Universidad de Navarra

General Chemistry

Teaching guide 2026-27

INTRODUCTION

Course description: Chemistry studies the composition of matter at a molecular level and how substances combine and transform. In this course, the chemical fundamentals needed to address more specific disciplines such as physical chemistry, organic chemistry, biochemistry or physiology are established. Additionally, useful practical skills are acquired through several laboratory sessions. [*Note:* Chem and Chem+Biochem degrees students must also take three extra credits in the first semester, which will be taught in Spanish; in addition, their lab sessions are replaced by seminars.]

- **Degree**: BIOCHEMISTRY, BIOLOGY, ENVIRONMENTAL SCI., BIO+ENV.SCI., CHEMISTRY, CHEM+BIOCHEM.
- **Module in the Degree Program**: Module I
- **Number of credits**: 6 ECTS (for CHEM and CHEM+BIOCHEM degrees: 6+3 ECTS)
- **Year**: First, 1st semester
- **Type of course**: Basic subject
- **Instructors**: Itziar Vélaz and José R. Isasi
- **Language**: English
- **Lecture schedule**: Mondays 11h-13h, Thursdays at 11h, Fridays at 10h. In addition, CHEM and CHEM+BIOCHEM students: martes 10:00h, jueves 8:00h, viernes 12: 00h (aula 32, taught in Spanish).

LEARNING OUTCOMES (Competencies)

1.1. BIOCHEMISTRY DEGREE COMPETENCIES

Specific competencies

- **CE4**. A knowledge of the foundations of Physics and Chemistry which are relevant to understand biological and biochemical processes and the acquisition of skills of basic experimental procedures to work in a laboratory in a safe and efficient way.

General and basic competencies

- **CB1**. That students had demonstrated knowledge and understanding in a subject starting from general secondary education and is typically at a level which, although supported by advanced textbooks, also includes some aspects related to a knowledge corresponding to the forefront of their field of study.
- **CG2**. Integrated thinking and the approach to problems from different perspectives. Acquiring critical thinking capabilities. Providing solutions to problems in Science.
- **CG6**. Working properly in a laboratory with chemical and/or biological material, including security, handling and disposal of waste, annotated record of activities and the interpretation of results.

1.2. BIOLOGY DEGREE COMPETENCIES

Specific competencies

- **CE3**. Proper and safe operation skills to work in a laboratory, including the correct handling and disposal of waste.
- **CE10**. A comprehension of the basics of Mathematics, Physics, Chemistry, Statistics and Computer Science, relevant to understand biological processes and living organisms, as well as to judiciously apply observing, measurement and experimentation techniques in Biology.

Universidad de Navarra

General and basic competencies

- **CB1**. That students had demonstrated knowledge and understanding in a subject starting from general secondary education and is typically at a level which, although supported by advanced textbooks, also includes some aspects related to a knowledge corresponding to the forefront of their field of study.
- **CG2**. Integrated thinking and the approach to problems from different perspectives. Acquiring critical thinking capabilities. Providing solutions to problems in Science.

1.3. ENVIRONMENTAL SCIENCES DEGREE COMPETENCIES

Specific competencies

- **CE1**. A knowledge of the scientific fundamentals required to address specific environmental training.
- **CE3**. A description of the structure, the physicochemical properties and reactivity of elements and compounds involved in biogeochemical processes.
- **CE4**. Using laboratory techniques and instrumentation appropriate to do research.

General and basic competencies

- **CB1**. That students had demonstrated knowledge and understanding in a subject starting from general secondary education and is typically at a level which, although supported by advanced textbooks, also includes some aspects related to a knowledge corresponding to the forefront of their field of study.
- **CG2**. Integrated thinking and the approach to problems from different perspectives.
- **CG3**. Acquiring critical thinking capabilities.

1.4. CHEMISTRY DEGREE COMPETENCIES

Specific competencies

- **CE1**. Analysis and resolution of qualitative and quantitative problems according to previously developed models as well as the recognition of new problems and planning strategies for their resolution.
- **CE6**. A knowledge of the main aspects of chemical terminology, nomenclature, conventions and units used in the various areas of chemistry, and the importance of the periodic table and the periodic variation of the properties of the elements according to their location in the table.
- **CE7**. A knowledge of the chemical elements and their most relevant compounds -organic, inorganic and organometallic-, and the functional groups in organic molecules as well as their properties, applications and main sources or synthesis routes.
- **CE9**. A knowledge of the characteristics of the states of matter.

General and basic competencies

- **CB1**. That students had demonstrated knowledge and understanding in a subject starting from general secondary education and is typically at a level which, although supported by advanced textbooks, also includes some aspects related to a knowledge corresponding to the forefront of their field of study.
- **CG2**. Integrated thinking and the approach to problems from different perspectives. Acquiring critical thinking capabilities. Providing solutions to problems in Science.

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

A) Lab sessions for Biochemistry, Biology and Environmental Sciences students:

1. Preparation of solutions and acid-base titrations

1. Making up solutions of known concentrations for diverse substances.
2. Titration of oxalic acid with sodium hydroxide.

2. Complexometric titrations

1. Determination of calcium and magnesium contents in running water by the formation of coordination compounds.
2. Removal of water hardness using precipitation reactions.

3. Organic reactions. Filtration methods and purification by crystallization.

1. Synthesis of acetylsalicylic acid (aspirin), crystallization and purity test.

4. Separation techniques. Liquid-liquid extraction.

1. Separation of benzoic acid and ethyl acetate by extraction using aqueous sodium hydroxide.
2. Purification of the isolated components.

B) Problem solving sessions and seminars common to all four degrees

---

DEGREE IN CHEMISTRY (3 ECTS specific for Chemistry degree students, taught in Spanish)

Advanced Structure of Matter

1. Inorganic formulation and stoichiometry

2. Atomic structure II

3. The covalent bond

4. Molecular symmetry

5. The structure of solids

Note: In lieu of the lab practical sessions, the Chemistry (and Chem+Biochem.) students will attend **ten hours** of seminars on additional advanced General Chemistry problems.

EDUCATIONAL ACTIVITIES

Universidad de Navarra

1. Classroom activities common to all Science degrees

1. LECTURES. **40 Hours** (***1.6 ECTS***)

- *Methodology:* lectures in the classroom for all the students, in which interactive and participative training will be encouraged. The fundamental concepts for each lesson will be presented.
- *Acquired competencies:* the students will learn the basic aspects of the subject and how to apply them to problem solving.

2. PROBLEM SOLVING SEMINARS. **11 Hours** (***0.45 ECTS***)

- *Methodology:* classroom sessions in which students work individually or in groups solving problems or exercises.
- *Acquired competencies:* the students will apply their basic knowledge to the resolution of problems and case studies, interpret analytical data and evaluate the obtained results.

3. TUTORING. **1 Hour** (***0.04 ECTS***)

- *Methodology:* non-compulsory sessions in which the lecturer and students meet to work on specially hard aspects of the course.
- *Acquired competencies:* the students will learn how to apply their knowledge to solving problems and will improve their comprehension of the subject.

4. EXAMINATIONS. **4 Hours** (***0.16 ECTS***)

2. Out of classroom activities common to all Science degrees

1. SOLVING PROPOSED EXERCISES. **30 Hours** (***1.2 ECTS***)

- *Methodology:* Individual activities consisting on solving several exercises will be requested. These assignments must be completed before the indicated deadlines.
- *Acquired competencies:* the students will learn how to apply their theoretical knowledge to the resolution of problems.

2. PERSONAL AND/OR GROUP STUDY. **54 Hours** (***2.16 ECTS***)

- *Methodology:* the students must study the material covered in the lectures, with particular emphasis on solving the exercises proposed for each lesson.
- *Acquired competencies:* after studying the lessons and solving the corresponding related exercises, the knowledge required to reach the goals of this course will be set.

3. Classroom activities common to Biochemistry, Biology and Environmental Sciences degrees

LABORATORY SESSIONS. **10 Hours** (***0.4 ECTS***)

- *Methodology:* practical sessions in the chemistry laboratory; the students will be asked to register their activities in a lab notebook and/or will respond to questionnaire about the lab session while in progress.
- *Acquired competencies:* the students will learn how to work with standard laboratory equipment, how to weigh and measure volumes precisely and how work in an adequate fashion (safety and waste disposal); besides, they will learn how to quantitatively determine the components in a sample.

Universidad de Navarra

4. Exclusive activities of the Chemistry degree

4.1. Classroom

THEORETICAL-PRACTICAL LECTURES: **27 Hours** (***1 ECTS***)

- *Methodology:* Lectures (on Wednesdays and Thursdays) will be combined with seminars and workshops to put into practice the acquired knowledge.
- *Acquired competencies:* the students will expand their basic knowledge of nomenclature, atomic structure, chemical bond and the structure of solids.

FORMULATION AND SPECIAL PROBLEMS. **10 Hours** (***0.4 ECTS***)

- *Methodology:* 10 seminars with problems and case studies will be held.
- *Acquired competencies:* the students will apply their knowledge to the resolution of problems and exercises.

4.2. Out of classroom

1. SOLVING PROPOSED EXERCISES. **20 Hours** (***0.8 ECTS***)

- *Methodology:* each student must solve two sets of three problems that need to be handed to the instructor.
- *Acquired competencies:* the students will apply their basic knowledge to problem solving.

2. PERSONAL AND/OR GROUP STUDY. **30 Hours** (***1.2 ECTS***)

- *Methodology:* the student must go through the material covered in class and solved the proposed exercises for seminars.
- *Acquired competencies:* the proper knowledge of the subject is acquired.

5. Time schedule

Biochemistry, Biology and Environmental Sciences degrees

- *Classroom activity:* Lectures and problem seminars, 40 hours + 11 hours.
- *Classroom activity:* Laboratory sessions, 10 hours.
- *Out of classroom activity:* Proposed exercises, 30 hours.
- *Classroom activity:* Final exam, 3 hours.
- *Classroom activity:* Midterms of formulation and laboratory, 1 hour.
- *Personal study (out of classroom):* 55 hours.

Chemistry degree

- *Classroom activity:* 40 h of lectures (part I) y 27 theoretical-practical of part II
- *Classroom activity:* 11 h problem seminars (part I)
- *Classroom activity:* 10 h formulation and specific problems
- *Classroom activity:* 1 h tutoring
- *Classroom activity:* 5 h assessment sessions
- 130 hours of student's personal work (study and problem solving)

ASSESSMENT

ORDINARY CALL (December)

DEGREES IN BIOCHEMISTRY, BIOLOGY AND ENVIRONMENTAL SCIENCES

- Two **requirements to pass** the subject must be fulfilled:

Universidad de Navarra

1. A test on fundamental concepts in Chemistry (**10%** of the final grade), essential to take this subject (corresponding to "bachillerato" in the Spanish system): quantitative aspects of chemical reactions, electronic configuration and periodic table, oxidation states, basic concepts of chemical bonding, equilibrium, acids and bases. Minimum mark: 5/10.
2. An exam including two parts: 2 stoichiometry exercises and 10+10 questions about nomenclature of inorganic compounds (mark: 7/10, in each part).

- ***Laboratory sessions*** will be held at the beginning of the semester; attendance is compulsory and the lab assessment will account for **15%** of the course grade. Each day, a brief report of the practical must be turned in. After all sessions have been completed, there will be a lab exam. Care and skill in the laboratory will also be assessed. (Ratings: exam, 70%; reports and lab skills, 30%). A pass grade (5/10) in the lab is a must in order to pass the whole course.
- The ***final exam*** will account for **60%** of the course grade, and it will consist of multiple choice questions and problems. (Ratings: test, 30%; problems, 70%). A minimum score of 4.0 points must be obtained in this exam to pass the course. Should this minimum be not reached, the mark obtained in this final exam will appear as the final grade for the course. Students who do not take the final exam will be graded as "*no presentados*" (*absent*) for the course.
- Throughout the semester, *six* ***quiz tests*** with multiple choice questions will be taken during lectures. Of these, only the top five, which will provide **10%** of the final grade, will be taken into account.
- In addition, *five homework* ***assignments*** (with six questions each), accounting for **5%** in the course grade, will be given. Homework (handwritten and scanned) uploading on or before the due date will be assessed with a full mark. Late submission will be penalized with half of that mark.

DEGREE IN CHEMISTRY (and CHEM+BIOCHEM) only

Part I (2/3 of the final grade, 6 ECTS credits)

- An exam covering inorganic formulation and nomenclature will be taken (minimum score: 9/10), and a problem exam (from the weekly specific seminars for Chemistry degree students) whose score will account for **15%** of the grade of this "part I".
- There will be a preliminary required exam on basic concepts of chemistry (**10%** of the final grade), equivalent to the 1st year of the Spanish system's "bachillerato": quantitative aspects of chemical reactions, electronic configuration and periodic table, oxidation states, basic concepts of chemical bonding, equilibrium, acids and bases.
- The final exam will account for **60%** of the grade of this part of the course and will consist of multiple choice questions, short questions, and problems. (Ratings: test 30%, questions and problems 70%). A minimum score of 4.0 points must be obtained to pass the course. Should this minimum be not reached, the mark obtained in this final exam will appear as the final grade for the course. Students who do not take the final exam will be graded as "*no presentados*" (*absent*) for the course
- Throughout the semester, *six* ***quiz tests*** with multiple choice questions will be taken during lectures. Of these, only the top five, which will provide **10%** of the final grade, will be taken into account.
- In addition, *five homework* ***assignments*** (with six questions each), accounting for **5%** in the course grade, will be given. Homework delivery will be assessed.

Part II (1/3 of the final grade, 3 ECTS credits) ***Lectures in Spanish only***

- Two homework assignments will be given, accounting for **20%** of the grade for this part of the course.
- It will be required to pass a formulation and stoichiometry exam, and, additionally, two 50-min midterm exams will be taken during the semester. These midterms will account for **30%** of the grade of this part of the course.
- The final exam (**50%**) for Part II of the course will consist of multiple choice questions, short questions and problems.

- *Note*: The evaluation system of part II for second-year students will be the same as for students in the first call.

EXTRAORDINARY CALL (June)

The **re-sit examination** assessment will be based on a final exam, similar to the ordinary examination period, whose score will be averaged with laboratory, homework assignments, and quizzes scores in the same way as in the ordinary call.

- Degree in Chemistry (or CHEM+BIOCHEM): los alumnos que no hayan superado la asignatura en la convocatoria ordinaria deberán realizar un examen de la parte I y otro de la parte II (Ampliación de Química), cuyas calificaciones promediarán con las de los exámenes, pruebas breves y tareas de la misma forma que en la convocatoria ordinaria.

Students who are taking the course for a second time are not required to repeat the laboratory sessions and they may keep the score they got the first time (provided they passed the exam). If a student wishes to improve his/her score, he/she could repeat the lab sessions, but they must take the exam once again. For the final course assessment, the final exam (60%), the preliminary exam (10%), the laboratory score (15%) and that for a series of specific assignments proposed for these students (15%) will be averaged.

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

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)