorphous polymers. ▪ Mechanical properties of polymers. *Nanocomposite materials* ▪ Fullerenes, Carbon Nanotubes. ▪ Other Carbon Nanostructures ▪ Metal Organic Frameworks. ▪ Dendrimers.

	▪ Nanoparticles. *Porous Materials* ▪ Non porous nanocrystals. ▪ Porous nanocrystals-Zeolites. ▪ Ordered Mesoporous amorphous particles (MCM, SBA, etc.). ▪ Foams. ▪ Intraparticle porosity. ▪ Nanoparticles agrigation–Development of Interparticle porosity. ▪ Shaped particles. ▪ Catalytic nanoparticles dispersed on the surface of porous materials.
Recommended reading	1. D.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.
Teaching and learning methods	Power-point presentations. Problem-solving seminars. Laboratory exercises performed by the students working in teams of four.
Assessment and grading methods	1. 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). 2. Written examination (80% of the final mark). 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
Language of instruction	Greek

Course title	**Environmental Chemistry**
Course code	EnCh790
Type of course	Semi optional
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	5
Name of lecturer(s)	Drs S. D. Glavas, H. K. Karapanagioti
Learning outcomes	At the end of this course the student will know: 1. The structure and division of the atmosphere. Units of concentration of air pollutants and their conversion. Formation and destruction of Stratospheric Ozone, with natural and anthropogenic emissions. Formation of ozone hole in the stratosphere of Antarctica.

	2. Planetary Climatic Change. Green house effect. Factors that affect the global warming action of global warming gases. Effects of global warming 3. Air Quality Standards of regulated pollutants: NOx, CO, SO_2, ozone and particulate matter PM10 and PM2.5. Methods of their determination in the atmosphere. 4. Tropospheric ozone. Formation. Destruction. The role of NOx and VOC. Emissions of stationary and mobile sources. Mechanisms of reaction of alkanes-olefins-aromatic hydrocarbons with hydroxyl and nitrate radicals as well ozone. 5. Acid Rain. Definition of acid rain. Dissolution of carbon dioxide in rain water and pH of pure rain. Emissions of NOx and SO_2. Mechanism of transformation of NOx and SO2 to nitric and sulfuric acid in the gaseous and aqueous phase. The role of oxidants of the atmosphere. 6. 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 7. Recognize the differences in wastewater characteristics and the treatment methods required for each type of wastewater. 8. Compare the available analytical methods for measuring wastewater COD and BOD. 9. Describe pollution phenomena for the various water bodies.
Competences	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 Air pollution. 2. Ability to write and present proposals for his research activities. 3. Ability to compare different methodologies for measuring or calculating different parameters. 4. Ability to interact with others on chemical or interdisciplinary problems. 5. Ability to observe the environment and explain everyday phenomena by using his knowledge. 6. Ability to consider the existence of regulations 7. Realization that alternative ways of analysis exist (e.g. using microbes as in the case of BOD measurements)
Prerequisites	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.
Course contents	1. *Structure of the Atmosphere*. Its chemical composition in troposphere and stratosphere. Formation of the Earth;s atmosphere. Division in troposphere and stratosphere. Units of concentration of air pollutants. 2. *Stratospheric ozone*. Formation and destruction of stratospheric ozone. Chapman mechanism. Destruction of stratospheric ozone from man made emissions. Chlorofluorocarbons, Halogenated hydrocarbons. Ozone hole in Antarctica. 3. *Planetary climate change*. Energy balance. Absorption of outgoing radiation by global warming gases. Factor that determine the action of global warming gases. Sources of emissions of carbon

	dioxide, methane, nitrous oxide and chlorofluorocarbons. Scenarios of climate change. Consequences. 4. *Tropospheric Ozone*. Photochemical air pollution. Precursors' Emissions in urban centers. Stationary and mobile sources of NOx and VOC. Mechanisms of transformation of alkanes, olefins and aromatic hydrocarbons under atmospheric conditions and formation of ozone. Hydroxyl and nitrate radicals. Control strategies of photochemical ozone formation. 5. *Acid rain*. Acid rain in US, Scandinavia and Greece. Emissions of NOx and SO2 from stationary sources. Energy production, industry. Mechanisms of transformation of NOx and SO2 to nitric and sulfuric acids in the gaseous and aqueous phase. Nuetralization of atmosphere; acidity. 6. *Elements of Meteorology*. Dry adiabatic lapse rate. Boundary layer. Horizontal and vertical dispersion. Mechanisms of formation of temperature inversions. Synoptic and local winds. 7. *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.* 8. *Basic hydrology, hydrological cycle, groundwater, surface and submarine estuaries, saltwater intrusion, water pollution originating from land pollution.* 9. *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 color from water), chemical sedimentation (solubility product, hardness removal, occurrence and removal of iron and manganese from groundwater), removal of taste and odor, reverse osmosis.* 10. *Municipal and industrial wastewater characteristics, first, second and third grade treatment, sludge treatment.* 11. *Laboratory exercises: COD and BOD measurements.* 12. *Field trips to: desalination plant for drinking water, surface water treatment plant for drinking water, wastewater biological treatment plant, industrial wastewater treatment plant.*
Recommended reading	1. S.D. Glavas, "Introduction to Atmospheric Chemistry", Publications of University of Patras, 2000. 2. S.P. Tsonis, "Water Treatment", Papasotiriou Publications, 2003. 3. S.P. Tsonis, "Waste Treatment", Papasotiriou Publishing, 2004.
Teaching and learning methods	Lectures using power-point presentations (400-500 slides) that are then available at the educational platform eclass.upatras.gr, problem-solving seminars for the instructive solution of problems without and with the use of software in the multimedia laboratory room, laboratory exercises, field trips, a collaborative laboratory semester project for students working in teams of 2-4.
Assessment and grading methods	The grade percentage provided by Karapanagioti is distributed as follows: 1. Laboratory and field trip reports (20% of the final mark, taken into account only when the student secures the minimum mark of 5 in the final written examination). 2. Semester project proposal and report (30% of the final mark, taken into account only when the student secures the minimum mark of 5 in the final written examination). 3. Written examination (50% of the final mark). 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
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Principles and Applications of Nuclear Chemistry**
Course code	NuCh741
Type of course	Semi Optional
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	5
Name of lecturer(s)	Drs M. Soupioni, V. Simeopoulos
Learning outcomes	At the end of this course the student should be able to 1. Know the basic concepts of radiochemistry. 2. Have a concise knowledge of the basic applications of radioactivity in chemistry. 3. Know the basic principles of nuclear instrumentation. 4. Manipulate radioactive substances safely and carry out measurements by using Geiger-Muller counter and scintillation detector. 5. Understand how basic determinations related to radioanalytical techniques are carried out. 6. Know how matter to be shielded and protected from ionizing radiation. 7. Know the process of monitoring exposure to radiation and the units used to measure radiation effects.
Competences	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 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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of General Chemistry.
Course contents	*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, advantages and disantvantages, sources used, kinds of interferences, qualitative and quantitative determination. Types of Activation Analysis (TNAA, ENAA, RNAA) and their applications. *7. Radiotracer Methods* Choice and production of radiotracers. Essential knowledge of Isotope Dilution Analysis. *8. Ion Beam Analysis* Brief description of Rutherford Backscattering and Mossbauer Spectroscopy. *9. Principles of Nuclear Reactors* Multiplication factor, four factor formula, reactor core, critical mass, reactor coolant, moderator, enriched fuels, poisons, excess reactivity, temperature coefficient of reactivity, delay neutrons, breeder reactor. *10. Interactions of radiation with matter* Modes of interactions, Alfa-particle, beta-particle, gamma-ray and neutron interactions, Physical effects of radiation on matter. *11. Health Physics* Radiation quantities and units, Biological Effects of Radiation, Sources of Radiation exposure, Radiation Protection and control.
Recommended reading	1. W.D. Ehmann, D.E. Vance, "Radiochemistry and Nuclear Methods of Analysis", Translation: P. Dimotakis, P. Misailidis, E. Papaeftymiou, et al., Macedonian Publications, 1998. 2. K.H. Lieser, "Nuclear Chemistry and Radiochemistry: Fundamentals and Applications", VCH Publishers, 1997. 3. G.R. Choppin, J. Rydberg, "Nuclear Chemistry-Theory and Applications", 1st Edition, Pergamon Press, 1980. 4. A. Mozumber, "Fundamentals of Radiation Chemistry", Academic Press, 1999.
Teaching and learning methods	Lectures using power-point presentations and multimedia. Problem-solving work by the students.
Assessment and grading methods	1. Written examination (70% of the final mark). 2 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) 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
Language of instruction	Greek

Optional (Elective) Chemical Courses
(one or two courses/10 ECTS credits)

Course title	**NMR Spectroscopy, Molecular Modeling and Design**
Course code	NsMd705
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	5
Name of lecturer(s)	Drs J. Matsoukas, T. Tselios
Learning outcomes	At the end of this course the student should be able to: 1. Present the 2D NMR techniques, ^{1}H-^{1}H /^{13}C/^{15}N, and their importance on identification and conformational analysis of molecules. 2. Analyze and Interpret homo- & hetero- nuclear 2D NMR spectra. 3. Present methods for Conformational Analysis of molecules. 4. Select and apply the most appropriate methods for conformational analysis of molecules. 5. Select and apply the most appropriate Energy Minimization Methods for conformational analysis of molecules.
Competences	At the end of the course the student will have further develope the following skills/competences 1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to 2D NMR, ^{1}H-^{1}H/^{13}C/^{15}N, Molecular Modeling and Molecular Design and to perform assignment of signal resonances in 2D NMR spectra. 2. Ability to apply such knowledge and understanding to the solution of NMR , Molecular Modelling and Molecular Design issues. 3. 2D NMR, Molecular Modelling and Molecular Design skills needed for continuing professional development. 4. Ability to interact with others on inter or multidisciplinary 2D NMR, Molecular Modelling and Molecular Design problems.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of NMR and Organic Chemistry.
Course contents	*1. Principles of NMR and Organology* Fourier Transform (FT) and Continuous Wave (CW) NMR, Organology data, T1 and T2 relaxation time. Inversion Recovery experiment, chemical shift ^{13}C, "Spins Echo" method, APT και DEPT techniques. Examples. *2. 2D NMR* Principles, Hetero nuclei coupling, Hetero nuclei 1D NMR, 2D spectrum theory, Types of 2D spectrums: COSY, TOCSY, RELAY, COLOC, INADEQUATE, Examples. Analysis of 2D homo- & hetero- nuclear NMR spectra. Examples. Evaluation of homo- & hetero- nuclear 2D NMR . *3. Nuclear Overhauser Effect (NOE)* Principles, Effect explanation, NOE and nuclei distance, NOE and rotation time Tc (Correlation Time).

	4. Molecular Modeling Basic Principles, Molecular Graphics, Conformations of Proteins-Peptides, Molecular Surfaces, Potential Energy Surfaces, Computer Simulation Methods-Molecular Mechanics, Energy Minimization and Related Methods for Exploring the Energy Surface. Examples and Applications. *5. Conformational Analysis* Monte Carlo method, Molecular Dynamics-Constraint Dynamics method, Grid Scan method, Boltzmann Jump method. Examples and Applications.
Recommended reading	1. T. Mavromoustakos, J. Matsoukas, "NMR: Principles and Applications in Medicine, Pharmaceutical Chemistry, Biochemistry, Food Chemistry", 1st Edition, G.V. Parisanos, Publications, 2006. 2. T. Mavromoustakos, P. Zoumpoulakis, "Μοριακή Μοντελοποίηση: Εφαρμογές στην Οργανική και Φαρμακευτική Χημεία", 1st Edition, G. Parisanos Publications, 2008. 3. J. Matsoukas, "Modern methods of spectroscopy", Publications of 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. G.L. Patrick, "An introduction to Medicinal Chemistry", 3rd Edition, Oxford University Press, 2005.
Teaching and learning methods	Lectures using slides for overhead projector and/or power-point presentations and appropriate software (Molecular Conceptor II). Problem-solving seminars for 2D NMR and Molecular Modeling-Design. Collaborative problem-solving work by the students working in teams of two.
Assessment and grading methods	1. An assay comprising off a presentation of a subject referred to 2D NMR and Molecular Modeling-Design (groups of two students, 50% of the final mark). 2. Written examination (50% of the final mark) 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
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Synthetic Organic Chemistry**
Course code	SoCh706
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	5

Name of lecturer(s)	Dr Dionysios Papaioannou
Learning outcomes	At the end of this course the student should be able to: 1. Present the most important methods for the preparation of open chain and cyclic mono- and poly-functional compounds (reactions involving interconversion of functional groups and introduction and removal of protecting groups, formation of new C-C and C-heteroatom bonds, and appropriate oxidation or reduction agents/conditions). 2. Apply the principles of retro synthetic analysis to identify the most appropriate disconnections for use in the synthesis of organic molecules of moderate complexity. 3. Evaluate chemical methods for the creation of asymmetric centres and their possible stereo-chemical outcomes in multi-step synthesis. 4. Apply antithetic analysis to propose synthesis of well-known natural products and current drugs. 5. Present the most important methods of asymmetric synthesis and of other current methods of synthesis including synthesis on solid supports, combinatorial synthesis and syntheses involving multi-component reactions and tandem reactions 6. Apply the principles and the methods of asymmetric synthesis to propose syntheses of chiral organic molecules of moderate complexity.
Competences	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, theories and strategic relating to Synthetic Organic Chemistry chemistry 2. Ability to apply such knowledge and understanding to the solution of synthetic 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.
Prerequisites	There are no prerequisite courses. It is, however, recommended that students should have at least a basic knowledge of Organic Chemistry.
Course contents	1. *Preparation and Interconversion of Functional Groups* Syntheses and Reactions of the foolloeing functional groups: Alkanes, Alkenes, Alkynes, Alcohols, Alkyl halides, Ethers-Epoxides, Aldehydes-Ketones, Carboxylic acids-Anhydrides-Acyl chlorides-Esters-Amides-Nitriles, Amines, Aromatic compounds. 2. *Preparation of Functional Groups with C-C Bond Formation* Nucleophilic Carbon Compounds, Electrophilic Carbon Compounds, Syntheses of compounds with one fanctional group Συνθέσεις Ενώσεων με μια Λειτουργική Ομάδα (Alkanes, Alkenes, Alkynes, Alcohols, Aldehydes-Ketones, Carboxylic acids, Nitriles), Syntheses of compounds with two functional groups at positions 1,2-, 1,3-, 1,4-, 1,5- and 1,6- 3. *Methods for the Synthesis of Cyclic Compounds* Types of ring-forming reactions, Factors affecting ring- formation, Methods for the formation of macrocyclic compounds, Methods for the formation of 3-6membered carbocyclic rings 4. *Retrosynthetic (or Antithetic) Analysis*

	Introduction (Transforms or retro-reactions, Target-molecule, Synthons, Equivalent reagents or reactants, Retrons, Types of Transforms), Antithetic Disconnections (disconnections of one and two functional groups at positions 1,2-, 1,3- and 1,5-, Non-obvious disconnections of functional groups at positions 1,2-, 1,4- and 1,6-, Disconnection of the pericyclic type, Disconnections of heteroatoms and heterocycles, Disconnections of small rings), Strategy in Synthesis, Applications of the Retrosynthetic Analysis to the synthesis of natural products. 5. *Asymmetric Synthesis* Chemical [with the use (α) chiral templates, (β) asymmetric induction] and biological methods of asymmetric synthesis, Applications to the synthesis of natural products and drugs. 6. *Current Trends in Synthesis* Solid-phase Synthesis, Combinatorial Chemistry, Multi-component Reactions, Tandem Reactions, Selection of other synthetic methodologies from the current Organic Chemistry research literature.
Recommended reading	1. D. Papaioannou, "Synthetic Organic Chemistry", Papazisis Publications, 1995. 2. J.R. Hanson, "Organic Synthetic Methods" Tutorial Chemistry Texts No. 12, Royal Society of Chemistry, 2002. 3. J.-H. Fuhrhop and G. Li, "Organic Synthesis: Concepts and Methods", 3rd revised 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",JohnWiley & Sons, 2007. 6. Review papers on current trends in synthesis from the Organic Chemistry Literature.
Teaching and learning methods	Lectures using slides for overhead projector or powerpoint presentations. Problem-solving seminars for the instructive solution of synthetic problems. Collaborative problem-solving work by the students working in teams of two.
Assessment ang grading methods	1. Optionally, three assays with synthetic problems solved by groups of two students (the 30% of the mean mark for the three assays is added to the final exams mark, taken however into account only when the student secures the minimum mark of 4 in the final written examination) 2. Written examination (final mark, unless the student participated in the preparation of the afore mentioned all three assays during the semester, in which case the final mark is calculated as described above). 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 holds: 5 (or 5.5) ⇔ E, 6 (or 6.5) ⇔ D, 7 (or 7.5) ⇔ C, 8 (or 8.5) ⇔ B and ≥9 - 10 ⇔ A
Language of instruction	Greek. Instruction may be given in English in case foreign students attended the course.

Course title	**Food Chemistry and Technology-Oenology I**
Course code	FcTo771

Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	10
Name of lecturer(s)	Dr. A. A. Koutinas, Dr. M. Kanellaki, Dr. A. Bekatorou
Learning outcomes	At the end of this course the student will attain knowledge on: 1. The chemistry, nutritional value, microbiology and methods of production of carbohydrate, protein and fat containing foods, juices, alcoholic beverages, and dairy products at industrial, trade or household scale. 2. The industrial practices and new trends for the improvement of quality and production processes of foods, as well as for the production of novel foods with health benefits. 3. The significance of fermentation technology on food production and the connection of biotechnology with the food industry. 4. The application of analytical methods for the determination of food composition.
Competences	At the end of the course the student will have further developed the following skills/competences: 1. Practical skills on the separation and analysis of food components using classical and instrumental analytical techniques. 2. Ability to recognize the role and nutritional value of food components and be able to adapt his dairy diet in order to obtain health benefits and face food associated problems (obesity, diabetes, anaemia, etc.) and to inform other people accordingly. 3. Ability to evaluate the nutritional value and safety of industrialized food. 4. Knowledge of winemaking practices (dry, sweet, semi-sweet, red and white winemaking). 5. Ability to evaluate the effect of processing on food composition and quality. 6. Skills to seek employment in food industries, small scale enterprises and laboratories, which comprise the biggest part of the Greek market. 7. Ability to assess knowledge for the selection of suitable products/technologies for the development of new enterprises for production, processing or analysis of food. 8. Ability to consult food production, processing or analysis enterprises.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry, Biochemistry and Chemical Technology.
Course contents	*Lectures*: 1. *Sugars*: Production of syrups (raisin syrup, date syrup). Sugar production-molasses. Flour-pasta-bread. Sweeteners. Starch and glucose industry. Honey. 2. *Oenology*: Must composition. Must adjustments. Alcoholic fermentation. White dry wine making. Red dry wine making. Sweet wine making (*misteli*). Sparkling wines. *Retsina-Stafiditis* wines. *Mavrodafni* wine. Thermovinification. Wine composition.

Volatile by-products of alcoholic fermentation. Ageing-esterification. Wine defects and spoilage-haze formation. Clarification and finishing. Decanting. Cold stabilization. Filtration/filters. Centrifugation. Anhydrous sulphite in wine making. Pasteurization. Bottling. Oenology mechanics: Grape crushing/crushers. Destemming/destemmers. Presses. Pumps. Types of fermentation bioreactors (fermentation tanks). Must recirculation during fermentation. Wine fillers cappers, packers. Bottle washers. Installation of bottling unit. Wine testing: colour and appearance, aroma and taste, sweet, sour or astringent constituents. Sulphited musts. Vinegar production. Wine and other grape products in human nutrition. Alcoholic beverages: Distillates. *Tsipouro*, *tsikoudia*, *ouzo*, brandy, whiskey, vodka. Potable alcohol from raisins, molasses, cereals and potatoes. Fast alcoholic fermentations using *Saccharomyces cerevisiae* and *Zymomonas mobilis.* Bioreactors. Alcoholic fermentation parameters. Refineries. Liquors.

3. *Brewing*. Malting. Brewing Beer maturation. By-products.
4. *Citrus juice industry*. Raw material. Juice extraction. Juice quality and factors affecting it. Thermal treatment of juice. Juice concentration. Essential oils.
5. *Fats and oils*. Degradation of fats and oils. Raw material and product treatments (purification, decolourisation, deodorization, hydrogenation).
6. *Meat technology*. Composition. Microbiology. Canning. Meat products.
7. *Milk technology*. Composition. Microbiology. Treatments (filtration, cooling, pasteurization, concentration, homogenization, skimming).
8. *Dairy products*.

Laboratory exercises:

1. Analytical presentation of all exercises that will be performed in the laboratory – Assessment.
2. Analysis of flour. (a) Gluten determination, (b) ash determination, (c) detection of oxidants.
3. Analysis of edible oils. Determination of: (a) saponification number, (b) acidity, (c) iodine number, (d) colour reactions, (e) chemical antioxidants and paraffin oil in olive oil by thin layer chromatography.
4. Analysis of milk. Determination of: (a) proteins by the Kjeldahl method, (b) fat by the Gerber method, (c) specific weight.
5. Analysis of total fat in olive pit, cocoa and dried fruit, by Soxhlet extraction.
6. Analysis of sugars in honey. Determination of: (a) reducing sugars, (b) total sugars, and (c) sucrose.
7. Analysis of sugars in honey. Determination of glucose and fructose. Detection of adulteration by synthetic invert sugar and concentrated starch hydrolysate.
8. Oenology. Yeasts. (a) Preparation of liquid culture. (b) Preparation of solid culture. (c) Preparation of liquid culture in grape must for the promotion of wine fermentation. (d) Determination of yeast concentration in fermenting must.
9. Oenology. Examination of grape must and alcoholic fermentation. (a) determination of ^{o}Be density, (b) determination of total acidity, (c) must adjustments, (d) alcoholic fermentation for white wine making, (e) alcoholic fermentation for red sweet

	wine making, (f) production of *misteli* wine, (g) fast alcoholic fermentation by addition of yeast, (h) fermentation kinetics, (i) determination of cell concentrations, (j) microscopic examination of yeasts (observation of healthy yeast cells, dead cells, bacteria), (k) examination of yeast cells before fermentation. 10. Oenology. Chemical analysis of wines: (a) alcoholic degree, (b) total acidity, (c) volatile acidity, (d) sulphite determination (free, bonded and total). 11. Oenology. Post fermentation treatments for red and white wine making. (a) 48-hour monitoring of fermentation: macroscopically and microscopically. Promotion of stuck fermentations by addition of yeast. (b) Cease of fermentation by addition of alcohol for sweet wine making. (c) Confirmation of the end of fermentation. Decanting. Clarification by racking. Fining by egg-white albumin. Addition of sulphur dioxide. Cold-stabilisation. Filtration. 12. Analysis of olive oil and seed oils by gas chromatography. 13. Wine testing. Sensory evaluation of wine aroma and taste.
Recommended reading	1. A.A. Koutinas, M. Kanellaki, "Food Chemistry and Technology", Publication of University of Patras, 2010. 2. E. Voudouris, M. Kontominas, "Introduction to Food Chemistry", OEDB Publications, 2006. 3. H.-D. Belitz, W. Grosch, P. Schieberle, "Food Chemistry", 3rd revised edition, Ed.: S. Rafailidis, Translation: M.D. Papageorgiou, A.I. Varnalis, Tziolas Publication, 2007. 4. . N. Potter, J. H. Hotchkiss, "Food Science", 5th Edition,Chapman & Hall, 1995. 5. O.R. Fennema, "Food Chemistry", 3rd Edition, Marcel Dekker Inc., 1996. 6. Fennema O.R. Food Chemistry. 3rd edit., Marcel Dekker Inc., New York, 1996. 7. R.S. Jackson "Wine Science: Principles and Applications, 3rd Edition, Elsevier, 2008.
Teaching and learning methods	1. Power point presentations or transparencies. Theoretical presentation of laboratory exercises and solution of example calculations. 2. Laboratory exercises by teams of 2-3 students. 3. Visits to food industries/enterprises.
Assessment and grading methods	1. Laboratory exercises (account for 40% of the final mark). Average of: (a) oral and written test examination marks after the end of each exercise, (b) final written laboratory examination mark, and (c) final oral examination mark on Oenology exercises. 2. Final written course examination mark (accounts for 60% of the final mark).
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Chemistry of Organometalic Compounds and Mechanism in Inorganic Reactions**
Course code	CoMi726
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th

Semester	7th
ECTS credits	5
Name of lecturer(s)	Dr N. Klouras
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.
Competences	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 constitution 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.
Prerequisites	General Chemistry, Inorganic Chemistry, Organic Chemistry
Course contents	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.
Recommended reading	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. Omae, "Applications of Organometallic Compounds", John Willey & Sons, 2001.
Teaching and learning methods	Lectures using power-point presentations and personal website. Problem-solving seminars during the lecture presentation.
Assessment and grading methods	Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.
Language of instruction	Greek

Course title	**Special Topics in Physical Chemistry**
Course code	StPc736
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	5

Name of lecturer(s)	Dr G. Karaiskakis
Learning outcomes	At the end of this course the student should be able to: 1. Know the basic physicochemical principles of the physical methods of separation. 2. Apply the basic principles of the mass transport phenomena to the understanding of the resolution of the separation methods. 3. Apply the chromatographic techniques to the determination of basic physicochemical parameters.
Competences	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 principles, concepts and theories relating to the chromatographic techniques especially. 2. Ability to apply such knowledge to the simultaneous determination of essential physicochemical quantities. 3. Study and laboratorial skills needed for continuous professional development.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Physical Chemistry and Analytical Chemistry.
Course contents	1. Physicochemical principles of the physical methods of separation. 2. Mass transport phenomena. 3. Physicochemical applications of the chromatographic techniques.
Recommended reading	1. G. Karaiskakis, "Physicochemical Aspects of the Physical Methods of Analysis", Publications of University of Patras, 2000. 2. R.J. Laub, R.L. Pecsok, "Physicochemical Applications of Gas Chromatography", John Wiley & Sons, 1978.
Teaching and learning methods	Problem-solving seminars for the easier and more complete understanding of the course contents.
Assessment and grading methods	1. Two (2) optional tests. 2. Written final examination. The final mark results from the contribution of the final examination and the optional tests with different weightiness. 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
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Quality Control in Analytical Chemistry**
Course code	QcAc755
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4^{th}
Semester	7^{th}

ECTS credits	5
Name of lecturer(s)	Dr. Th. Christopoulos
Learning outcomes	• Quality characteristics of analytical methods such as: accuracy, reproducibility, repeatability, detectability, sensitivity, specificity, robustness. • Experimental approaches used for the evaluation of the quality characteristics of analytical methods. • 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.
Competences	The student will be able to: • Evaluate the performance of analytical methods and validate analytical methods. • Deal with internal and external quality control. • Carry out method comparison studies. • Organize the accreditation of a laboratory. • Apply ISO to an analytical laboratory. • Develop appropriate sampling strategies.
Prerequisites	None
Course contents	• Quality characteristics of analytical methods such as: accuracy, reproducibility, repeatability, detectability, sensitivity, specificity, robustness. • Experimental approaches used for the evaluation of the quality characteristics of anal. methods. • 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.
Recommended reading	Lecture notes.
Teaching and learning methods	PowerPoint presentation.
Assessment and grading methods	Assignments and written examination.
Language of instruction	Greek or english.

Course title	**Catalysis**
Course code	CaTa791
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	5
Name of lecturer(s)	Dr A. Lycourghiotis
Learning outcomes	At the end of this course the student should be able to: • present the fundamental concepts and methods of the homogeneous and heterogeneous catalysis including enzymatic catalysis, photocatalysis and electrocatalysis. • classify the catalysts and the catalytic reactions in important groups presenting the fundamental aspects of the catalytic action related to each catalytic group. • present the structure and the methods of preparation and characterization of the solid catalysts as well as the assesment of the catalytic performance. • explain the contribution of catalysis in the chemical industry and pollutant devastation as well as in the production and improvement of traditional and environmentally friendly fuels and processes.
Competences	At the end of this course the student should be able to • Select the appropriate catalyst for a given catalytic process-reaction. • Prepare a solid catalyst. • Obtain a clear picture for the surface characteristics of a solid catalyst by combining the results of various characterization techniques. • Design suitable reactors and perform kinetic experiments for testing the activity and selectivity of a catalyst.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge on General, Inorganic, Organic and Analytical Chemistry as well as on Chemical Reactors.
Course contents	• Introduction • Catalysis by acids and bases in solutions • Catalysis by transition metal complexes in solutions • Enzyme Catalysis • Acid-Base Catalysis at surfaces-zeolites • Partial oxidation on transition metal oxides • Catalysis by metals • Hydro treatment of oils over supported metal sulfides • Photocatalysis • Electrocatalysis • Structure and texture of the solid catalysts • Synthesis of catalytic supports and non-supported catalysts • Synthesis of supported catalysts • Determination of geometrical characteristics of solid catalysts • Determination of chemical characteristics of solid catalysts • Determination of kinetic parameters : Laboratory catalytic reactors

	• Surface kinetics • Literature
Recommended reading	1. A. Lycourghiotis and Ch. Kordulis, "Catalysis (an undergraduate course)", Publications of University of Patras, 2010. 2. A. Lycourghiotis, "Introduction to Contact Catalysis", Stamoulis Publications, 1987. 3. I.M. Campbell, "Catalysis at Surfaces", Chapman and Hall Ltd., 1988. 4. R.A. Van Santen, "Theoretical Heterogeneous Catalysis", World Scientific Lecture and Course Notes in Chemistry, Vol. 5, World Scientific Publishing Co., 1991. 5. B. C. Gates, "Catalytic Chemistry", The Wiley Series in Chemical Engineering, Wiley, 1992. 6. 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. 7. J.M. Thomas, W.J. Thomas, "Principles and Practice of Heterogeneous Catalysis, VCH, 1997. 8. G. Ertl, H. Knözinger, F. Schüth, J. Weitkamp (editors), "Handbook of Heterogeneous Catalysis", Volumes 1-8, 2nd Edition, Wiley-VCH, 2008. 9. R.J. Wijngaarden, A. Kronberg, K.R. Westerterp, "Industrial Catalysis: Optimizing Catalysts and Processes", Wiley-VCH Verlag GmbH, 1998. 10. B. 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. 11. J. Hagen, "Industrial Catalysis: A Practical Approach", 2nd Edition, Wiley-VCH Verlag GmbH, 2006. 12. A. Lycourghiotis and Ch. Kordulis, "Catalysis", Volume I, Helenic Open University, 2003. 13. Ch. Kordulis and A. Lycourghiotis, "Catalytic Surfaces", Helenic Open University, 2003.
Teaching and learning methods	Lectures and tutorials using power-point presentations.
Assessment	Written examinations during the course or final written examinations
Language of instruction	Greek.

Course title	**Biochemistry III (Gene expression and regulation–Genetic engineering)**
Course code	GeRe712
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	5
Name of lecturer(s)	Dr. D. Vynios, Dr. A. Theocharis
Learning outcomes	At the end of this course the student should be able to: 1. Present the most important aspects of gene expression and regulation.

	2. Recognise the critical steps of gene expression. 3. Evaluate the specificity of gene expression and possible applications in genetic engineering. 4. Combine and apply the appropriate methodologies for the production of recombinant proteins.
Competences	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 gene expression. 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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Biology and Biochemistry.
Course contents	1. Gene expression. 2. Regulation of gene expression, hormonal and epigenetic regulation, the role of chromatin, of histones, and of protein-protein interactions in gene expression. 3. Post-transcriptional regulation of gene expression. 4. RNA interference. 5. Genetic engineering. 6. Restriction enzymes. 7. PCR. 8. Recombinant DNA technology. 9. DNA manipulation. 10. Cell transfection. 11. Recombinant proteins.
Recommended reading	1. 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. 2. B. Lewin, "Genes VIII", Volume I και II, 8th Edition, Translation.: G. Stamatogiannopoulos, University Publications I. Mpasdras, 2004.
Teaching and learning methods	Lectures using power-point presentations and multimedia. Problem-solving work by the students.
Assessment ang grading methods	1 Written examination of the theory (2/3 of the final mark) 2 Oral presentations by the students (1/3 of the final mark) Both marks should be ≥5. 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
Language of instruction	Greek

Course title	**Clinical Chemistry**
Course code	ClCh713
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	7th
ECTS credits	5
Name of lecturer(s)	Dr. N. Karamanos, Dr. A. Theocharis
Learning outcomes	At the end of this course the student should be able to: 1. Recognize and apply the basic analytical techniques and methods of evaluation in the clinical chemistry laboratory. 2. Evaluate the analytical data of the clinical laboratory in regards to the pathophysiological situations.
Competences	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 related to clinical chemistry. 2. Ability to apply such knowledge and understanding to clinical chemistry laboratory and to expand his/her education to more complex issues of clinical 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.
Prerequisites	There are no prerequisite courses. It is however recommended the students should have at least a basic knowledge of biochemistry and general biology.
Course contents	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, localization. 4. Analysis of carbohydrates, lipids and lipoproteins Control of carbohydrates, lipids and lipoproteins in pathological situations. 5. Control of endocrine system Control of thyroid, suprarenal glands, hypophysis and gonads. 5. Acid-base balance, electrolytes and renal function Control of acid-base balance, electrolyte concentration and renal function. 6. Control of hepatic, gastric, pancreatic and intestinal function Control of hepatic, gastric, pancreatic and intestinal function. Indicators of dysfunction. 7. 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.
Recommended reading	1. I. Georgatsos, P. Arzoglou, "Principles of clinical chemistry", Giaxoudis-Giapoulis Publications, 1999. 2. A. Skorilas, "Principles of clinical chemistry and molecular diagnostic", Symmetria Publications, 2009. 3. P. Karlson, W. Gerok, W. Grob, "Clinical Pathobiochemistry", Translation: K. Sekeris, Litsas Medical Publications, 1993.
Teaching and learning methods	Lectures using PowerPoint presentations.
Assessment and grading methods	Written examinations.
Language of instruction	Greek

8th Semester

Semi-optional Courses
(three courses/15 ECTS credits)

Course title	**Chemical Technology-2 (Special Topics of Physical and Chemical Processes)**
Course code	ChTe882
Type of course	Semi-Optional
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. J. Kallitsis, Dr. Ch. Kordulis
Learning outcomes	At the end of this course the student should be able to 1. apply the Chemical Technology Principles for solving problems related to mass and heat transfer taking place in Advanced Physical and Heterogeneous Chemical Processes, 2. choose the best conditions for carrying out effectively physical processes such as diffusion masstransfer, size reduction membranes separations etc., 3. determine deviation from the ideal flow in chemical reactors, 4. choose the suitable performance conditions of heterogeneous chemical reactors, 5. determine the rate equation of heterogeneous reactions, 6. solve problems related to bio-reactors.
Competences	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 productive performance of advanced physical processes and heterogeneous chemical processes. 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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Chemical Technology-1 and Physical Chemistry.
Course contents	Physical Processes. Diffusion and Mass Transfer Size reduction and Mechanical Separations Crystallization Membrane Separation Processes Gas Absorption Liquid Extraction Chemical Processes Basics of Non-Ideal Flow Heterogeneous Reactions Solid Catalyzed Reactions

	The Packed Bed Catalytic Reactor Biochemical Reaction Systems
Recommended reading	«Unit operations of Chemical Engineering» McCabe, Smith, Harriott, (Translated in Greek language) McGraw-Hill Editions. «Physical Processes». I. Gentekakis, (Written in Greek language) Kleidarithmos Editions, 2010. "Chemical Reaction Engineering", O. Levenspiel, (Translated in Greek language) Kostarakis Editions, Athens, 2004. "Elements of Chemical Processes", P. Mavros, K. Matis, K. Triantafyllides, (Written in Greek language) Tziolas Editions, Thessalonica, 2009. 1. W.L. McCabe, J.C. Smith, P. Harriott, "Unit operations of chemical engineering", 6th Edition, Translation: S. Polymatidou, Tziolas Publications, 2002. 2. I. Gentekakis, "Physical processes: analysis and design" Kleidarithmos Publications, 2010. 3. O. Levenspiel, "Chemical reaction engineering", Translation: F. Pomonis, K. Matis, N. Papagiannakos, et al., Kostarakis Publications, 2004. 4. P. Mavros, K. Matis, K. Triantafyllides, "Elements of chemical processes", Tziolas Publications, 2009.
Teaching and learning methods	Power-point presentations. Problem-solving seminars. Laboratory exercises performed by the students working in teams of four.
Assessment and grading methods	1) Two written examinations (one in the middle of the semester and one at the end), which substitute the final written one when the student secures the minimum mark of 7.0 in each one of them. 2) Problems given during the corresponding seminars solved by each student (20% addition of the mark of final written examination, taken into account only when the student secures the minimum mark of 5 in the final written examination) 3) Written examination 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
Language of instruction	Greek

Course title	**Chemistry of Heterocyclic Compounds and Natural Product**
Course code	ChNp807
Type of course	Semi-optional
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. T. Tsegenidis, Dr. G. Tsivgoulis
Learning outcomes	At the end of this course the student should be able to 1. To name 3-6 membered aromatic or saturated heterocyclic compounds with one or more heteroatoms. 2. To describe and write mechanisms for the most important reactions for the synthesis of heterocyclic compounds like

	oxiranes, oxetanes, pyrroles, indoles, furans and thiophenes, pyridines, quinolines and isoquinolines, triazoles, tetrazoles, purines and pyrimidines. 3. Compare the aromaticity of pyrrole, furan, thiophen and pyridine with that of benzene, showing similarities and differences. Explain the different effect that nitrogen has on the chemistry of pyrrole and pyridine in realizing their contrasting chemical behavior. Relate the differing chemistry of pyrrole, furan and thiophene to the influence of the heteroatom. 4. Predict the site of electrophilic or nucleophilic (where applicable) attack on heterocyclic compounds like pyrrole, furan, thiophen, pyridine, indole, quinoline and isoquinoline. 5. Recognize features of general organic chemistry in given examples of the chemistry of natural products. Predict the behaviour of natural products under given reaction conditions based on a knowledge of general organic chemistry. 6. Recognize a given natural product as belonging to (a) the shikimic acid pathway, (b) the polyketide patway, (c) the mevalonic acid pathway, (d) the amino acids, peptides and proteins, (e) the alkaloids and (f) the *N*-heteroaromatics families of natural products. 7. Explain the ways through which the various living organisms in the environment communicate, react and defend. 8. Identify isoprene units in a given terpene using the isoprene rule. Propose a possible primary structure for a given oligopeptide based on chemical and biochemical information. 9. Devise a synthetic sequence for the synthesis of a given oligopeptide and a given oligonucleotide using appropriate protecting groups and coupling agents/conditions. 10. Utilize the chemistry of the functional groups of a monosaccharides in order to identify an "unknown" carbohydrate. 11. Propose a synthetic sequence for the preparation of a given disaccharide.
Competences	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, theories and applications relating to Heterocyclic Chemistry and Natural Product Chemistry 2. Ability to apply such knowledge and understanding to the solution of problems related to Heterocyclic Chemistry and Natural Products Chemistry 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.
Prerequisites	There are no prerequisite courses. It is, however, recommended that students should have at least a basic knowledge of Organic Chemistry.
Course contents	*1. Chemistry of Heterocyclic Compounds (26 hours)* Systematic nomenclature of heterocyclic compounds. Structure, synthesis, reactions and applications of the most interesting heterocyclic compounds with one or more heteroatoms, simple and fuzed. These include: • Three-membered heterocycles (oxirane, aziridine, dioxirane)

	• Four-membered heterocycles (oxetane, azetidine/azetidin-2-one) • Five-membered heterocycles (furan, pyrrole, thiophene, benzofuran, indole, oxazole, imidazole, triazoles, tetrazole • Six-membered heterocycles (pyridine, quinoline, isoquinoline, pyrimidine, purine, pteridine). *2. Natural Products Chemistry (26 hours)* Primary and Secondary Metabolism. Chemical Ecology (Introduction, plant-animal, animal-animal, plant-plant and plant-microorganism relationships). Carbohydrates and primary metabolites. The shikimic acid pathway (aromatic amino acids, cinnamic acids, coumarins, quinines, lignins). The polyketide pathway (fatty acids, prostaglandins, macrolides, anthraquinones, flavonoids, tropolones). The mevalonic acid pathway (The terpenes). Amino acids, peptides and proteins. The Alkaloids. *N*-Heteroaromatics (pyrimidines, purines, noukleotides, pteridines, pyrroles, porphyrines).
Recommended reading	1. T. Eicher, S. Hauptmann, A. Speicer, "The Chemistry of Heterocycles: Structure, Reactions, Syntheses, and Applications", 2nd Edition, Wiley-VCH, 2003. 2. T.L. Gilchrist, "Heterocyclic Chemistry", 3rd Edition, Longman, 1997. 3. K.B.G. Torssell, "Natural Product Chemistry: A Mechanistic, Biosynthetic and Ecological Approach", 2nd Edition, Apotekarsocieteten, Sweden Pharmaceutical Society, 1997. 4. J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthorpe, J.B. Harborne, "Natural Products: Their Chemistry and Biological Significance", Longman Scientific & Technical, 1994.
Teaching and learning methods	Lectures using slides for overhead projector or powerpoint presentations. Problem-solving seminars for the instructive solution of problems related to the heterocyclic chemistry and the chemistry of natural products. Collaborative problem-solving work by the students working in teams of two.
Assessment ang grading methods	1. Optionally, three assays with heterocyclic chemistry (two) and natural product chemistry (one) related problems solved by groups of two students (the 30% of the mean mark for the three assays is added to the final exams mark, taken however into account only when the student secures the minimum mark of 4 in the final written examination) 2. Written examination (2 questions on heterocyclic chemistry and 2 questions from natural product chemistry, final mark, unless the student participated in the preparation of the afore mentioned all three assays during the semester, in which case the final mark is calculated as described above). 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 holds: 5 (or 5.5) ⇔ E, 6 (or 6.5) ⇔ D, 7 (or 7.5) ⇔ C, 8 (or 8.5) ⇔ B and ≥9 - 10 ⇔ A

Language of instruction	Greek. Instruction may be given in English in case foreign students attended the course.

Course title	**Computational Chemistry**
Course code	CoCh837
Type of course	Semi-Optional
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Lectures: Dr. G. Maroulis Laboratory: Dr. G. Maroulis
Learning outcomes	At the end of this course the student should be able to use computers to solve advanced problems in all fields of Chemistry
Competences	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.
Prerequisites	There are no prerequisite courses.
Course contents	A. Introduction to the use of computers/PCs to problem solving in Analytical Chemistry, Organic Chemistry, Physical Chemistry and Quantum Chemistry. Analysis of chemical information. Pattern recognition. Similarity and clustering. More general applications of computers: Cosmochemistry and Quantum Pharmacology. Artificial Intelligence. B. Dissociation of monoprotic acids. Dissociation of polyprotic acids H_nA Study of Mixtures of acids Finding the PH of a $Na_mH_{n-m}A + H_nA$ mixture Solubility in saturated solutions Titration simulation Maxwell-Boltzman distribution Propeties of the wavefunction of Schrödinger’s equation.
Recommended reading	1. K. Ebert, H. Ederer and T.L. Isenhour, “Computer Applications in Chemistry”, VCH, 1989.
Teaching and learning methods	Lectures and Laboratory.
Assessment ang grading methods	Written examination.
Language of instruction	Greek.

Course title	**Structural Chemistry**
Course code	StCh861
Type of course	Semi-Optional
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr V. Nastopoulos

Learning outcomes	At the end of this course the student should be able to 1. Have a good understanding of the three-dimensional architecture of the various types of crystal structures. 2. Recognize the structural differences among the various types of crystal structures, and the impact of the structure upon their chemical and physicochemical properties and behaviour. 3. Combine and apply the knowledge obtained in other fields of Chemistry (e.g. Inorganic, Organic, Biochemistry etc) in which certain notions and principles of structural chemistry are necessary and useful. 4. Understand the principles and the basics of a crystal/ molecular structure determination.
Competences	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 concepts, principles and applications that are related to the structure of the various types of crystalline materials. 2. Ability to apply such knowledge to the solution of problems in other fields of Chemistry or inter/multidisciplinary problems. 3. Ability to use computers, specialized software and structural databases in order to investigate unfamiliar structural problems. 4. Study skills needed for continuing professional development.
Prerequisites	There are no prerequisite courses. It is, however, recommended that students should have a basic knowledge of General Chemistry.
Course contents	Crystalline and amorphous state of matter. Crystal lattice, unit cell. Symmetry, point groups, chirality, crystal systems, Bravais lattices, space groups. Types of crystalline compounds. Chemical bonds in crystals. Metals and alloys. Ionic crystals, coordination, lattice energy. Covalent crystals, molecular crystals. Structure of macromolecules, polymers, nanostructures etc. Liquid crystals. Representative compounds. Basics of crystallochemistry. Crystal growth and defects. Crystal structure-properties relationship. Principles of crystal structure determination: X-ray, neutron and electron diffraction, powder methods, electron microscopy. Training with structural models, educational software, three-dimensional representation of crystal and molecular structures. Application to chemical and pharmaceutical molecules and biomolecules (proteins, DNA, RNA, complexes, viruses etc). Exploring the structural databases - Data mining.
Recommended reading	1. V. Nastopoulos, "Structural Chemistry", Publications of University of Patras, 2009. 2. S.M. Allen, E.L. Thomas, "The Structure of Materials", MIT Series in Materials science and Engineering, John Wiley & Sons, 1998. 3. W. Massa, "Crystal Structure Determination", 2nd Edition, Springer-Verlan, 2004.
Teaching and learning methods	Lectures using power-point presentations, structural models and multimedia. Training with models, educational software, three-dimensional representation of crystal and molecular structures. Application to representative crystal structures. Exploring the structural databases - Data mining and retrieval.

	Problem-solving.
Assessment ang grading methods	1. Problem-solving by the students (20% of the final mark). 2. An assay at the end of the semester by each student (20% of the final mark). 3. (1 and 2 are taken into account only when the student secures the minimum mark of 5 in the final written examination). 4. Written examination (60% of the final mark). 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
Language of instruction	Greek

Optional (Elective) Courses
(one course/5 ECTS credits)

Course title	**Food Biochemistry**
Course code	InMd814
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr A. Aletras
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.
Competences	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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry and Biochemistry.
Course contents	1. Carbohydrates. The role of carbohydrates in foods. Changes of carbohydrates during foods processing (Hydrolysis, crystallization, isomerisation, dehydration, non-enzymatic browning). 2. 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, color, taste and smell of lipids. 3. 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. 4. Natural pigments in foods. Chlorophylls, carotenoids, phenolic compounds. 5. Biochemical processes, occurred during fruits ripening and meat tenderization that affect the food texture, color, taste and smell. 6. 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. 7. Enzymatic browning. Reaction mechanism, polyphenolases. Methods of enzymatic browning control and restriction. 8. Vitamins. Fat-soluble and water-soluble vitamins. Vitamins in foods. Vitamins loss during foods processing. 9. Food additives. Conservatives, taste and smell additives, pigments, structure additives. 10. Alterations of foods by microorganisms (Biodegradation).
Recommended reading	1. A. Vafopoulou-Mastrogiannaki, “Food Biochemistry”, Ziti Publications, 2003. 2. D. Galanopoulou, J. Zampetakis, M.-Mavri-Vavagianni, A. Siafaka, “Food Biochemistry”, Stamoulis Publications, 2007.
Teaching and learning methods	Lectures using power-point presentations and/or slides for overhead projector.
Assessment and grading methods	Written examination. 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
Language of instruction	Greek

Course title	**Introduction to Molecular Design**
Course code	InMd838
Type of course	Optional (Chemical)
Level of course	Undergraduate

Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. G. Maroulis
Learning outcomes	Nature and energetic content of the chemical bond, calculation and plotting of HOMO-LUMO. Calculation of the molecular geometry.
Competences	At the end of the course the student will have further developed the use of advanced and specialized software for wider application in chemistry: spectroscopy, molecular modelling in Organic and Inorganic Chemistry.
Prerequisites	Physical Chemistry II and Computational Chemistry.
Course contents	• Chemical Graph Theory. • Topological Matrix and Hückel 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 stryct, ure of small molecules. • Peptides and proteins. • Structure and conformation in oligopeptides.
Recommended reading	1. A. Hinchliffe, “Molecular Modelling for Beginners”, Wiley, 2008.
Teaching and learning methods	Lectures and laboratory practice.
Assessment ang grading methods	Compulsory project and/or Written examination.
Language of instruction	Greek.

Course title	**Bioinorganic Chemistry**
Course code	BiTe815
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. E. Manesi-Zoupa
Learning outcomes	At the end of this course the student should 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.
Competences	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 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 present literature reports.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a good knowledge of Coordination Chemistry and an elementary knowledge in Biology.
Course contents	1. Bioinorganic Chemistry: Introduction a) Definitions. b) Metal functions in metalloproteins. c) Metal functions in metalloenzymes. d) Communication roles for metal ions in Biology. e) Interactions of metal ions and nucleic acids. f) Metal-ion transport and storage in Biology. g) Metals in Medicine. 2. Properties of Biological Molecules a) Proteins. b) Nucleic acids. c) Other metal-binding biomolecules. 3. Physical Methods in Bioinorganic Chemistry a) Time scales. b) X-ray methods. c) Spectroscopic methods. d) Magnetic measurements. e) Electrochemistry. 4. Choice, Uptake and Assembly of Metal-Containing Units in Biology a) Bioavailability of metal ions. b) Intracellular chemistry of metal ions. c) Spontaneous self-assembly of metal clusters. 5. Control and Utilization of Metal-Ion Concentration in Cells a) Beneficial and toxic effects of metal ions. b) The generation and uses of metal-ion-concentration gradients.

	6. Metal-Ion Folding and Cross-Linking of Biomolecules a) Stabilization of protein structure by metal ions. b) Stabilization of nucleic acid structure by metal ions. c) Protein binding to metallated DNA. d) Metallointercalators. 7. Binding of Metal Ions and Complexes to Biomolecule-Active Centers a) Selection and insertion of metal ions for protein sites. b) Preservation of electroneutrality. c) Metal-ion and metal-complex binding to nucleic acids. 8. Electron-Transfer Proteins a) Electron carriers. b) Long-distance electron transfer. 9. Substrate Binding and Activation by Nonredox Mechanisms a) Hydrolytic enzymes. b) Carbonic anhydrase and alcohol dehydrogenase. c) Nucleotide activation. 10. Atom- and Group-Transfer Chemistry a) Dioxygen transport. b) Oxygen-atom-transfer reactions. c) The Cu-Zn superoxide dismutase, catalase and peroxidases. 11. Metal Complexes in Medicine a) Metal complexes in nutrition. b) Anticancer activity of metal complexes. c) Diagnostic agents. d) Chelation therapy for removal of iron overload and toxic overloads of other metal ions. 12. Bioinorganic Catalysis a) Introduction. b) Catalysis by nitrogenases and synthetic analogs. c) Catalysis by nickel in biological systems. d) Oxygen activation at nonheme iron centers.
Recommended reading	1. S.J. Lippard, J.M. Berg, "Principles of Bioinorganic Chemistry", University Science Books, 1994. 2. R.M. Roat-Malone, "Bioinorganic Chemistry: A Short Course", Wiley-Interscience, 2002. 3. R.W. Hay, "Bioinorganic Chemistry", Translation: E. Manesi-Zoupa, D. Raptis, Papazisis Publications, 1992.
Teaching and learning methods	Lectures using slides for overhead projector and power-point presentations. Problem-solving seminars. Collaborative problem-solving work and presentations by the students working in pairs.
Assessment ang grading methods	1. Written examination (50% of the final mark). 2. An assay comprising the writing of one literature report accompanied by an oral presentation (50% of the final mark).
Language of instruction	Greek

Course title	**Biotechnology**
Course code	BiTe815
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th

ECTS credits	5
Name of lecturer(s)	Dr. D. Vynios
Learning outcomes	At the end of this course the student should be able to 1. Present the most important applications of biological processes for the industrial (large scale) production of chemicals, pharmaceuticals, food and food additives, fuels, etc. 2. Recognise the critical steps in industrial processes. 3. Evaluate the methodologies for biotechnological products production. 4. Combine and apply the appropriate methodologies for the production of new chemicals, pharmaceuticals, etc.
Competences	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 Biotechnology 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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Biology, Biochemistry, Molecular Biology, Mikrobiology, Chemical Technology and Organic Chemistry.
Course contents	1. Historical background. 2. Microbial culture growth (upstream processing): kinetics and bioreactors. 3. Biotechnological applications of microorganisms. 4. Downstream processing: large scale separation, purification and production of proteins and enzymes. 5. Immobilised biocatalysts and their applications. 6. Protein and enzyme modifications. 7. Biocatalysis, biotransformation in organic solvents. 8. Animal cell cultures, monoclonal antibodies. 9. Genetic engineering and applications. 10. Laboratory excercises a. Isolation and characterisation of alcohol dehydrogenase from yeast. b. Immobilisation of enzymes on various solid pases and their application in different types of bioreactors. c. Enzymatic reactions in organic solvents. d. Applications of enzymes in food industry and environment (Multimedia). e. Pharmacogenomics (Multimedia).
Recommended reading	1. D.A. Kyriakides, "Biotechnology", 2nd Edition, Zitis Publications, 2002. 2. V. Moses, R.E. Cape, D.G. Springham (editors), "Biotechnology: The Science and the Business", Harwood Academic Publishers, 1999. 3. D. Vynios, "Laboratory Practice in Biotechnology",

	Publications of University of Patras.
Teaching and learning methods	Lectures using power-point presentations and multimedia. Laboratory excercises of biotechnological applications. Problem-solving work by the students.
Assessment ang grading methods	1 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) 2 Written examination (30% of the final mark) 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
Language of instruction	Greek.

Course title	**Organic Industrial Products and Green Chemistry**
Course code	OpGc808
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. C. Poulos
Learning outcomes	At the end of this course the student should be able to 1. Present a)the most important methods for the preparation of chemicals which are necessary for the quality of life of our society and b) methods and processes that protect our health, the environment and promote sustainable development. 2. Apply the principles of green chemistry for a) the design of products that are safe for man and the environment b) the design of innovative processes for sustainable industry and c) the design of products from renewables. 3. Evaluate chemical processes that produce less wastes (liquids, solids, gases) necessary factors for sustainability. 4. Use and apply the principles of the principles of green chemistry in the design and synthesis of organic compounds that are used in every day life.
Competences	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 he design and production of safe for health and environment organic products. 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.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry.
Course contents	*1. Green Chemistry* Philosophy, principles, tools. *2. From lab to industrial scale* *3. Basic raw materials-Petrochemical processes –Biorefinery* Biomass, biorefinery, goal, natural gas, petroleum. Fractional distillation, petrochemical processes, applications of petrochemical processes, catalytic alkylations. *4. Aromatic intermediate materials* Raw materials, industrial processes: electrophilic substitution, halogenation, nitration, soulphonation, carboxylation, Friedel-Craft alkylation, diazonium salts as electrophiles, oxidation-reduction. Benzene derivatives and its application to industrial production of phenol, chlorobenzene, 2,4,5-trichlorophenol (TCP). Naphalene derivatives, Organic products for production of everyday goods applying green processes. Food additives, antioxidants, hair colours, sun protecting agents, photography materials, polymers from biomass, green solvents. *5. Fats and oils* Chemical composition and chemical reactions of fat and oils, fatty alcohols, fatty acids and esters, production of biodiezel. *6. Soaps* Classes, action, production. *7. Detergents* Synthetic detergents, classes, synthesis of cationic, anionic and non-ionic detergents, applications. *8. Paints* Introduction and applications to textile industry. *9. Explosives* *10. Agrochemicals* History, definition and their necessity, properties and classes, Natural pesticides: nicotinoides, rotenoids, pyrethroids, Decamethrine synthesis, all classes of synthetic pesticidesand their action, philosophy of the new generation of pesticides, phytohormones and growth regulators: growth hormones, ethylene, hormone inhibitors, strigol, Glycinoecleptin A, hormones and growth factors of insects, immune system in insects, pheromones, nitrogen fixation and photosynthesis. *11. Pharmaceuticals* Definition and necessity, disinfectants, sulphonamides, medicines for tuberculosis, antibiotics, steroids, drugs which caused social revolutions in the 20th century. Green chemistry and pharmaceutical industry. *12. Sweetwners* Definition and necessity, natural sweeteners, synthetic sweeteners: derivatives of sulphamic acid, saccharine, aspartame. *13. Fragrances* Definition, natural and synthetic fragrances.
Recommended reading	1. C. Poulos, "Industrial Organic Products", Publications of University of Patras. 2. H.A. Wittcoff, B.G. Reuben, J.S. Plotkin, "Industrial Organic Chemicals", John Wiley & Sons Inc, 2004. 3. M.M. Green, H.A. Wittcoff, "Organic Chemical Principles

	and Industrial Practice", Wiley-VCH, 2003. 4. B.G. Reuben, H.A. Wittcoff, "Pharmaceutical Chemicals in Perspective", John Wiley & Sons Inc., 1989. 5. H.O. House, "Modern Synthetic Reactions", The Benjamin/Cummings Publishing Co, 1972. 6. J. Fuhrhop, G. Penzlin, "Organic Synthesis", Verlag Chemie, 1984. 7. K. Weissermel, H.-J. Arpe, "Industrial Organic Chemistry", 3rd Edition, VCH, 1997. 8. P. Anastas, T. Williamson, "Green Chemistry", Oxford University Press,1998. 9. D. Warren, "Green Chemistry: A resource outlining areas for the teaching of green and environmental chemistry and sustainable development for 11-19 year old students", Royal Society of Chemistry, 2001. 10. P. Tundo, P. Anastas (editors), "Green Chemistry: Challenging Perspectives", Oxford University Press, 2000. 11. P.T. Anastas, J.C. Warner, "Green Chemistry: Theory and Practice", Translation: K. Ampeliotis, M. Kapassa, P. Siskos, Creta University Press, 2007. 12. M. Lancaster, "Green Chemistry: An Introductory Text", Royal Society of Chemistry, 2002. 13. J. Clark, D. MacQuarrie (editors), "Handbook of Green Chemistry and Technology", Blackwell Science, 2002. 14. A.S. Matlack, "Introduction to Green Chemistry", Marcel Dekker, Inc., 2001.
Teaching and learning methods	Lectures using slides for overhead projector and/or power-point presentations. Problem-solving seminars for the instructive solution of synthetic problems. Collaborative problem-solving work by the students working in teams of two or three.
Assessment ang grading methods	• A group of 2 or 3 students write an essay (min.15 pages A4) on a topic chosen from those in the course content and after searching the literature (40% of the final mark). • They present their work orally using PowerPoint (40% of the final mark). • After the presentation are asked questions from the instructor (20% of the final mark).
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Science of Polymers**
Course code	PoSc883
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. I. Mikrogiannidis
Learning outcomes	At the end of this course the student should be able to 1. Know the basic synthetic methods of polymers using the step-growth, free radical, anionic and cationic polymerization. 2. Know the most important industrial polymers, their synthetic methods, properties and technological applications.

	3. Know the methods for the synthesis of copolymers and particularly of graft and block copolymers. 4. Combine and apply the appropriate methods for the production of new polymers and forecast their properties.
Competences	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 concepts and methods for the synthesis of polymers with different chemical structures and properties. 2. Ability to recognize various polymers and suggest methods for their synthesis. 3. Ability to work in the production and processing of polymers.
Prerequisites	There are no prerequisite courses**.** It is however recommended that students should have at least a basic knowledge of Organic Chemistry.
Course contents	*1. **Introduction**.* 1.1. Classification and basic definitions. 1.2. Nomenclature. ***2. Step-growth polymerization.*** 2.1. Polyesters. 2.2. Polyamides. 2.3. Polyurethanes. 2.4. Epoxy resins. 2.5. Thermosetting polymers. 2.6. Heat-resistant polymers. 2.7. Kinetics. *3. **Free radical addition polymerization**.* 3.1. Initiators. 3.2. Chain growth. 3.3. Termination. 3.4. Steady-state kinetics. 3.5. Industrial polymers prepared through free radical polymerization. 3.6. Inhibitors and retarders. 3.7. Free radical transfer. *4. **Ionic polymerization**.* 4.1. Anionic polymerization. 4.2. "Living" polymers. 4.3. Cationic polymerization. *5. **Copolymerization*** 5.1. General characteristics. 5.2. Random copolymers. 5.3. Alternating copolymers. 5.4. Graft copolymers and methods for their synthesis. 5.5. Block copolymers and methods for their synthesis.
Recommended reading	1. A.D. Dondos, "Synthetic Macromolecules ", Kostarakis Publications., 2002. 2. G.P. Karayannidis, E.D. Sideridou, "Polymer Chemistry", Ziti Publications, 2006. 3. J.M.G. Cowie, "Polymers: Chemistry & Physics of Modern Materials", Blackie Academic & Professional, 1994. 4. G. Odian, "Principles of Polymerization" John Wiley Inc., 1991. 5. C.E. Carraher, "Seymour/Carraher's "Polymer Chemistry", 6th Edition, Marcel Dekker Inc., 2003.
Teaching and learning	Lectures and problem-solving seminars for the synthesis of

methods	polymers and their precursors.
Assessment ang grading methods	Write examination
Language of instruction	Greek

Course title	**Special Topics of Environmental Chemistry**
Course code	StEc892
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. S. D. Glavas, Dr. H.K. Karapanagioti
Learning outcomes	At the end of this course the student should be able to 1. Comprehend the main sources of air pollution with regard the tropospheric ozone, acid rain and climatic change. 2. Describe the nutrient cycle in the environment 3. Choose methods to analyze for nutrients 4. Use pC-pH diagrams and respective codes 5. Describe the distribution of organic pollutants in the aqueous environment 6. Use predictive tools to estimate the organic pollutant distribution properties in the environment.
Competences	At the end of the course the student will have further developed the following skills/competences 1. Ability to write and present proposals for his research activities. 2. Ability to compare different methodologies for measuring or calculating different parameters. 3. Ability to interact with others on chemical or interdisciplinary problems. 4. Ability to observe the environment and explain everyday phenomena by using his knowledge. 5. Ability to consider the existence of regulations 6. Realization that alternative ways of analysis exist (e.g. using microbes as in the case of BOD measurements)
Prerequisites	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.
Course contents	1. Energy and environment. 2. Detailed chemistry of the troposphere. 3. Climate change. 4. Alternative fuels, Renewable sources of energy, Nuclear energy 5. Laboratory exercises for the determination of gaseous pollutants. 6. Nutrients in aqueous systems, nutrient cycles, pC-pH diagrams, Computing models and codes (e.g. Visual Minteqa). 7. Organic pollutants in the environment (petroleum hydrocarbons, surfactants, solvents, etc.), distribution of organic pollutants in the aqueous environment, methods for the prediction of distribution constants. Theoretical models

	(e.g. 1-box models). 8. Laboratory exercises: nutrient measurements, sorption experiments with organic pollutants and various sorbents. 9. Field trips for surface and marine water quality on-site measurements.
Recommended reading	1. Course notes. 2. C. Baird, "Environmental Chemistry", W.H. Freeman and Company, 1999. 3. J. Firor, "The changing atmosphere: a global challenge", Translation: E. Ioannidou, Ed.: P.A. Siskos, Kostarakis Publications, 1992.
Teaching and learning methods	Lectures using powerpoint (400-500 slides) that will be uploaded to the educational platform eclass.upatras.gr , tutoring sessions for problem solving with and without the use of software in the multimedia room, laboratory exercises, field trips, semester project to be implemented by groups of 2-4 students.
Assessment ang grading methods	Grade percentages for Dr. Karapanagioti's subjects would be as follows: 1. Final written examination (50% of the final grade). 2. Reports from laboratory exercises and field trips (20% of the final grade, valid only for students that pass the final exam). 3. Report of the semester project (30% of the final grade, valid only for students that pass the final exam).
Language of instruction	Greek. English could also be used in case students from other countries attend the classes.

Course title	**Chemical Industries (Inorganic and Organic)**
Course code	ChIn884
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. C. Papadopoulou, Dr. G. Bokias
Learning outcomes	The aim of this course that the student will be able to: 1. Present the processes for the industrial production of the most important inorganic and organic chemical products, giving special attention to the Greek chemical industry. 2. Understand the thermodynamics and kinetics of the essential steps involved in the production of important inorganic and organic products and to recognise their importance for the design of the respective industrial process. 3. Define related common concept like: petroleum, fossil fuels, hydrocarbons, octane number, feed, heat exchanger, etc. 4. Describe basic parts of the structure of an industrial chemical unit, e.g. a specific process of a petroleum distillation unit. 5. Describe the chemical processes needed for a desired product to be produced from a specific raw material used as feed. 6. Evaluate the essential technological, environmental and financial aspects for the design of important chemical industries.

Competences	At the end of the course the student must have developed the following skills/competences: 1. Find information he/she needs from a book on Industrial Chemistry. 2. Recognize and name different parts of a chemical industry unit and describe their function, i.e. 'read' and describe a schematic representation of a chemical industrial unit. 3. Find the appropriate process for the production of a desired product from a feed of given properties. 4. Ability to transfer and to apply fundamental knowledge τo the solution of qualitative and quantitative problems in various steps of industrial processes. 5. Ability to adopt and apply such knowledge and understanding to similar industrial processes. 6. Extract the kinetic equation for a catalytic process, based on data and assumptions. 7. Study skills needed for continuing professional development. 8. Ability to interact with others on inter or multidisciplinary problems.
Prerequisites	It is however recommended that students should have at least a basic knowledge of General Chemistry, Physical processes, Chemical Technology and Catalysis.
Course contents	1. Purification treatment of water as a primary material for industrial chemistry 2. Industries of nitrogen and nitrogen compounds. Ammonia, nitric acid, nitrogen-containing fertilizers. 3. Phosphorus-containing fertilizers. 4. Sulfur and sulfuric acid. Industrial production of sulfuric acid using the contact process. 5. Hydrochloric acid and halogens. 6. Sodium carbonate and sodium hydroxide. 7. Electrolysis processes. Aluminum and manganese. 8. Portland cement. 9. Iron and steel. 10. Row materials for Organic Chemistry. 11. Natural gas and petroleum: historical background of the discovery and uses of fossil hydrocarbons, origin, physical and chemical properties. 12. Refining and uses of natural gas. 13. Structure of crude petroleum refinery, flow diagram. 14. Analytic methods applied to define the composition and the quality of crude petroleum. 15. Atmospheric and vacuum distillation, products and their uses. 16. Catalytic reforming of naphtha, products and their uses. 17. Catalytic isomerizations, products and their uses. 18. Hydrorefining. 19. Cracking processes, products and their uses. 20. Methane, ethylene, propylene, butanes, benzene, toluene and xylenes as raw materials of petrochemichals. Every process is focused on the characteristics of the feed, the properties of the product, the types of the chemical reactors and the reaction conditions, the catalytic materials and their function, the schematic representation of the industrial process.
Recommended reading	1. A. Lycourghiotis, C. Kordulis, "Catalytic processes of Organic Industries", Publications of University of Patras.

	2. Royal Dutch Shell Group of Companies, Koninklijke Nederlandsche, Petroleum Maatschappij, "The Petroleum Handbook", 6th Edition, Elsevier, 1986. 3. H.A. Wittcoff, B.G. Reuben, "Industrial Organic Chemicals in perspective", J. Wiley-Interscience, 1980. 4. F. Pomonis, "Organic Chemical Technology", University of Ioannina. 5. Kallitsis, N. Kalfoglou, " Basic principles of inorganic chemical industries", Publications of University of Patras. 6. Sdoukos, F. Pomonis, "Inorganic Chemical technology", Tziolas Publications, 2010. 7. I. Chatiris, N. Kalkanis, "Chemical technology", S. Parikou Publications, 1998.
Teaching and learning methods	Lectures using power-point presentations. The students have active participation, e.g. based on given information they are asked to identify the next step in a certain industrial process. Using of process flow diagrams and obtaining the information they contain.
Assessment ang grading methods	1. Evaluation of the student's progress throughout the whole semester by written tests in every chapter. If they succeed to all of them (mark ≥ 5 for each test) this may be their final mark. 2. Written examination at the end of the semester. Exams in both cases comprise questions of various types: multiple choice, right/ wrong, correlations, filling the gaps, extracting kinetic equations, etc. 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.
Language of instruction	Greek.

Course title	**Food Chemistry and Technology – Oenology II**
Course code	FcTo872
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. A. A. Koutinas, Dr. M. Kanellaki, D. A. Bekatorou
Learning outcomes	At the end of the course the student will have acquired the necessary knowledge on: 1. All the factors (microbiological, environmental, etc.) that affect food spoilage. 2. The ways of food preservation at at industrial, trade or household scale. 3. The effects of food spoilage on human health. 4. The biochemistry of wine making. 5. The nutritional value of genetically engineered food and probiotic food. 6. Food legislation.
Competences	At the end of the course the student will have further developed

	the following skills/competences: 1. Ability to know and apply the optimum conditions for food preservation and storage, and to easily recognize spoiled food such as meat, milk, cheese, etc. 2. Ability to intervene and modify the course of fermentation when correctional action is needed, exploiting the knowledge obtained on wine making biochemistry. 3. Ability to seek employment in food industries, small scale enterprises and laboratories, or to develop new food related enterprises, exploiting the knowledge obtained on food microbiology and food legislation.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Organic Chemistry, Biochemistry and Chemical Technology.
Course contents	*A. Food spoilage and preservation - Oenology* 1. Food microbiology. Bacteria (morphology, physiology, classification). Environmental factors that affect bacterial growth. Fungi (morphology, physiology, classification). Environmental factors that affect fungal growth and metabolic activity. 2. Food spoilage. Causes. Spoilage of the main food constituents (carbohydrates, proteins, fats and oils, vitamins, natural pigments). Spoilage of specific food groups (fruit and vegetables, meat, milk, cereals and their products). 3. Food preservation. Thermal preservation. Drying of various food products fruit and vegetables, animal products, beverages and condiments). Preservation by condensation. Preservation by salting and curing. Preservation by smoking (smoked food). Preservation by canning and bottling. Preservation by freezing. Preservation by chemical additives. Preservation by irradiation. Packaging materials. Food legislation. 4. Oenology–Wine microbiology. Yeast morphology, physiology, composition, and nutritional requirements. Microorganisms related with alcoholic fermentation: *Candida, Saccharomyces, Torulopsis*. *Saccharomyces* species: *S. cerevisiae, S. elipsoides, S. apiculatus, S. pombe, S. bayanus, S. pastorianus*. Sugars in alcoholic fermentation. Biochemistry of alcoholic fermentation. Wine spoilage microorganisms. Control of grape must fermentation. Factors that affect yeast viability and wine spoilage. Causes and cure of stuck fermentations. Malolactic fermentation. Yeast isolation. Liquid and solid yeast cultures. Preparation of liquid culture in grape must for the promotion of wine fermentation. The role of oxygen in alcoholic fermentation. Redox potential of wine. Redox constituents of wine. Baker's yeast and fodder yeast production. Other microorganisms in alcoholic fermentation: the bacterium *Zymomonas mobilis*. *B. Nutritional value of genetically modified food.* *C. Probiotic food.* *D. Food legislation-chemical additives in food.* *E. Two-month practical training*, which will be supervised by the academic staff, in a winery, alcohol distillery, liquor production enterprise, brewery, or baker's yeast production plant.
Recommended reading	1. A. A. Koutinas, M. Kanellaki, "Food Chemistry and Technology", Publications of University of Patras, 2010. 2. J. Jay, "Modern Food Microbiology", 6^{th} Edition, Springer-

	Verlag, 2000. 3. H.-D. Belitz, W. Grosch, P. Schieberle, "Food Chemistry", 3rd revised edition, Editor.: S. Rafailidis, Translation: M.D. Papageorgiou, A.I. Varnalis, Tziolas Publications, 2007. 4. O.R. Fennema, "Food Chemistry", 3rd Edition, Marcel Dekker Inc., 1996. 5. R.S. Jackson "Wine Science: Principles and Applications", 3rd Edition, Elsevier, 2008.
Teaching and learning methods	• Power point presentations or transparencies. • Visits to food industries/enterprises.
Assessment and grading methods	Final written course examinations
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Renewable Energy Sources and Chemical Storage**
Course code	ReCs893
Type of course	Optional (Chemical)
Level of course	Undergraduate
Year of study	4th
Semester	8th
ECTS credits	5
Name of lecturer(s)	Dr. A. A. Koutinas, Dr. P. Giannoulis, Dr. A. Lykourgiotis, Dr. A. Bekatorou
Learning outcomes	At the end of this course the student will be able to: 1. Know the various forms of Renewable Energy Sources (RES), such as solar, wind and hydroelectric, biomass, geothermal, as well as spatial dispersion. 2. Know the operation fundamentals of the various RES exploitation systems (solar heat, photovoltaics, wind power, hydroelectric power, biofuels, and geothermal systems). 3. Calculate the available potential of each energy source. 4. Calculate the yield factors of the various RES exploitation systems.
Competences	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 data, concepts, principles, and theories related to the exploitation of energy sources. 2. Ability to apply this knowledge and understanding to solve qualitative and quantitative problems. 3. Ability to adopt and apply methodologies in problem solution.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Physical Chemistry
Course contents	1. Development of methods for physicochemical energy storage. 2. Chemical reactions of energy storage – Chemical heat pumps. 3. Biofuels: Raw materials, enzymes, microorganisms, and traditional technology in bioethanol production. 4. Biofuels: New trends in bioethanol production – bioreactors. 5. Biofuels: Production of Bioethanol from sugar beet and straw –

	Biogas. 6. Introduction: Renewable sources, potential and methods of exploitation. 7. Thermal solar systems. 8. Photovoltaics. 9. Biodiesel: Raw materials and methods of production. 10. Biohydrogen: Biological methods of production – Microbial fuel cells. 11. Production, storage and conversion of hydrogen to electric energy I. 12. Production, storage and conversion of hydrogen to electric energy II.
Recommended reading	1. Giannoulis, A. A. Koutinas, "Renewable Sources and Chemical Storage of Energy", Publications of University of Patras. 2. P. Giannoulis, "New sources of energy", Publications of University of Patras, 2009. 3. J.A. Duffie, W.A. Beckman, "Solar Engineering of Thermal Processes", 3rd Edition, Wiley, 2006. 4. J. Twidell, T. Weir, "Renewable Energy Resources", 2nd Edition, Taylor & Francis, 2006. 5. J.F. Kreider, F. Kreith (editors), "Solar Energy Handbook", McGraw Hill Series in Modern Structures, McGraw Hill, 1981.
Teaching and learning methods	Lectures using slides for overhead projector and power-point presentations.
Assessment and grading methods	Final written course examination.
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Optional (Elective) non-chemical Courses in 1st and 3rd Semester

Course title	**Elements of General Biology**
Course code	GeBi120
Type of course	Optional (Non Chemical)
Level of course	Undergraduate
Year of study	1st or 2nd
Semester	1st or 3rd
ECTS credits	5
Name of lecturer(s)	Dr A. Theocharis
Learning outcomes	At the end of this course the student should 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.
Competences	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 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.
Prerequisites	There are no prerequisite course.
Course contents	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. Cytoskeleton – cellular motility Organization of cytoskeleton, microtubules, microfibrils, intermediate fibrils, motility of the cells and organelles. 9. Cell growth – cellular division Mitosis, cellular division, meiosis. 10. Animal tissues Origin and characteristics of animal cells and tissues. 11. Animal organs Organization and functions of animal organs. 12. Laboratory courses Identification of cells and cytoskeleton in microscopy. Identification of blood group substances. Microscopy of tissues. Study of oxidative enzymes. Study of organs. Study of physiological function of various systems (respiratory, cardiovascular etc).
Recommended reading	1. V. Marmaras and M. Labropoulou-Marmara, "Cell Biology: a molecular approach", 4th Edition, Typorama Edition, 2000. 2. B. Lewin, "Genes VIII", Volume I and II, (Greek edition), 8th Edition, Translation: G. Stamatogiannopoulos, Academic Editions I. Basdra, 2004. 3. D. Mathiopoulos, "Principles of General Biology", Typothito Edition, 2005.
Teaching and learning methods	Lectures using PowerPoint presentations.
Assessment and grading methods	Written examinations.
Language of instruction	Greek

Course title	**Microbiology**
Course code	MiBi321
Type of course	Optional (Non Chemical)
Level of course	Undergraduate
Year of study	1st or 2nd
Semester	1st or 3rd
ECTS credits	5
Name of lecturer(s)	Dr G. Aggelis, Dr. O. Georgiou
Learning outcomes	The students will study the structure of prokaryotic and eukaryotic microbial cell and of viruses, and comprehend the biology of microorganisms on molecular level, as well as the mechanisms used by the microorganisms for energy generation. Also, they will learn the biology of representative genera of bacteria and fungi and of important viruses.
Competences	The students will be able to: • use aseptic technique, • 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, • use stain procedures,

	• study life cycle of fungi, • examine sensitivity of bacteria to antibiotics.
Prerequisites	Formally there are no prerequisites. However, knowledge of General Biology, Biochemistry and Molecular Biology is recommended.
Course contents	1. Evolution of the science of Microbiology. 2. Organization and structure of prokaryotic and eukaryotic cell: cytoplasmic membrane and its functional role, cell wall, flagellum. Chemotaxis. The bacterial endospore. Chromosome and plasmids. Ribosomes. 3. Molecular biology of microorganisms: DNA replication, gene expression, regulation of gene expression, DNA transfer in bacteria. 4. Generation of energy in aerobic and anaerobic microorganisms, chemoautotrophy, photoautotrophy. 5. Microorganisms without a cellular structure. 6. Taxonomic hierarchies and taxonomic unit. 7. The microbial world. 7.1. Gram negative bacteria [aerobic. facultative anaerobic], Gram positive [cocci, spore forming, regular and irregular non-spore forming]. Mycobacteria. Photosynthetic. Aerobic chemolithotrophic. Actinomycetes. 7.2. Archaea (methanogens, sulfate reducers, cell wall-less, extremely halophilic, extremely thermophilic sulfur-metabolizing). 7.3. Characteristics of Fungi. Chytridiomycota, Zygomycota [*Rhizopus*, *Mucor*, Mycorrhizae], Ascomycota [*Schizosaccharomyces*, *Aspergillus* and *Penicillium*, Order Lecanorales, Order Saccharomycetales], Basidiomycota [genus *Agaricus*, White and brown rot fungi, Order Uredinales - the rust fungi, Order Ustilaginales – the smut fungi]. 7.4. Fungi like organisms. 7.5. Viruses: Animal viruses [Adenoviruses, Retroviruses], plant viruses [tobacco mosaic virus], phages [T4, λ].
Recommended reading	1. G. Aggelis, "Microbiology and Microbial Technology", A. Stamoulis Publications, 2007.
Teaching and learning methods	Lectures, Laboratory exercises.
Assessment and grading methods	Written exams at the end of semester. Exams during semester.
Language of instruction	Greek.

Course title	**Viticulture**
Course code	ViTi322
Type of course	Optional (Non Chemical)
Level of course	Undergraduate
Year of study	1st or 2nd
Semester	1st or 3rd
ECTS credits	5
Name of lecturer(s)	Dr. A. Koutinas, Dr. M. Kanellaki, Dr. A. Bekatorou
Learning outcomes	At the end of this course the student should be able to:

	1. Know the suitable cultivation practices for the production of good quality vine products (varieties, grafting, vineyard establishment, pruning, vineyard management and protection practices, rootstocking, sensory evaluation). 2. Know the chemical composition of vine products (grapes & wine) and their significance on human nutrition. 3. Understand the basic principles of organic viticulture.
Competences	At the end of the course the student will have further developed the following skills/competences: 1. Practical skills related with knowledge on the vine varieties indigenous in different geographical parts of Greece, the quality of raw material necessary for excellent vinification, and the significance of organic viticulture. 2. Skills to seek employment in downstream vinification enterprises where the raw material is produced in the manufacturer's vineyards. 3. Ability to consult wine makers and wine making enterprises on the cultivation of suitable varieties and proper handling of grapes, the raw material of winemaking.
Prerequisites	There are no prerequisite courses. It is however recommended that students should have at least a basic knowledge of Biology and Biochemistry.
Course contents	*Lectures/Laboratory exercises*: 1. Viticulture in Greece and worldwide. 2. Vine morphology and physiology. 3. Annual growth cycle of grapevines; Propagation; Soil and climate requirements; Vineyard establishment. 4. Rootstocks (choice of rootstock; American rootstocks). 5. Grape varieties (table grape varieties; wine grape varieties; Greek grape varieties; foreign grape varieties). 6. Vine grafting (bench grafting; in situ grafting; grafting principles). 7. Vine pruning (dormant pruning; winter pruning; summer or herbaceous pruning; removal of primary shoot growth; removal of excess grapes). 8. Vine training systems (cane and spur pruning systems; cordon training systems; trellis height; vine tying on trellis). 9. Vineyard management (soil preparation; pest and weed control; irrigation; pruning; special cultivars; greenhouses etc.). 10. Vineyard fertilization. 11. Common vineyard diseases (effect of soil and climate; natural diseases; diseases caused by viruses; bacteria or fungi; diseases caused by animals and pests; botrytis; eutypa dieback; cancer; bacterial blight; berry rot; anthracnose etc.). 12. Common vineyard enemies (phylloxera; mealybug; grape root borer; grape berry moth; hornworm; etc.) – Protection and treatment programs. 13. Grape microflora. 14. Grapes (chemical composition; growth stages; changes during maturation; grape must; alcoholic degree; harvest; nutritional value). 15. Grapes as raw material related with wine quality. 16. Organic viticulture. 17. Sensory evaluation.

Recommended reading	1. N. A. Nikolaou, "Viticulture", Syghroni Paideia Publications, 2008. 2. K. Kousoulas, "Viticulture", Ekdotiki Agrotehniki Publications, 2002. 3. Hofmann, Kopfer, Werner, "Organic Viticulture", Translation: Ilias Korkas, Phsyxalos Publications, 2003. 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. 6. I. Vagianos, "Practical Viticulture-Enology", Psyxalos Publications, 1986.
Teaching and learning methods	1. Power point presentations or transparencies. Theoretical presentation of laboratory exercises. 2. Laboratory exercises by teams of 2-3 students.
Assessment and grading methods	Final written course examination mark.
Language of instruction	Greek. Instruction may be given in English if foreign students attend the course.

Course title	**Economics**
Course code	EcOn130
Type of course	Optional (Non Chemical)
Level of course	Undergraduate
Year of study	1st or 2nd
Semester	1st or 3rd
ECTS credits	5
Name of lecturer(s)	Dr C. Siriopoulos
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.
Competences	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.
Prerequisites	There are no prerequisite courses. However, it would be useful to remember basics Mathematics and Statistics.
Course contents	1. Historical background in the evolution of the economic thought.

	2. Introduction to microeconomics. 3. Introduction to Macroeconomics. 4. International finance, cpital markets and financial institutions. 5. Introduction to financial management. 6. Capital budgeting. 7. Theory of firm..
Recommended reading	1. K. Syriopoulos, "International Capital Markets", Anikoula Publications, 1999. 2. Notes and papers. 3. www.siriopoulos.tk
Teaching and learning methods	Lectures using power-point presentations and blackboard.
Assessment ang grading methods	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. 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
Language of instruction	Greek.

Course title	**Didactics of Natural Sciences**
Course code	DiNs 340
Type of course	Optional (Non Chemical)
Level of course	Undergraduate
Year of study	1st or 2nd
Semester	1st or 3rd
ECTS credits	5

Course title	**English Chemical Terminology**
Course code	EnCt141
Type of course	Optional (Non Chemical)
Level of course	Undergraduate
Year of study	1st or 2nd
Semester	1st or 3rd
ECTS credits	5
Name of lecturer(s)	Dr. E. Spiliopoulou
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.
Competences	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.
Prerequisites	Students are required to be Independent Users – Upper Intermediate Level (B1, B2)
Course contents	1. History of the periodic table. 2. Chemistry and matter. 3. Atoms, elements and compounds. 4. Chemicals. 5. The Halogen Family. 6. Acids, bases and salts. 7. Inorganic Nomenclature. 8. Chemical properties of elements and compounds. 9. Oxygen, Hydrogen, Nitrogen, Carbon. 10. Biochemistry. 11. Laboratory equipment. 12. The laboratory report. 13. Laboratory safety guidelines. 14. Reading passages.
Recommended reading	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.
Teaching and learning methods	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.
Assessment and grading methods	Written examination at the end of the teaching semester. Students are required to have a pass mark of 5.
Language of instruction	English.

Course title	**Main European Languages (one of the following: French, German, Italian, Spanish**
Course code	EuLa142-145
Type of course	Optional (Non Chemical)
Level of course	Undergraduate
Year of study	1st or 2nd
Semester	1st or 3rd
ECTS credits	5

Course title	**Business Administration**
Course code	BuAd331
Type of course	Optional (Non Chemical)
Level of course	Undergraduate
Year of study	1^{st} or 2^{nd}
Semester	1^{st} or 3^{rd}
ECTS credits	5
Name of lecturer(s)	Dr. P. Polychroniou

V. POSTGRADUATE STUDIES

For the doctorate degree, a supervisory three-member committee is assigned upon the approval of the Department and the graduate student conducts research under the direction of the chairman of the supervisory committee. The average time required for the doctorate degree is four years. MSc is required for the application for Ph.D.. During the first year of the doctorate studies the student is obliged to follow four courses (two courses each semesters) and pass the associated exams. The minimum passing grade is 5 out of 10. The exams take place at the end of each semester and there are repeat exams in September. The above mentioned four courses are selected from the following list of postgraduate courses to accord with the research project of each particular student. No specific requirements for admission and registration apply to ERASMUS students.

The PostGraduate Studies Program of the Deprtment of Chemistry of the University of Patras was established at 1993 and it is active since 1994. Since 2010, the Program has been reorganised and updated, following the recent European and international standards.

The PostGraduate Studies Program enrols graduates from all Departments of the Schools of Sciences and Polytechnic Institutes of the Country or corresponding Departments abroad.

The PostGraduate Studies Program of the Department of Chemistry offers:

The Master of Science (MSc) Degree in the following specializations :

1. *Applied Biochemistry: Clinical Chemistry, Biotechnology and Evaluation of Pharmaceutical Products.*
2. *Advanced Polymeric and Nanostructured Materials.*
3. *Catalysis for Environmental Protection and Clean Energy Production.*
4. *Environmental Analysis*
5. *Analytical Chemistry and Nanotechnology*

Each specialization is coordinated by a faculty member of the Department. The coordinators are:

- *Applied Biochemistry: Clinical Chemistry, Biotechnology and Evaluation of Pharmaceutical Products.* (D. Vynios)
- *Advanced Polymeric and Nanostructured Materials.* (G. Bokias)
- *Catalysis for Environmental Protection and Clean Energy Production.* (C. Kordulis)
- *Environmental Analysis* (S. Glavas)
- *Analytical Chemistry and Nanotechnology* (Th. Christopoulos).

✓ The Director of the PostGraduate Studies Program for the period 2009-2011 is Prof. S. Perlepes.

The Doctor of Philosophy (Ph.D.) Degree

The Ph.D. degree covers all research activities of the Department of Chemistry.

The PostGraduate Studies Program enrols graduates from all Departments of the Schools of Sciences and Polytechnic Institutes of the Country or corresponding

Departments abroad.

MSc Degree

Applied Biochemistry: Clinical Chemistry, Biotechnology and Evaluation of Pharmaceutical Products

General Description:

The previous MSc program entitled “Applied Biochemistry – Biotechnology” has been reorganised to “Applied Biochemistry: Clinical Chemistry, Biotechnology and Evaluation of Pharmaceutical Products’’. Through the reorganisation, “Applied Biochemistry” is now including Clinical Chemistry and Biological Evaluation of Pharmaceutical Products, which are indispensable for the vocational rehabilitation of graduates.

Study Program

First Semester

Biochemical Analysis-Clinical Biochemistry	**10** *ECTS*
Advanced Biochemistry	**10** *ECTS*
Literature Review and Research Methodology	**10** *ECTS*
Total:	**30** *ECTS*

Second Semester

Molecular Pharmacology-Immunology	**10** *ECTS*
Molecular Biology-Molecular Biotechnology	**10** *ECTS*
Launch of Research Activities for MSc Thesis	**10** *ECTS*
Total:	**30** *ECTS*

Third Semester

MSc Thesis: Completion of the research project Writing and Defense of the Thesis	**30** *ECTS*
Total:	**30** *ECTS*

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.
- Radionucleids in analysis.
- Immunoenzymatic analytical methods: Theory, techniques, applications.
- Automatisation in analysis, Modern auto-analyzers,
- 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).

Literature Review and Research Methodology

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).

Launch of Research Activities for MSc Thesis

Faculty members

The MSc programme is supported mainly by the following faculty members of the Department of Chemistry:

A. Aletras,
A. Theocharis,
N. Karamanos,
T. Tsegenidis,
D. Vynios.

ADVANCED POLYMERIC AND NANOSTRUCTURED MATERIALS

General Description:

Education and training on the design and techniques necessary for the development and characterization of functional polymeric and nanostructured materials for advanced applications.

Study Program

First Semester

Advanced Synthetic Techniques and Properties of Polymeric Materials	**10** *ECTS*
Functional Materials	**10** *ECTS*
Literature Review and Research Methodology	**10** *ECTS*
Total:	**30** *ECTS*

Second Semester

Characterization of Nanostructured Materials	**10** *ECTS*
Nanostructured Materials	**10** *ECTS*
Launch of Research Activities for MSc Thesis	**10** *ECTS*
Total:	**30** *ECTS*

Third Semester

MSc Thesis: Completion of the research project Writing and Defense of the Thesis	**30** *ECTS*
Total:	**30** *ECTS*

Courses

Advanced Synthetic Techniques and Properties of Polymeric Materials

- Step-Growth Polymerization.
- Chain-Growth Polymerization.
- Copolymerization.
- "Living"/Controlled Polymerization.
- Design of Macromolecular Architecture.
- Molar Mass Characterization.
- Amorphous, Crystalline and Liquid Crystalline Polymers.
- Mechanical Properties of Polymers.
- Property/Structure Relationships in Polymers and Copolymers.

Characterization of Nanostructured Materials

- Thermal Analysis (TG/DTG, DSC, DTA etc.).
- Nuclear Magnetic Resonanse (NMR).
- Vibrational Spectroscopy (IR, Raman).
- Mass Spectroscopy.
- X-Ray Diffraction.
- Magnetochemical Characterization.
- Electronic and Photoelectronic Spectroscopy (AES, XPS).
- Electron Microscopy (TEM, SEM etc.).
- Atomic Force Microscopy (AFM).
- EPR Spectroscopy.

- Chromatography (GPC, GC, FFF).

Literature Review and Research Methodology

Functional Materials

- Semi-Conductive Polymers.
- Luminescent Molecular Materials.
- Materials for Light Emitting Diodes.
- Materials for Photovoltaic Applications.
- Molecular Magnets.
- Sensors.
- Membranes.
- Degradable Polymers.
- Responsive Poymers.
- Hydrogels.

Nanostructured Materials

- Carbon Nanotubes (CNT). CNT-hybrids.
- Colloids.
- Block Copolymers.
- Dendrimers.
- Monomolecular Magnets.
- Hybrid Organic/Inorganic Nanostructured Materials.

Launch of Research Activities for M.Sc Thesis

Faculty members

The specialization is mainly supported by the following faculty members :

J. Mikroyannidis,
J. Kallitsis,
G. Bokias,
S. Perlepes,
E. Dalas,
K. Galiotis,
C. Tsitsilianis,
Ch. Kordulis,
Ch. Papadopoulou,
G. Karaiskakis,
A. Koliadima.

CATALYSIS FOR ENVIRONMENTAL PROTECTION AND CLEAN ENERGY PRODUCTION

General Description:

The program aims to familiarize the graduates with the development and use of catalytic processes for protecting the environment through pollutants destruction, the development of green catalytic processes and the production of bio-fuels and hydrogen.

The graduates of this program will be able to:
1. select the most suitable pollution control process for a certain case,
2. select the most suitable process for liquid fuels and hydrogen production from the available renewable sources (e.g. biomass, water),
3. select and/or develop suitable catalysts for destruction of pollutants and production of bio-fuels and hydrogen,
4. characterize and evaluate solid catalysts by the joint use of modern physicochemical methods.

Study Program

First Semester

Development of Solid Catalysts	**10** *ECTS*
Physicochemical Characterization and Evaluation of Solid Catalysts	**10** *ECTS*
Bibliographic review and Research Activities for MSc Thesis	**10** *ECTS*
Total:	**30** *ECTS*

Second Semester

Catalytic and Sorption Processes for Pollution Control	**10** *ECTS*
Processes for Bio-fuels and Hydrogen Production	**10** *ECTS*
Launch of Research Activities for MSc Thesis	**10** *ECTS*
Total:	**30** *ECTS*

Third Semester

MSc Thesis: Completion of the research project Writing and Defense of the Thesis	**30** *ECTS*
Total:	**30** *ECTS*

Courses

Development of Solid Catalysts

- Introduction to the catalytic materials.
- Design of solid catalysts for environmental applications.
- Methods for preparation of oxide carriers.
- Methods for preparation of mesoporous carriers.
- Methods for preparation of zeolite carriers.
- Methods for preparation of nanostructured carbon carriers.
- Methods for preparation of supported catalysts.

Physicochemical Characterization and Evaluation of Solid Catalysts

- Textural characterization of solid catalysts.
- Chemical and structural characterization of solid catalysts.

- Surface analysis of solid catalysts.
- Kinetics of surface reactions.
- The influence of mass and heat transfer phenomena on the kinetics of heterogeneous catalytic processes.
- Laboratory reactors for the evaluation of solid catalysts.

Literature Review and Research Methodology

Catalytic and Sorption Processes for Pollution Control

- Reduction of pollutants emission from mobile sources.
- Reduction of nitrogen oxides emission from stationary sources.
- Reduction of volatile organic compounds emission from stationary sources.
- Catalytic combustion for the reduction of the emitted pollutants.
- Reduction of ozone concentration in the airplanes.
- Reduction of sulfur oxides emission from stationary sources.
- Fixation/destruction of pollutants by metal complexes.
- Sorption processes for pollution control.

Processes for Biofuels and Hydrogen Production

- Chemistry of biomass and its growth rate.
- Gasification of biomass.
- Synthesis gas applications.
- Bio-oil production.
- Bio-oil upgrading.
- Production of monomers from biomass.
- Production of fuels from carbohydrates.
- Exploitation of non carbohydrate products of cellulose.
- Bio-diesel production.
- The hydrogen as an alternative fuel.
- Methods for hydrogen production.
- Hydrogen storage.
- Hydrogen use in fuel cells.

Launch of Research Activities for MSc Thesis

Faculty members

The specialization is mainly supported by the following faculty members :

A. Lycourghiotis,
C. Kordulis,
H. Matralis,
C. Papadopoulou,
E. Manessi-Zoupa,
H. Karapanagioti,
B. Symeopoulos.

ENVIRONMENTAL ANALYSIS

General Description:

Training in chemical analysis related to atmospheric and aqueous (wastewater and drinking water) environment.

Study Program

First Semester

Environmental Chemistry	**10** *ECTS*
Analytical Techniques for Gases	**10** *ECTS*
Literature Review and Research Methods	**10** *ECTS*
Total:	**30** *ECTS*

Second Semester

Analytical Techniques for Liquids	**10** *ECTS*
Methods for the Determination of Trace Elements	**10** *ECTS*
Launch of Research Activities for MSc Thesis	**10** *ECTS*
Total:	**30** *ECTS*

Third Semester

MSc Thesis: Completion of the research project Writing and Defense of the Thesis	**30** *ECTS*
Total:	**30** *ECTS*

Courses

Environmental Chemistry

- Stratospheric ozone. Greenhouse effect.
- Release of gas pollutants: CO, VOC, NOx, SO_2, particulate matter (PM). Transformation of primary pollutants: Photochemical ozone, Acid rain. Basic meteorology.
- Water in the environment. Basic hydrology and water chemistry. Organic and inorganic substances in aquatic systems. Characteristics and treatment of drinking water. Heavy metals in the environment. Wastewaters and their treatment.

Analytical Techniques for Gasses

- Gas chromatography application for the determination of hydrocarbons and chlorinated substances in the atmosphere.
- HPLC application for the determination of aldehides and ketones in the atmosphere.
- Ionic chromatography application for studying the acid rain phenomenon.
- Methods for the determination of primary and secondary gaseous pollutants: ozone, nitrogen oxides, carbon monoxide and sulfur dioxide.
- Assessment of human exposure to gas pollution.

Laboratory Exercises

- Determination of pollutants in the atmosphere using automated devices:
  - Ozone.
  - Nitrogen oxides.
  - Carbon monoxide.
- Calibration of automated devices for ozone, NOx and CO.
- Determination of particulate matter in the atmosphere, PM 2.5.

- Determination of electroniophilic substances (halogenated hydrocarbons, nitric alkyls) in the atmosphere.

Literature Review and Research Methodology

Analytical Techniques for Liquids

- Analysis of Chemical Pollutants in water.
    - ✓ Sampling.
    - ✓ Analytical techniques.
- Analysis of Organic Pollutants using Gas Chromatography.
- HPLC application for the analysis of organic pollutants.
- Metal analysis with atomic absorption and emission.
- Ionic chromatography.
- Colorimetric analysis.
- Analysis using selective electrodes.
- Titration analysis (Alkalinity, acidity, Redox titrations).
- Microbiological analysis.
- Control parameters for Water Quality.

Laboratory Exercises

- Determination of ammonia, BOD, COD.
- Determination of organic pollutants using GC-MS.
- Standardized kits for water analysis.
- *Field trips.*

Methods for the determination of trace elements

- Atomic absorption.
- Inductively coupled plasma mass spectrometry (ICP-MS).
- X-Ray Fluorescence spectroscopy (XRF).
- Instrumental neutron activation analysis (INNA).
- Particle Induced X-Ray Emission (PIXE).
- α-Ray spectroscopy, γ-Ray spectroscopy

Laboratory Exercises

- Determination of trace elements with atomic absorption
- Determination of trace elements using inductively coupled plasma mass spectrometry in particulate matter
- Determination of elemental carbon in particulate matter.

Launch of Research Activities for MSc Thesis

Faculty members

The specialization is mainly supported by the following faculty members :

S. Glavas,
H. Papaefthymiou,
B. Symeopoulos,
M. Soupioni,
H. K. Karapanagioti.

Analytical Chemistry and Nanotechnology

General Description:

This program is designed to provide broad training in modern analytical techniques and their wide-ranging applications to biomedical, pharmaceutical, environmental, food, and materials analysis. Emphasis is given to the impact of nanotechnology on the development of novel analytical methods and sensing devices as well as to those techniques that play an important role in the investigation of the morphology, composition and structure at the micro- and nanoscale.

Study Program

First Semester

Micro/Nanotechnology - Chemical Sensors	**10** *ECTS*
Investigating the Micro- and Nanoworld: Microscopy	**10** *ECTS*
Literature Review and Research Methods	**10** *ECTS*
Total:	**30** *ECTS*

Second Semester

Investigating the Micro- and Nanoworld: Spectroscopy	**10** *ECTS*
Separation Science	**10** *ECTS*
Launch of Research Activities for MSc Thesis	**10** *ECTS*
Total:	**30** *ECTS*

Third Semester

MSc Thesis: Completion of the research project Writing and Defense of the Thesis	**30** *ECTS*
Total:	**30** *ECTS*

Courses

Micro/Nanotechnology - Chemical Sensors

Design and construction of analytical chips. Microfluidic devices. Detectors. Microarray technology. Exploiting the new properties of the nanoparticles (electrical, optical and magnetic) for the development of novel analytical methods and devices. Chemical modification and conjugation of nanoparticles. Principles of sensor development. Optical, electrochemical and mass sensors.

Investigating the Micro- and Nanoworld: Microscopy

Transmission electron microscopy (TEM). Scanning electron microscopy (SEM). Focused ion beam (FIB). Analytical electron microscopy (AEM). Electron energy-loss spectroscopy (EELS). Energy-dispersive X-ray spectroscopy (EDS). Wavelength-dispersive X-ray spectroscopy (WDS). Atomic force microscopy (AFM). Scanning tunneling microscopy (STM). Cathode luminescence spectroscopy and microscopy.

Literature Review and Research Methodology

Investigating the Micro- and Nanoworld: Spectroscopy

Structural analysis. X-ray diffraction. Data bases for mining structural information. Mass spectrometry. Raman spectroscopy. Auger electron spectroscopy (AES). X-ray photoelectron spectroscopy (XPS)

Separation Science

Physicochemical approach of the chromatographic techniques. Gas chromatography. Liquid chromatography. High performance liquid chromatography (HPLC). Comparison between liquid and gas chromatography. One-phase chromatography (Field-Flow Fractionation). Comparison between Field-Flow Fractionation and conventional chromatographic techniques.

Launch of Research Activities for MSc Thesis

Faculty members

The specialization is mainly supported by the following faculty members :

Th. Christopoulos,
G. Karaiskakis,
D. Papaioannou,
V. Nastopoulos,
Ch. Papadopoulou,
A. Koliadima.

Ph.D. DEGREE

The courses list for the Ph.D. degree includes all courses of the five specializations of the MsC degree, as well as of other interdepartmental or international PostGraduate Studies Programs 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 A. Theocharis N. Karamanos T. Tsegenidis D. Vynios	Autumn
Advanced Biochemistry	A. Aletras N. Karamanos D. Vynios	Autumn
Molecular Pharmacology - Immunology	A. Aletras A. Theocharis N. Karamanos	Spring
Molecular Biology – Molecular Biotechnology	D. Vynios A. Theocharis	Spring
Advanced Synthetic Techniques and Properties of Polymeric Materials	J. Mikroyannidis G. Bokias C. Tsitsilianis	Autumn
Functional Materials	J. Mikroyannidis J. Kallitsis G. Bokias S. Perlepes	Autumn
Characterization of Nanostructured Materials	J. Kallitsis G. Bokias S. Perlepes Ch. Kordulis Ch. Papadopoulou G. Karaiskakis A. Koliadima	Autumn
Nanostructured Materials	J. Kallitsis G. Bokias S. Perlepes E. Dalas	Spring
Development of Solid Catalysts	A. Lycourghiotis	Autumn
Physicochemical Characterization and Evaluation of Solid Catalysts	C. Kordulis	Autumn
Catalytic and Sorption Processes for Pollution Control	H. Matralis E. Manessi-Zoupa H. Karapanagioti B. Symeopoulos	Spring
Processes for Bio-fuels and Hydrogen Production	C. Papadopoulou	Spring
Environmental Chemistry	S. Glavas H. K. Karapanagioti	Autumn

Course	Teaching Staff	Semester
Analytical techniques for gases	S. Glavas	Spring
Analytical techniques for liquids	H. K. Karapanagioti	Autumn
Methods for the determination of trace elements	H. Papaefthymiou B. Symeopoulos M. Soupioni	Spring
Micro/Nanotechnology - Chemical Sensors	T. Christopoulos	Autumn
Investigating the Micro- and Nanoworld: Microscopy	Ch. Papadopoulou	Autumn
Investigating the Micro- and Nanoworld: Spectroscopy	V. Nastopoulos D. Papaioannou Ch. Papadopoulou	Spring
Separation Science	G. Karaiskakis A. Koliadima	Spring
Synthetic Pharaceutical Chemistry	C. Barlos J. Matsoukas G. Tsivgoulis	Autumn
Peptide and Combinational Chemistry	D. Gatos C. Barlos	Autumn
NMR Spectroscopy and Molecular Design	J. Matsoukas Th. Tselios C. Spiroulias	Autumn
Biomolecular Analysis	(teaching by Profs. of Pharmacy Department)	Autumn
Pharmaceutical Products-Naturals and Synthetics	(teaching by Profs. of Pharmacy Department)	Autumn
Molecular Pharmacology	(teaching by Profs. of Medicine Department)	Autumn
Food Microbiology and Preservation	P. Demertzis E. Bezirtzoglou	Spring
Food Biotechnology	A. Koutinas M. Kanellaki A. Bekatorou	Spring
Food Chemistry	M. Kontominas M. Komaitis M. Tasioula	Spring
Advanced Exercises in Food Chemistry and Biotechnology I	A. Koutinas M. Kanellaki M. Soupioni A. Bekatorou	Spring
Advanced Exercises in Food Chemistry and Biotechnology I	A. Koutinas M. Kanellaki M. Soupioni A. Bekatorou	Spring
Protection and Improvement of Agricultural Production - Agrochemicals	C. Poulos	*

* Autumn or spring semester according to the teaching requirements of the Department.

TRANSNATIONAL AND TRANSISTITUTIONAL POSTGRADUATE PROGRAM SPECIALIZATION DIPLOMA: "*Food Biotechnology*"

Department of Chemistry (University of Patras), Department of Chemistry (University of Ioannina), Biotechnology Group of School of Biomedical Science (University of Ulster-U.K.)

http://www.chemistry.upatras.gr/~msc-foodbiotechnology/

General Description:

The Departments of Chemistry of the Universities of Patras and Ioannina (Greece) and the School of Biomedical Sciences of the University of Ulster (UK) have organised and run since 1997 the Transnational and Transistitutional Post Graduate Course MSc Food Biotechnology. This course is designed to provide specialised training in food biotechnology for the introduction and implementation of new biotechnology processes and products in the food industry. It is well established that the food industry is one of the most developed and competitive industrial sectors. Also, the last 15 years there is an eruptive development of biotechnology as a science. Many of the findings of this science have found applications in the food industry aiming at the reduction of production cost, the improvement of quality, the development of less energy demanding and environmental friendly technologies, the reduction of investment size and cost, and the increase of food productivity, to face world hunger and exploit agro-industrial wastes and by-products. The above, in combination with the biotechnological methods used traditionally for food production pointed out, around the early 90s, the need for a new scientific orientation of food biotechnology. Therefore, training of scientists in this field at postgraduate level, in combination with the available traditional knowledge that is offered by the MSc Food Biotechnology Course, will give them skills to seek employment in food industries and to assess knowledge for the selection of suitable products/technologies for the development of new food enterprises, and will thus help their professional development in an extremely competitive environment. Students will be taught for one semester in Coleraine, Northern Ireland, and one semester in Greece. Research students then return to Coleraine or can remain in Greece to carry out a research project in Semester 3.

Study Program

First Semester (at University of Ulster)

Process Biotechnology	**7,5** *ECTS*
Recombinant DNA technology	**7,5** *ECTS*
Research Design and Statistics	**7,5** *ECTS*
Enterprise in Biotechnology	**7,5** *ECTS*
Total:	**30** *ECTS*

Second Semester (at University of Patras)

Food Microbiology and Preservation	**5** *ECTS*
Food Biotechnology	**5** *ECTS*
Food Chemistry	**5** *ECTS*
Advanced Exercises in Food Chemistry and Biotechnology (I & II)	**15** *ECTS*
Total:	**30** *ECTS*

Third Semester (Coleraine or Greece)

MAT 300	Food Biotechnology research project	**60** *ECTS*
	Total:	**60** *ECTS*

POSTGRADUATE PROGRAM: *"Medicinal Chemistry: Drug Discovery and Design"*

Departments of Chemistry and Pharmacy (Euromaster Label, ECTN Association)
www.medicinalchemistry.gr

General Description:

The Master's thesis in Medicinal Chemistry consists of both research and written work. The aim 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. An independently produced Master's thesis, demonstrates the student's ability to think scientifically and use the necessary research methods to properly treat the topic of the thesis by applying the knowledge and skills acquired in previous studies. The student also proves that he or she is familiar with the thesis topic and can communicate in the field of chemistry and pharmacy. The scope of the Master's thesis is an advanced Research in "Medicinal Chemistry" which can be achieved through 45 ECTS-compatible credits, including both research and written work. Students must complete a Master's thesis independently, not in pairs or groups. Each student is assigned a personal supervisor and specific project. Students must agree with the Professor of their laboratory on a thesis topic and supervision arrangements (supervisors/immediate supervisors). The professor will also be one of the three examiners assessing the completed thesis. The students most often conduct their research as members of research group and advice also from the other group members. Oral presentation as seminar is given related to the Master Thesis.

Study Program

First Semester (Compulsory studies)

SPC 100	Synthetic Pharmaceutical Chemistry	**5** ***ECTS***
PCC 101	Peptide and Combinational Chemistry	**4** ***ECTS***
NMD 102	NMR Spectroscopy and Molecular Design	**5** ***ECTS***
BAN 103	Biomolecular Analysis	**4** ***ECTS***
PPR 104	Pharmaceutical Products – Naturals and Synthetics	**5** ***ECTS***
MOP 105	Molecular Pharmacology	**5** ***ECTS***
REM 106	Research Methodology	**2** ***ECTS***
	Total:	**30** ***ECTS***

Second Semester (Compulsory studies)

LPC 200	Laboratory Course of Pharmaceutical Chemistry	**10** *ECTS*
CPR 201	Collection of Bibliography Data and Presentation of Resume Project of Research Field of Master's Thesis	**5** *ECTS*
MAT 202	Master' s Thesis (Research)	**15** *ECTS*
	Total:	**30** *ECTS*

Third Semester (Compulsory studies)

MAT 300	Master's Thesis (Research–Writing– Presentation of the Project)	**30** ***ECTS***
	Total:	**30** ***ECTS***

VI. RESEARCH ACTIVITIES OF FACULTY MEMBERS

Research in the Department of Chemistry is at the forefront of modern science, both in the core chemical discipline (Inorganic, Organic, Physical and Analytical chemistry) and as a key element of life, environmental and materials sciences (biochemistry and biochemical analysis, synthetic organic and medicinal chemistry, bioinorganic chemistry, catalysis and interfacial chemistry, food chemistry and biotechnology, polymer science, structural and environmental chemistry).

The faculty members are active in all aspects of the chemical sciences and in constant collaboration with Universities, Research Institutes and Industry in Europe, Asia and USA. Senior academics of the Department are internationally recognised scientists in their fields and through the postgraduate programs they are joined by young promising fellows who will be the leaders of tomorrow.

State-of-the-art facilities for synthesis, analysis, cell molecular biology and drug preclinical evaluation, biotechnology, interfacial and environmental chemistry within the Department, as well as the NMR and DNA-sequence facilities of the "Laboratory of Instrumental Analysis" enable the high-quality research of the Faculty members. Facilities for technical, computing and analytical support are excellent. Access to transmittance and scanning electron microscopes equipped with EDS & WDS instruments are also provided by a link to the "Laboratory of Electron Microscopy".

The Chemistry buildings house two well-equipped Multimedia Laboratories used for Seminars and Workshops, a fully equipped Seminars Room with audio and video facilities and a library with a collection of approximately 3,200 book titles.

As a department, we are strongly committed to innovation and improvement in our undergraduate and graduate programs.

▪ ORGANIC CHEMISTRY

Synthetic Organic Chemistry

Faculty Members: Prof. D. Papaioannou, Assist. Prof. C. Athanassopoulos.

Organic Peptide and Medicinal Chemistry

Faculty Members: Prof. J. Matsoukas, Assist. Prof. T. Tselios.

Peptide Chemistry

Faculty Members: Prof. K. Barlos, Assoc. Prof. D. Gatos

Design and Synthesis of Analogues of Biologically Active Peptides

Faculty Members: Prof. C. Poulos.

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

Faculty Members: Prof. T. Tsegenidis.

Supramolecular Chemistry

Faculty Members: Assist. Prof. G. Tsivgoulis.

- **BIOCHEMISTRY, BIOCHEMICAL ANALYSIS AND MATRIX PATHOBIOLOGY**

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

- **INORGANIC-BIOINORGANIC-ORGANOMETALLIC CHEMISTRY**

Faculty Members: Prof. S. Perlepes, Prof. P. Ioannou, Prof. N. Klouras, Prof. T. Zafiropoulos, Prof. E. Manessi-Zoupa.

- **PHYSICAL CHEMISTRY**

Physical Chemistry of Interfaces

Faculty Members: Prof. G. Karaiskakis, Assist. Prof. A. Koliadima.

Physical, Aquatic & Colloidal Chemistry

Faculty Members: Prof. E. Dalas.

Quantum Chemistry

Faculty Members: Prof. G. Maroulis.

- **RADIOCHEMISTRY**

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

- **CATALYSIS AND INTERFACIAL CHEMISTRY FOR ENVIRONMENTAL APPLICATIONS**

Faculty Members: Prof. A. Lycourghiotis, Prof. Ch. Kordulis, Assist. Prof. H. Matralis, Assist. Prof. Ch. Papadopoulou, Lect. H. Karapanagioti.

- **FOOD CHEMISTRY AND FOOD BIOTECHNOLOGY**

Faculty Members: Prof. A. Koutinas, Prof. M. Kanellaki, Assist. Prof. M. Soupioni. Assist. Prof. A. Bekatorou,

- **POLYMER SCIENCE AND TECHNOLOGY**

Polymer Chemistry and Technology

Faculty Members: Prof. J. Mikroyiannidis.

Advanced Polymers and Hybrid Nanomaterials

Faculty Members: Prof. J. Kallitsis.

Stimuli-Responsive Polymers

Faculty Members: Assist. Prof. G. Bokias.

- **ANALYTICAL AND STRUCTURAL CHEMISTRY**

Analytical Chemistry
Faculty Members: Prof. T. Christopoulos.

X-ray Crystallography
Faculty Members: Assoc. Prof. V. Nastopoulos.

- **ATMOSPHERIC CHEMISTRY**

Faculty Members: Prof. S. Glavas.

Useful link: www.chem.upatras.gr/ResearhGroups/