

**Class: (L-27 Sciences and Chemical Technologies)**

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**Degree Course Presentation**

*While you are reading these information your eyes are using a chemical molecule, the retinale, to convert the visible light in nervous impulses that you are received and elaborate to turn into image. While you are holding this brochure, in your muscles some chemical reactions are*

*happening, which turns sugars into the energy you are using. If you place one hand on a chair, on your suit, if you graze your hair, if you are eating, if.. if.. For anything you are doing you must know that some chemical molecules are turned into other chemical molecules. We are immersed in a world "totally" composed of molecules in movement. Chemistry is the science that studies molecules and their changes. Without them, without chemical reactions, earth would be a planet without life. All the things that we use, we wear, we eat, we see around us are produced through controlled chemical reactions. Molecules are therefore fundamental for our life and you should be curious to know their structure, behavior and characteristics that are extraordinarily fascinating and less complicated than you can expect.*

The importance of Chemistry in the modern world is underlined by the fervour of activity in such sector. In main industrialized Countries the percentage of growth in the chemical sector is approximately the double quantity that the average in other sectors, and such growth is particularly in the field of new medicines, new materials, in the environment and in biotechnologies. A measure of the interest for chemical sciences is annually given by the number of scientific articles summarized in the "Chemical Abstract": in 1960 the annual number was of 106.600 publications, in 1975 more than tripled to 324.000. For extrapolation it can be estimated that actually they join over a million articles per year.

Up today the number of known compounds has overcome the ten million and the number grows of six thousand unity a week, where many of such compounds have never been found in nature. Such exponential growth of the chemical knowledge can be attributed to three main factors:

- understanding and control of the chemical reactions;
- ability to work with complex molecules;
- revolution in the scientific instrumentation.

In the light of the productive ferment above described, we can affirm that the discipline "Chemistry" has a great general importance for the society, both as enrichment of our cultural baggage and as ability to answer to mankind needs.

The primary cultural motivations of Science are tied up to the understanding of the universe around us, of the nature of matter and the nature of life. The observation and study of the universe is a dominion of Astronomy with the help of Physics; the intimate nature of matter is connected with atoms and molecules and, beyond, with the structure and components of the elementary particles. The Physics of high energies is dealing with such elementary particles, while atoms and molecules, whose behaviour directly manifests them in the forms and properties of everything around us, are the object of Chemistry. The area related to the nature of life, that is perhaps the more urgent cultural area for the human needs, is separated between Biology and Chemistry: Biology studies the phenomenology of the living being, while Chemistry gives the fundamental bases for the understanding of living processes. Every other process (growth, reproduction, mutation, death) is nothing else than a complicated sequence of chemical reactions. Besides his cultural values, Science is able and must give, at least potentially, an answer to the needs of the society. Chemistry is a discipline of extreme importance for the solution of the needs of society, more and more addressed to the improvement of the quality of life. This is in fact the chemist's job: to invent reactions that can turn the existing chemical substances into products useful to satisfy our needs. For instance: (i) the silicon-based materials for our computers are not found in nature, but are produced by the silica, drawn by the sand, through chemical processes, (ii) the taxol, a substance drawn by the bark of young trees of the *Taxus Brevifolia* of the Pacific, has been revealed extremely effective in the medical therapy of the tumour. To get of it as soon as 1 gram it is necessary to demolish 3-4 trees, but chemists have realized the synthetic production of this molecule in notable quantity and it is actually available for many patients. The first level degree in Chemistry has the purpose to form graduates able to undertake the scientific career or to develop professional activity. The chemical research is essential in different fields and is the base of the development of knowledge in many fields of pure and applied sciences.

Modern society is not conceivable without the contribution of industrial chemical products, such as medicines, dyes, insecticides, fertilizers, ceramics, plastics and textile fibbers.

The contribution of Chemistry is fundamental for the solution of important social problems as man's health, the improvement of quality of life, the development of new materials for the electronics or other special uses, for the search of alternative sources of energy and also for the safeguard of the environment.

A modern society in continuous development has therefore necessity of more and more graduates in Chemistry able to create new products and, contemporarily, to solve the problems of environment. A positive aspect of the First Level Degree in Chemistry is represented by the very favourable teacher-student relationship, in fact students can easily compare with the teaching staff and easily establish with teachers a profitable direct relationship. Given the experimental character of Chemistry, particular importance is given to the part of the practice in laboratory, for which an assiduous frequency is required.

## **Job's perspectives**

The University of Camerino supplies the Diploma Supplement to all graduates. The graduates in Chemistry can develop their own profession as Junior Chemists in the following field:

1. Public and private research agencies;
2. Laboratories of analysis, control and quality assurance;
3. Chemical, Pharmaceutical and Biotechnological industries;
4. Free professional activity, especially in the sectors of safeguard of the environment, of maintenance of the cultural heritage, of health and energy.

Functions of Junior Chemist:

- to assist specialists in chemical research activities or in activities requiring application of chemical protocols;
- to carry out well defined protocols or procedures;
- to execute laboratory tests for the development of new products under the supervision of a Senior Chemist;
- to carry out chemical analyses and quality checks, that can require the knowledge and mastery of advanced chemical and instrumental techniques, on the basis of the specific product under control;
- to apply standard methodologies in the chemical analyses, in the direction of chemical laboratories, in pure and applied chemical advices and in any other activity of Junior Chemist professional as defined by the actual legislation;
- to deal with customers' demands, suggesting them on the correct use of products. To put in relationship the customers' requests with the development activities in laboratory, production and marketing.

Additionally, the Chemistry graduate can also continue the studies for attaining the second level Degree in Chemistry or first level Masters.

## **Requirements (or Syllabus):**

Admission to studies for the Degree in Chemistry does not require specialized preparation; the knowledge needed to pass the Secondary School final exam, or any other High School- leaving certificate in other countries, is sufficient. The Chemistry Degree Course sets out a procedure before the beginning of didactical activities, on the basis of Didactical Regulation of the Course, in order to ascertain the mastery of the minimal pre-requisites, however this procedure is not a restraint for inscription to the course. The Chemistry Degree Course organizes facultative integration courses and activities with the aim to help new students filling up any formative lack in knowledge.

## **Learning objectives**

The main goal of the Chemistry Degree Course is the formation of a graduated with good basic skills and knowledge on chemistry, suitable for the introduction in job's activities requiring confidence with the scientific method, ability in applying innovative technologies and methodologies, in the use of complex instruments, also computer-based, in the effective use of the English language, both in written and oral forms, for the exchange of general information, in working within interdisciplinary groups with a well-defined degree of autonomy and to enter the job world.

The proposed curriculum is based on the first two years concerning basic and characterizing teachings, while the third year concerns more specialized and applicative teachings. The acquired skills and competences allow to better conform oneself to the evolution of the discipline, to interact with neighboring professionals and also to continue the studies in second

level Degree Courses. The didactical organization is essentially based on the model of the "Chemistry Eurobachelor" and on that drawn up by the Italian Chemical Society concerning the "core chemistry" basic contents for the first level degrees in the class 27. In particular:

- (a) a "core" of at last 90 ECTS in mathematics, physics, inorganic chemistry, organic chemistry, physical chemistry, analytical chemistry and biochemistry;
- (b) a final stage activity of 15 ECTS;
- (c) semi-optional teachings on at last three additional "sub-disciplines", having each 5 ECTS;
- (d) optional teachings

## **Expected learning results:**

### *Knowledge and ability to understanding*

The Chemistry graduated will:

- possess basic knowledge in mathematics: algebra, numerical calculation, study of functions, differential and integral calculus, statistical treatment of the experimental data;
- possess basic knowledge in physics: mechanics, classic thermodynamics, optics, electromagnetism, error analysis.
- possess basic knowledge in chemistry: main aspects of chemical terminology, of nomenclature, of conventions and units of measures. Chemical reactions and their main characteristics. Quantum-mechanics principles and applications in the description of the structure and properties of atoms and molecules. The properties of elements and their compounds, together with the relationships between groups and trends in the periodic table. Structural features of elements and their compounds, included the stereochemistry. Characteristics of the states of matter and theories for their description. Principles of thermodynamic and applications in chemistry. Kinetics of chemical transformations, catalysis and mechanistic interpretation of chemical reactions. Knowledge of the main techniques of structural investigation, included the spectroscopic techniques. The relationship between the properties of the groups and those of individual atoms and molecules, as also the macromolecules (both natural and synthetic ones), the polymers and other related materials. Relationships between the structure and properties of materials. The structure and properties of organic and organometallic compounds; the behavior of functional groups. The main synthetic routes in organic chemistry, included the transformation of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds. Structure and reactivity of the most important classes of biomolecules and the chemistry of some important biological processes. Basic knowledge in the polymer science and in their properties. Theory and procedures in chemical analyses and in the characterization of chemical compounds. The principles of validation of chemical methodologies. Planning of a procedure for the sample analysis: choice of the more appropriate quantitative method.
- possess also the fundamental knowledge on assurance and certification, of environmental control, of safety in chemical plants, and in economy and marketing.

All these knowledge and abilities will be achieved through the participation to frontal lessons, guided personal study, and independent study, as expected from the teachings activated in the basic, characterizing and integrative disciplinary sectors: MAT/05, FIS/01, CHIM/01, CHIM/02, CHIM/03, CHIM/05, CHIM/06, CHIM/10, BIO/10, IUS/14 e SECS-P/07.

The verification of the attainment of learning results is carried out at the end of each teaching through oral and/or written examinations. The graduated will achieve also a suitable knowledge of the English language that will allow the exchange of general.

### *Ability to apply knowledge and understanding*

The Chemistry graduated will:

- be able to execute stoichiometric calculations and practical operations for the preparation of solutions at a given concentration;
- be able to execute elementary calculations of energetic balance, determination of order of reaction and kinetic constant, equilibrium constants;
- be able to manipulate in safety the chemical substances, included their correct disposal;
- be able to carry out the synthesis and characterization of simple compounds by using standard procedures, safety laboratory protocols and standard instruments of laboratory;

- be able to choose the best separation method for a given analytical problem, standard separations and purifications (column chromatography, crystallization, distillation, liquid-liquid extraction);
- be able to collect and interpret scientific data through observations and laboratory measurements;
- be able to use physico-chemical techniques and methodologies (basic calorimetric, electrochemical and spectroscopic measurements) in order to obtain molecular information for the structural identification;
- be able to use the common analytical techniques and methodologies and to choose the most appropriate technique for the pursuit of a particular aim;
- be able to carry out titrations within the limit of accepted errors and to use atomic and molecular spectroscopic techniques, chromatographic (GC and HPLC) techniques and electrochemical (potentiometry, conductometry and voltammetry) techniques to carry out qualitative and quantitative analyses.
- be able to perform a sampling procedure, the preparation of the sample under investigation and to document the executed analysis.
- be able to execute a calculation and present the results of analysis with the related uncertainty;
- possess basic informatics skills in operative systems, word processing, electronic sheets, databases, internet;
- possess skills in management of the information, included those gained from on-line research.
- be able to read an economic budget and to interpret the items concurring to define the income and the business patrimony.
- be able to transfer the contents of main laws in the field of quality and to prepare a document for the certification of a company.

All these abilities will be achieved through theoretical exercises, independent study, tasks assigned and performed at home, laboratory activities and working teams exercises. The verification of the attainment of results is carried out through intermediate exams during the execution of the teachings and at the end of each teaching through oral and/or written examinations.

### *Judgment autonomy*

The Chemistry graduated will:

- be able to collect and interpret the relevant scientific data arising from experimental observation and measurements;
- be able to program and carry out an experiment; to plan the times and conditions, to evaluate and quantify the results;
- be able to formulate an analytical problem and propose ideas and solutions;
- be able to give judgments and to reflect on important scientific and ethical questions;
- be able to adapt to different working and thematic situation;
- be able to find and examine information sources, data, chemical literature.

All these abilities will be achieved through theoretical exercises, independent study, tasks assigned and performed at home, preparation of the final exam and stage experiences. The verification of the attainment of results is carried out through intermediate exams during the execution of the teachings and at the end of each teaching through oral and/or written examinations.

### *Communication skills*

The Chemistry graduated will:

- be able to communicate, orally and in written form, scientific information, ideas, problems and solutions;
- be able to communicate, orally and in written form, in Italian and English language within the activities and professional relationships;
- be able to interact with other people and to carry out collaboration activities;
- be able to elaborate and present experimental data also with the help of multimedia systems.
- be able to describe and communicate in a simple and critical manner also topics of general character.

All these abilities will be achieved through independent study, tasks assigned and performed at home, preparation of seminars, preparation of the final exam.

The verification of the attainment of results is carried out through written and/or oral exams at the end of each teaching and presentation of specific topics in seminar form and the final exam.

### *Learning skills*

The Chemistry graduated will:

- be able to engage in future studies with a sufficient degree of autonomy and to continue the professional training;
- be able to work for aims, by alone or in team;
- be able to adapt in different working and thematic fields.

All these abilities will be achieved through independent study, tasks assigned and performed at home, preparation of seminars, preparation of the final exam and stage experiences.

The verification of the attainment of results is carried out through written and/or oral exams at the end of each teaching, presentation of specific topics in seminar form and the final exam. The overcoming of all the exams provided in the Degree Course and of the final exam will guarantee the acquisition of the suitable abilities to pursue the following studies with a high degree of autonomy.

### **Modality of verification of the profit and typology of examination**

The verification of the attainment of results is carried out through written and/or oral exams at the end of each teaching, presentation of specific topics in seminar form and the final exam. The overcoming of all the exams provided in the Degree Course and of the final exam will guarantee the acquisition of the suitable abilities to pursue the following studies with a high degree of autonomy.

### **Features of the final examination**

The final examination is based on the verification of the ability of the student to clearly organize and explain the result of a chemical project. The written thesis will be concerned on data and competences attained during a stage period under the supervision of a tutor of the university and a tutor of a private or public company, a department, center or laboratory of university. The written thesis will introduce the state-of-the-art of the chemical problem under consideration, will describe the study methodologies applied, will report the obtained results and critically analyze them. For the final examination of the stage period are assigned at least 15 ECTS.

### **Didactical periods**

The acquisition of skills and knowledges from the students is measured in ECTS. The credits correspond to the work, consisting of individual study and exercise and laboratory activities, required to each student to achieve the degree in Chemistry.

The mean amount of learning work carried out in one year by a student engaged full time in university studies and starting from an adequate preparation is fixed in 60 credits.

To graduate in Chemistry the student must acquire 180 credits.

For the students that enrol in A.A. 2009/2010 the didactical activities will start on September 30 with the National test for Science and Technologies Faculty.

The didactical activities are offered into 2 semesters following this calendar:

I Semester October, 5 2009 – January, 29 2010

I Session of Exam January, 30 2010 – February, 28 2010

II Semester March, 1 2010 – June, 11 2010

II Session of Exams June, 13 2010 – July, 31 2010

III Session of Exams September, 1 2010 – October, 3 2010

Between the semesters there is a short period of stop of didactical activities that the teacher can use to carry out partial checks.

It is mandatory to attend particularly for laboratory activities.

At the beginning of the academic year the examination data of each teaching (at least 8 per year) will be communicated.

There are 5 data per year for the final exam.

Facultative integration courses and activities are organized for first year students in the following disciplines: Mathematics, Physics, Chemistry.

## Stage

The students can perform a stage period in industries and companies, laboratories and public agencies having an agreement with the University of Camerino, or in a department, center or laboratory of university. Such period will be done under the supervision of a university tutor and a company tutor.

## International mobility

Within the ERASMUS Program the Chemistry Course offers a wide choice of international partner institutions in which the students can follow courses or spend the stage period performing research activities under the supervision of a local tutor and a tutor from the University of Camerino.

For economic facilities you can visit the following website:

[http://web.unicam.it/international/mobility/socrates\\_erasmus\\_eng.asp](http://web.unicam.it/international/mobility/socrates_erasmus_eng.asp)

or contact:

Dott. Anna Pupilli - relazioni.internazionali@unicam.it - Phone: +39 0737 404619

## Tutoring Service

Periodical meetings with students will be held to analyze the state of formative activities. Each student will be supported by a teacher tutor .

## Support services

## ECTS validation

The council of Course can validate the formative activities acquired in different course or Universities or skills. The related ECTS are attributed having in mind the contribute of the activity to the attainment of formative objectives of Chemistry degree.

## Quality Assurance

The first level degree in Chemistry of Camerino has obtained the quality assurance UNI EN ISO 9001:2000 by AFAC Group (France).

## Formative Curriculum:

TABELLA 1: INSEGNAMENTI E MODULI I ANNO						
		*4-15	(**) ≥ 3	(***) Insegnamenti con + di 10 CFU "solo teoria" non possono essere svolti in un solo semestre		
N	Insegnamento	CFU totali (*)	Moduli (**)	CFU per SSD (***)	Tipologia dei moduli e crediti relativi (a,b,c,d,e,f,g, s) (#)	Voto o idoneità
1	Matematica	12		MAT/05 12	a 12	Voto
2	Chimica Generale Inorganica e Laboratorio	14	Chimica Generale Inorganica	CHIM/03 7	a 7	Voto
			Laboratorio di Chimica Generale Inorganica	CHIM/03 7	b 7	
3	Informatica e Applicazioni Numeriche	5		INF/01 5	a 5	Voto
4	Fisica e Laboratorio	12		FIS/01 12	a 12	Voto
5	Chimica Fisica 1 e Laboratorio	10	Chimica Fisica 1	CHIM/02 6	a 6	Voto
			Laboratorio di Chimica Fisica 1	CHIM/02 4	b 4	
6	Inglese	6		L-LIN/12 6	f 6	Voto

TABELLA 1: INSEGNAMENTI E MODULI II ANNO

\*4-15

(\*\*) ≥ 3

(\*\*\*) Insegnamenti con + di 10 CFU 'solo teoria' non possono essere svolti in un solo semestre

N	Insegnamento	CFU totali	Moduli	CFU per SSD	Tipologia dei moduli e crediti relativi (a,b,c,d,e,f,g, s) (#)	Voto o idoneità
7	Biochimica	6		BIO/10 6	b 6	Voto
8	Chimica Organica 1 e Laboratorio	10	Chimica Organica 1 Laboratorio di Chimica Organica 1	CHIM/06 7 CHIM/06 3	a 7 a 3	Voto
9	Chimica Inorganica 1 e Laboratorio	10	Chimica Inorganica 1 Laboratorio di Chimica Inorganica 1	CHIM/03 5 CHIM/03 5	a 5 b 5	Voto
10	Chimica Analitica 1 e Laboratorio	10	Chimica Analitica 1 Laboratorio di Chimica Analitica 1	CHIM/01 5 CHIM/01 5	a 5 b 5	Voto
11	Chimica Fisica 2 e Laboratorio	10	Chimica Fisica 2 Laboratorio di Chimica Fisica 2	CHIM/02 6 CHIM/02 4	b 6 b 4	Voto
12	Nozioni Generali di Economia	4		SECS-P/07 4	c 4	Voto
13	Chimica degli Alimenti	6		CHIM/10 6	c 6	Voto

TABELLA 1: INSEGNAMENTI E MODULI III ANNO

\*4-15

(\*\*) ≥ 3

(\*\*\*) Insegnamenti con + di 10 CFU 'solo teoria' non possono essere svolti in un solo semestre

N	Insegnamento	CFU totali	Moduli	CFU per SSD	Tipologia dei moduli e crediti relativi (a,b,c,d,e,f,g, s) (#)	Voto o idoneità
14	Chimica Organica 2 e Laboratorio	14	Chimica Organica 2 Laboratorio di Chimica Organica 2	CHIM/06 7 CHIM/06 7	b 7 b 7	Voto
15	Chimica e Tecnologia dei materiali	6		CHIM/07 6	c 6	Voto
16	Chimica Analitica 2 e Laboratorio	14	Chimica Analitica 2 Laboratorio di Chimica Analitica 2	CHIM/01 7 CHIM/01 7	a 7 b 7	Voto
17	Certificazioni	4		IUS/14 4	c 4	Voto
18	Stage	10			f 10	
19	Attività libere	12			d 12	
20	Prova finale	5			e 5	

(#)

- a attività formative di base
- b attività formative caratterizzanti
- c attività formative affini o integrative
- d attività formative a scelta dello studente
- e per la prova finale e per la conoscenza della lingua straniera
- f altre (ulteriori conoscenze linguistiche, abilità informatiche e relazionali, stage etc.)
- g ambito aggregato per crediti di sede
- s Tirocinio