

**COURSE DATA****Data Subject**

Code	33974
Name	General Chemistry
Cycle	Grade
ECTS Credits	6.0
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. Period
1103 - Degree in Food Science and Technology	Faculty of Pharmacy and Food Sciences	1 First term

Subject-matter

Degree	Subject-matter	Character
1103 - Degree in Food Science and Technology	3 - Chemistry	Basic Training

Coordination

Name	Department
PARDO MARIN, EMILIO JOSE	320 - Inorganic Chemistry

SUMMARY

General Chemistry is a basic course taught during the first semester of first year Grade in Food Science and Technology. Current study plan (curriculum) includes 4,5 theoretical credits and 1,5 laboratory credits.

The theoretical part attempts to provide the student the concepts and bases of chemistry in general, with special emphasis to those concerning the chemical elements and their compounds, while, at the same time, trying to highlight a scientific vision of reality, a fundamental aspect of university education. Students should achieve solid bases to interpret and build the potential applications and uses of inorganic compounds, not only to undertake the study of other courses with chemical contents, but also in carrying out the different aspects of the professional activities specific to this Grade, in research, teaching or industry.



Concerning theory lectures, they attempt that students consolidate and expand their knowledge on atomic structure, chemical bonding (both, in individual molecules and in solids), stoichiometric relationships, acid-base concepts, oxidation-reduction, and reactivity, as well as those principles determining kinetics and thermodynamic aspects of chemical transformations.

With respect to laboratory work, students should achieve basic technical skills and be able to perform experimental studies concerning some of the concepts covered in the theoretical lectures.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Formulation and stoichiometry basic knowledge

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

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- Know how to apply that knowledge to the professional world contributing to the development of human rights, democratic principles, the principles of equality between women and men, solidarity, protection of the environment and promotion of the culture of peace, from a gender perspective.
- Acquire the ability to interpret relevant data.
- Develop skills to undertake further study.
- Know reactions in solution, the different states of matter and the principles of thermodynamics.
- Be able to name and formulate inorganic and organic chemical compounds.
- Be able to solve basic problems for determining empirical and molecular formulas of compounds.
- Be able to solve simple quantitative problems related to chemical processes, both in equilibrium and from a kinetic standpoint.
- Be capable of explaining phenomena and processes related to basic aspects of chemistry in an understandable style.
- Know the mechanisms of the most important chemical transformations.
- Know the methods most commonly used for obtaining the different types of compounds.
- Develop the ability to estimate the risks associated with the use of chemicals and laboratory processes.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.



- Develop the capacity for organisation and planning.
- Acquire skills for presenting a project orally or in writing.
- Saber interpretar, valorar y comunicar datos relevantes en las distintas vertientes de la actividad profesional, haciendo uso de las tecnologías de la información y comunicación.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

. Students should consolidate and extend the general chemistry knowledge achieved in high school related to atomic structure, periodicity, chemical bonding, molecular structure, states of matter, and chemical reaction.

. Students should achieve solid bases on facts, concepts, and essential principles of Chemistry to be able to adequately use them in different situations and in the study of other courses with important chemical contents.

. Basic aspects and current applications should be highlighted, with especial emphasis on those relevant in the field of nutrition and food technology.

. The course should develop in the students the ability to lay-out and solve numerical problems, correctly using units and interpreting the results with analytical and critical mind.

. Laboratory work attempts to train the students in:

- manipulating chemical reagents, treatment of chemical waste and compliance with security regulations;
- basic laboratory techniques, such as mass and volume measurements, preparation of solutions, filtration, separation, centrifugation, etc.;
- the use of instrumentation of chemical interest;
- the study of different types of chemical reactions, such as redox and acid-base reactions;
- the interpretation of experimental facts by means of synthesis and reactivity of inorganic compounds of interest to nutrition.

DESCRIPTION OF CONTENTS

1. INTRODUCTION TO THE STUDY OF CHEMISTRY

Branches of Chemistry. Physical and chemical, intensive and extensive properties of matter. Classification of matter. Treatment of measurements in chemistry. Atomic composition. Atomic nucleus. Isotopes. Nuclear reactions. Applications of radioactivity. Chemical formulae. Rules for naming and formulating ionic compounds. Table of electrovalences and ionic radicals. Oxidation state. The chemical reaction. Stechiometric calculations. Limiting reagent and percent yield of chemical reactions.



2. ATOMIC STRUCTURE

Quantum-mechanical atomic model. The Schrodinger equation for the hydrogen atom. Quantum numbers and atomic orbitals. Polyelectronic atoms. Electronic configuration. The Periodic Table. Periodicity.

3. THE CHEMICAL BOND

The concept of bonding and its different types. Electronegativity and bond polarity. Covalent bond. Lewis structures. Resonance. Molecular geometry: the VSEPR model. Valence bond theory. Hybridization. Multiple bonds. Intermolecular forces: Van der Waals forces. Hydrogen bond. Physical states of matter: gases, liquids, and solids.

4. THERMOCHEMISTRY AND THERMODYNAMICS

Energy, heat, and work. Principles of thermodynamics. State functions. Enthalpy of physical and chemical changes. Hess's law. Enthalpy of formation. Entropy. Gibbs free energy. Criteria of spontaneity of chemical changes.

5. SOLUTIONS

Spontaneity of the dissolution process. Dissolution of solids in liquids. Solubility rules. Dissolution of liquids. Dissolution of gases. Saturation. Solubility and solubility product. Effect of temperature on solubility. Molarity; mole fraction; percentage of solute w/w, w/v, v/v; normality. Equivalent. Colligative properties of solutions: vapor pressure depression, boiling-point increase, freezing-point depression, osmotic pressure. Osmolarity. Iso- hyper- and hypotonic solutions. Colligative properties and dissociation of electrolytes. Colloids. Tyndall effect. Hydrophilic and hydrophobic colloids.

6. CHEMICAL KINETICS

Basic concepts: rate of reaction, rate equation, order of reaction. Elementary reactions. Molecularity of elementary reactions. Net reaction. Rate determining step. Reaction mechanism. Activation energy. Activated complex or transition state. Stationary state approach. Effect of temperature on the rate of reaction. Catalysis.

7. CHEMICAL EQUILIBRIUM

Reversibility and dynamic nature of chemical equilibrium. Equilibrium spontaneity. Thermodynamic aspects of chemical equilibrium. Equilibrium constant and reaction quotient. Homogeneous and heterogeneous equilibria. Factors affecting chemical equilibria. Le Chatelier's law. Free energy and equilibrium constant.

**8. ACID-BASE EQUILIBRIA**

Acid-Base concepts: Arrhenius, Bronsted and Lewis. Bronsted acids and bases in water. Neutralization. Acid-base character of oxides. Water autoionization; K_w . Strength of acids and bases. Acid-base equilibrium constant: K_a (pK_a), K_b (pK_b), K_w (pK_w). Leveling and differentiating effects of solvent. Molecular structure and acid strength. Polyprotic acids. Definition of pH and pH scale. pH calculations. Acid-base indicators. Acid-base titration curves. Buffer solutions. Hydrolysis. Acid-base character of aqueous solutions of salts.

9. REDOX EQUILIBRIA

Oxidation and reduction concepts. Redox reactions. Half-reactions. Electrochemical cells. Cell potential and free energy of redox reactions. Electrode potentials. Electrochemical series and activity of elements. Nerst equation. Systematic methods for balancing redox reactions: The ion-electrode method; the Valence Change Method.

10. LABORATORY SESSION 1

Introduction to most common laboratory techniques

- A. Use of labware. Preparation of solutions. Identification and use of labware. Introduction to chemical reagent handling, waste handling and compliance of security measures.
- B. Preparation of solutions.

11. LABORATORY SESSION 2

Separation of mixtures

- A. Separation of the casein from the milk and identification of the main components of the serum.
- B. Distillation of a commercial wine.

12. LABORATORY SESSION 3

Acid-base equilibria

- A. Study of acid-base concepts. Potentiometric titration of acetic acid.
- B. Determination of acidity of commercial vinegar.
- C. Preparation of buffer solutions and testing its buffer capacity.

**13. LABORATORY SESSION 4**

Redox equilibria

- A. redox equilibria. Cells
B. Titration of SO₂ in wines

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Laboratory practices	15,00	100
Seminars	2,00	100
Tutorials	2,00	100
Development of group work	4,00	0
Development of individual work	4,00	0
Study and independent work	15,00	0
Readings supplementary material	6,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	30,00	0
Preparation of practical classes and problem	12,00	0
Resolution of case studies	5,00	0
Resolution of online questionnaires	4,00	0
TOTAL	147,00	

TEACHING METHODOLOGY

This course is structured in three types of activities: theory lectures, tutorials (recitations), seminars, and laboratory sessions.

Study of theory contents. Students should acquire the basic knowledge included in the syllabus by means of their individual study and assistance to the lectures. During such lectures, the professor will set and explain a global perspective of each subject, will emphasize the key concepts needed for its understanding, and will answer questions from the students. To help in their individual study and in depth preparation of each subject, students will be provided with basic and complementary bibliography, internet addresses and supporting computer equipment, as well as the instructions and advice for handling information sources.



Laboratory work. Laboratory sessions are structured around four main components. In the first place, students must undertake a preparatory work before going to the laboratory, consisting in an effort to understand the laboratory guide provided for each experiment, review of the theoretical concepts involved, answering a set of previous questions, and preparing an outline of work process. During lab attendance, the professor will make a brief explanation of the keys aspects of the experimental work to be undertaken and will assist and monitor the students during the session. The student should analyze the observed facts and will answer some post-laboratory questions. By the end of the course all students will take a written exam on some questions directly related with the carried-out experiments.

Tutorials. During tutorials are meant to solve any doubt raised during theory lectures and to orient students about the most effective work methodology to improve their learning performance.

Coordinated Seminars. Students may have to prepare and make an oral presentation of a work on a subject of current interest relative to the course outline.

Attendance to seminars, laboratory sessions and tutorials is mandatory. Missing seminar and tutorial attendance will have a negative impact on the final grade. Missing any of the laboratory session will prevent passing the course.

EVALUATION

Learning evaluation of students will take into account all aspects exposed in the methodology section of this teaching guide and will be carried out by the professor in a continuous way.

Final grade will be calculated by weighing 75% the score assigned by the professor in evaluating the exams, attendance to lectures, tutorials, and seminars (Th). The score obtained in the laboratory work (Lab) will represent a 15% of the final grade. Finally, the grade obtained in the coordinated seminar (CSem) will represent a 10% of the final grade:

$$\text{Final grade (score)} = 0.75\text{Th} + 0.15\text{Lab} + 0.1\text{CSem}$$

In order to pass the course, a minimum score of 5 over 10 is required, both in the final exam as well as in the laboratory work.

REFERENCES

Basic

- QUÍMICA. Chang R. Ediciones McGraw-Hill. Décima edición, 2010.
- QUÍMICA. La Ciencia Central. Brown T.L., Lemay H.E., Bursten B. E. y Murphy C. J. Editorial Pearson. Décimoprimer edición. 2009.
- QUÍMICA GENERAL Enlace Químico y Estructura de la Materia. Petrucci R.H., Harwood, W.S. y Herring F.G. Prentice Hall. Octava edición, 2003.(Vol.I)

**Additional**

- QUÍMICA GENERAL Reactividad química. Compuestos inorgánicos y orgánicos. Petrucci R.H., Harwood, W.S. y Herring F.G. Prentice Hall. Octava edición, 2003.(Vol.II)
- PRINCIPIOS DE QUÍMICA. Atkins P.W. y Jones L. Editorial Panamericana. Tercera edición, 2005.
- FUNDAMENTOS DE ENLACE Y ESTRUCTURA DE LA MATERIA. E. Colacio Rodríguez. Base Universitaria, Anaya, 2004.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Volume of work and temporary planning of teaching

The teaching guide foresees a total of 57 hours of face-to-face activities divided into: theory classes (38 hours), laboratory practices (15 hours), seminars (2 hours) and regular tutorials (2 hours). This teaching will be given –in the number of hours provided in the teaching guide– according to a hybrid model, which will combine face-to-face and on-line teaching, and which may also be altered depending on the indications made by the health authorities regarding the evolution of the COVID-19 pandemic. For this, in the event that it must be done on-line, a series of tools described in the teaching methodology section will be used and, in addition, more weight will be given to continuous evaluation. In this way, the hourly distribution will be as follows:

- It is anticipated that the theory classes (38 h.) will start in an on-site way and can be carried out by synchronous videoconference once 50% of teaching hours have been given, attending health recommendations.
- The seminars (2 h.) will be carried out on-line by synchronous conference.
- It is expected that the tutorials (2 h.) will be done in person in the corresponding classroom.
- It is expected that the laboratory practices will be taught in person, limiting the capacity of the laboratory to 50%. For this reason, given the space limitations, the students will be divided into two groups and each of them will go to the laboratory on alternate days, so they will do, in person, 50% of the practices in each of the groups. In order to receive the teaching related to the 50% of remaining practices, the teacher will propose activities such as video viewing and activities that will be uploaded to the virtual classroom.

Teaching methodology

- Upload to the virtual classroom those materials required for the theoretical classes (scanned notes and solved problems).



- Attendance at the classroom or by means of BBC videoconferences to teach the theoretical contents of the subject reflected in the teaching guide, conducting seminars and regulated tutorials. In this sense, both the theoretical classes and the tutorials are expected to be done in person while the seminars will be done online (BBC videoconference).
- Proposal of activities via virtual classroom: In order to promote continuous evaluation, the teacher will periodically upload exercises and questionnaires (Moodle) that must be answered by the students and delivered by the same method.
- Non-face-to-face tutoring system: A virtual tutoring program will be developed using email, the virtual classroom forum and the BBC videoconference (or any similar platform) as tools.

Evaluation

- Maintenance of the weight of the laboratory practices of 15%. There will be an oral exam (by BBC conference) to replace the face-to-face exam reflected in the teaching guide.
- Maintenance of the weight of the seminars of 10%.
- Reduction of the weight of the final exam that goes from 75% to 65%. The final evaluation test will be based, preferentially, on an on-site exam or on an exam with multiple choice questions and short questions in the virtual classroom (Moodle questionnaire). This last point will be established by the teacher depending on the health situation, giving preference to the face-to-face option.
- As a result of the previous reduction, the remaining 10% of the mark will be calculated according to the activities carried out by the students (Moodle questionnaires and exercises and planned activities).

If a person does not have the means to establish this connection and access the virtual classroom, they should contact the teaching staff by email to find the appropriate solutions.