Universidad de Navarra

General Chemistry

Teaching guide 2026-27

INTRODUCTION

Course description: Chemistry studies the composition of matter at the molecular level, as well as its transformations. This course establishes the necessary chemical foundations for addressing other more specific disciplines such as physical chemistry, environmental chemistry, biochemistry, and physiology. This is a common course for the degrees in Biology (BIO), Biochemistry (BIOCHEM), Environmental Sciences (ENV. SCI.), and Chemistry (CHEM). Furthermore, students in the BIO, BIOCHEM, and ENV. SCI. degrees acquire skills useful for laboratory work.

- **Degree**: BIOCHEMISTRY, BIOLOGY, ENVIRONMENTAL SCI., BIO+ENV.SCI., CHEMISTRY, CHEM+BIOCHEM.
- **Module/Subject**:
- BIO: *Matemáticas, Física y Química para Biología* | *Matemáticas, Física y Química*.
- BIOCHEM: *Matemáticas, Física y Química* | *Bases Químicas de los Sistemas Biológicos*.
- ENV. SCI.: *Bases científicas del medioambiente* | *Bases científicas generales*.
- CHEM: *Fundamental* | *Química*
- **Number of credits**: 6 ECTS
- **Year**: 1st, **semester**: 1st
- **Type of course**: Basic subject
- **Instructors**: José Ramón Isasi (lectures and labs), Itziar Vélaz (CHEM degree practical sessions)
- **Language**: English
- **Lecture schedule**: Mondays 11h-13h, Thursdays at 9h, Fridays at 9h. In addition, CHEM and CHEM+BIOCHEM students: Xxx at xh (aula 32, taught in Spanish).

LEARNING OUTCOMES

1. BIOLOGY DEGREE

- **RA2**: Apply the bases of Mathematics, Physics, Chemistry, Biostatistics, and Bioinformatics in Biology studies.
- **RA11**: Perform analysis in health, industrial, agri-food, and environmental fields to solve problems through the scientific method.
- **RA23**: Collaborate actively and inclusively in academic environments, respecting diversity and contributing to constructive coexistence.

2. BIOCHEMISTRY DEGREE

- **RA3**: Explain the fundamentals of Physics and Chemistry relevant to understanding biological and biochemical processes.
- **RA12**: Manipulate chemical and/or biological material, including safety, waste disposal, annotated record of activities, and interpretation of results.

3. ENVIRONMENTAL SCIENCES DEGREE

- **RA1**: Identify the scientific bases necessary to describe the structure, physicochemical properties, and reactivity of the elements and compounds involved in biogeochemical processes.

4. CHEMISTRY DEGREE

- **RA1**: Identify the main aspects of chemical terminology, nomenclature, conventions, and units used in the various areas of Chemistry, as well as the importance of the Periodic Table and the periodic variation of the properties of the elements according to their location in it.
- **RA2**: Describe the chemical elements and their compounds – organic, inorganic, and organometallic – that are most relevant, and the functional groups in organic molecules, as well as their properties, applications, and main routes of obtaining or synthesis.
- **RA3**: Classify the characteristics of the main states of matter and the theories to describe them.
- **RA5**: Identify the types of chemical reactions, their kinetics and catalysis, and their application in analytical procedures for the identification, characterization, and determination of chemical compounds.
- **RA6**: Analyze the fundamental principles of thermodynamics, quantum mechanics, spectroscopy, and electrochemistry, assessing their application in the description of the structure and properties of atoms and molecules and in analytical and structural research techniques.
- **RA13**: Solve qualitative and quantitative problems according to previously developed models or through the planning of new strategies.
- **RA21**: Interpret the behavior and macroscopic properties of the most relevant types of materials as a result of a certain chemical composition and microstructure.
- **RA24**: Analyze experimental data with rigor, intellectual honesty, and a self-critical attitude, integrating the results into the theoretical framework of Chemistry and grounding their interpretations with scientific criteria.
- **RA26**: Apply inductive reasoning to generalize knowledge from experimental observations and transfer them to similar chemical situations.

PROGRAM

Lectures programme (common to all Science degrees)

1. **Atomic structure**
2. **Chemical bonds**
3. **Molecular structure**
4. **States of matter**
5. **Organic Chemistry**
6. **Thermodynamics: the 1st law**
7. **Thermodynamics: the 2nd law**
8. **Physical equilibria (solutions)**
9. **Chemical equilibria**
10. **Acids and bases**
11. **Aqueous equilibria**
12. **Electrochemistry**
13. **Chemical kinetics**
14. **Nuclear Chemistry**

Practical sessions (BIO, BIOCHEM and ENV.SCI. degrees)

- 0. Lab safety rules and risk prevention
- 1. Preparation of solutions and acid-base titrations.
- 2. Complexometric titrations.
- 3. Organic reactions: filtration methods and purification by crystallization.
- 4. Separation techniques: liquid-liquid extraction.

Practical seminars (CHEM and CHEM+BIOCHEM degrees)

Since students in the Chemistry degree are taking a “Chemical Experimentation” course, they will attend “Fundamentals of Chemistry” problem seminars (10 hours) in lieu of the laboratory sessions taught in BIO, BIOCHEM and ENV. SCI.

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EDUCATIONAL ACTIVITIES

Classroom activities (60 h)

- THEORETICAL LECTURES. 37 hours (1.48 ECTS). *Methodology*: theoretical lectures in the classroom, participatory and interactive, in which the fundamental concepts of each topic are covered (26 hours of lectures, 1 hour of flipped class).
- PROBLEM SEMINAR SESSIONS. 12 hours (0.48 ECTS). *Methodology*: classroom sessions in which problems are solved.
- LABORATORY SESSIONS (BIO, BIOCHEM and ENV.SCI.) 10 hours (0.40 ECTS). *Methodology*: practical sessions in the Chemistry laboratory; the student will complete a laboratory notebook and/or answer a questionnaire about the session.
- "FUNDAMENTALS OF CHEMISTRY" SEMINAR SESSIONS. (CHEM and CHEM+BIOCHEM only) 10 hours (0.40 ECTS). *Methodology*: classroom problem-solving sessions.
- MIDTERM EXAMS (6 classroom quizzes, 5-10 minutes each). 1 hour (0.04 ECTS).

Out of classroom activities (90 h)

- PREPARATION OF PROPOSED EXERCISES. 15 hours (0.6 ECTS). *Methodology*: Students are periodically asked to complete an activity that involves solving several exercises. This activity must be completed by the date indicated.
- PERSONAL STUDY. 75 hours (3 ECTS). Methodology: Students must learn the material covered in class, with a special emphasis on solving the problems proposed for each topic.

ASSESSMENT

Ordinary call (December)

- The following are essential requirements for passing the course:
    1. A comprehensive exam covering essential chemistry concepts (10% of the final grade) about quantitative aspects of chemical reactions, electron configuration and the periodic table, oxidation states, basic concepts of chemical bonding, equilibrium, acids and bases. Exam format: 25 multiple-choice questions with penalties. Minimum passing grade: 5/10.
    2. For BIO, BIOCHEM, ENV. SCI. degrees: the exam will include simple problems in stoichiometry and solutions, as well as questions on the formulation and nomenclature of inorganic compounds. Exam format: two exercises and 20 formulas/names. Minimum passing grade: 7/10. The score will not be considered to calculate the average mark of the course. For CHEM and CHEM+BIOCHEM degrees: the exam that will include questions on the formulation and nomenclature of inorganic compounds. Minimum passing grade: 9/10. The score will not be considered to calculate the average mark of the course.

Those described above are "key exams", for which *three opportunities* will be given in the ordinary call.

- For BIO, BIOCHEM, ENV. SCI. degrees: ***Laboratory sessions*** are mandatory and will account for **15%** of the course grade. Laboratory notebooks will be checked daily. Skill, organization, and cleanliness in the laboratory will also be assessed. There will be short quizzes (5 multiple-choice questions) at each session. (Grading: quizzes 50%; laboratory work 50%). A passing grade in the laboratory sessions is required to pass the course. For CHEM and CHEM+BIOCHEM degrees: A midterm exam of problems corresponding to the *seminars of Fundamentals of Chemistry* (**10%** of the final grade) and evaluation of participation in these classes (**5%** of the final grade).

- The final exam will account for **60%** of the course grade and will consist of multiple-choice questions and problems. (Grading: 30 multiple-choice questions, 30%; 6 problems, 70%). **A minimum grade of 4.0 is required to pass the course.** *If this minimum is not achieved, the exam grade will be considered the final grade for the course.* Students who do not take the final exam will be marked as "absent" (“no presentado”).
- Throughout the semester, six short multiple-choice quizzes will be taken during in-person classes. The five best scores will be considered and will account for **10%** of the final grade.
- In addition, five assignments will be given, which will account for **5%** of the final grade. Submission of these assignments before the deadline will be taken into account.

NOTE FOR STUDENTS REPEATING THE SUBJECT:

BIO, BIOCHEM, and ENV.SCI. students repeating the course are not required to repeat the laboratory sessions and retain their previous grade. CHEM (and CHEM+BIOCHEM) students also retain their grade from the *Fundamentals of Chemistry* seminars. The grade from the key exam on basic content is also retained. In these cases, if a student wishes to improve their grade, they may retake the corresponding exams, but they will lose their previous grade. The final grade will be averaged as follows: the final exam (60%), the grade from the laboratory sessions BIO, BIOCHEM, and ENV.SCI. or the *Fundamentals of Chemistry* seminar grade (CHEM and CHEM +BIOCHEM) (15%), the basic contents exam (10%), and the grade from a *series of assignments specifically designed* for these students (15%).

Extraordinary call (June)

The assessment for the extraordinary session will be based on a final exam, similar to that of the ordinary (December) call. This score will be averaged with the scores for the essential chemistry exam, the lab sessions and the assignments; short quizzes will be also considered if this improves the final mark. Key exams can be retaken in June if needed.

Students with special educational needs

Students with specific educational support needs must contact the Academic Coordination Office of their School beforehand to obtain authorization for any necessary accommodations (e.g., extra time for exams). This authorization must then be sent by the student to the professor. It is recommended that this process be completed at the beginning of the semester.

ATTENTION: Please remember that any attempt at fraud, copying, plagiarism, or other irregular behavior constitutes a serious offense as outlined in Title IV "Academic Discipline Rules for Students" within the System of Rules on Coexistence at the University of Navarra.

OFFICE HOURS

Dr J.R. Isasi (jrisasi@unav.es)

- Despacho 1170. Edificio de Investigación. Planta 1.
- Horario de tutoría: Tuesdays, 11:00 to 13:00 and 15:00 to 17:00, or by appointment.

Dr. I. Vélaz

- Despacho 0110. Edificio de Investigación. Planta baja.
- Horario de tutoría: martes de 12 a 14h, solicitando cita previa (itzvelaz@unav.es)

BIBLIOGRAPHY AND RESOURCES

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Adopted Textbook

- Chang R. (2023) **"Chemistry"** (14th ed.)". McGraw-Hill. Find it in the Library (*e-book*)
- Chang R. (2019) **"Chemistry"** (13th ed.)". McGraw-Hill. Find it in the Library (*e-book*)
- Chang R. (2021) **"Química"** (13ª ed.). McGraw-Hill. Find in the Library *(e-book)*
- Atkins, P., Jones, L., Laverman, L. (2013). **"Chemical Principles. The Quest for insight"**. (6th ed.)". W.H. Freeman & Co./Macmillan Higher Ed. Find it in the Library

Other recommended textbooks

- Petrucci R.H. (2011) "Química General. Principios y aplicaciones modernas". (10ª ed.)". Pearson. Find it in the Library (*e-book*)
- W.R. Peterson. "Introducción a la nomenclatura de las sustancias químicas". 2ª Ed. Reverté. 2011. Find it in the Library (*e-book*)

For the Chemistry degree:

- M. R. Fernández, J. A. Fidalgo. "Mil problemas de Química General". Everest, León, 2007. Find it in the Library
- J. Casabó. “Estructura atómica y enlace químico”. Reverté, Barcelona. 1997. Find it in the Library
- J. M. Fernández Álvarez, I. Navarro-Blasco; J.I. Álvarez Galindo. "A collection of Analytical Chemistry solved and explained exercises" EUNSA, Colección Apuntes. Pamplona, 2020. Find it in the Library (e-book)