# Course guide
# 370002 - QUIMICA - Chemistry for Vision Sciences

**Last modified:** 29/05/2025

**Unit in charge:** Terrassa School of Optics and Optometry
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.

**Degree:** BACHELOR'S DEGREE IN OPTICS AND OPTOMETRY (Syllabus 2020). (Compulsory subject).

**Academic year:** 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

## LECTURER

**Coordinating lecturer:** Joan Torrent Burgués (http://futur.upc.edu/JuanTorrentBurgues)
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**Others:** Ivanova, Kristina Dimitrova (https://futur.upc.edu/KristinaDimitrovaIvanova)
Pere Garriga Solé (http://futur.upc.edu/PereGarrigaSole)

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
CE05. (ENG) The ability to understand the structure of matter, the chemical processes of solutions and the structure, properties and reactivity of organic compounds. The ability to understand the composition and structure of the molecules that make up living beings. The ability to understand the transformation of certain biomolecules into others. The ability to study the molecular basis of the storage and expression of biological information. The ability to apply biochemical knowledge to the eye and the process of vision.

CE07. (ENG) The ability to understand and manage basic laboratory materials and techniques.
CE11. Describe the physical and chemical properties of the materials used in the field of optics and optometry.

**Generical:**
CG4. Critically reflect on the clinical, scientific, ethical and social issues involved in the professional practice of optometry, understand the scientific foundations of optics and optometry and critically evaluate terminology, clinical trials and research methods related to optics and optometry.
CG16. Participate effectively in both single-discipline and multidisciplinary work groups on projects related to optometry.

**Transversal:**
CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

CT3. Teamwork. To be able to work as a member of a multidisciplinary team, either as a base member or undertaking managerial decisions aiming at developing projects from a practical and responsible standpoint, adopting commitments given the available resources

## TEACHING METHODOLOGY

MD01. Participative class of theoretical and practical contents.
MD03. Practical class with the participation of the students, solving practical cases and/or exercises related to the contents of the course.
MD04. Laboratory practicals.
MD06. Completion of problems, exercises and assignments, and resolution of doubts through the Atenea virtual campus.
MD07. Tutorials.

During class hours, teachers give a brief presentation on a topic to introduce the general learning objectives related to the basic concepts of the subject. Subsequently, through practical exercises, they try to motivate and involve students so that they actively participate in the learning process. Students have at their disposal notes with the theory and the collection of problems and application exercises for each topic, presentations with the figures, diagrams and tables that are projected in class, and videos with explanations of some topics. Students are also provided with worksheets with the specific contents of each topic and the hours foreseen to carry out each activity, both face-to-face and personal work.

To encourage autonomous learning, students have self-learning and self-assessment questionnaires of the different contents through the Atenea virtual campus. On the other hand, learning is continuously assessed with evaluation questionnaires through the Atenea virtual campus.

Finally, laboratory practices are carried out in pairs. These sessions allow students to develop basic instrumental skills in a chemical laboratory, as well as to initiate students in the application of the scientific method in solving problems in the chemical laboratory. In general, after each session, students are required to hand in a report on the practical one week after the session and in some cases to answer an evaluation questionnaire. The schedule of the laboratory sessions is announced at the beginning of the course.

## LEARNING OBJECTIVES OF THE SUBJECT

11. Understanding the chemical processes in aqueous solution.
12. Being able to relate the structure with the properties of inorganic and organic compounds and biomolecules.
13. Being able to use basic laboratory equipment and techniques and to take, represent and interpret experimental data. rimentales.

## STUDY LOAD

| Type | Hours | Percentage |
|---|---|---|
| Hours small group | 15,0 | 10.00 |
| Hours medium group | 45,0 | 30.00 |
| Self study | 90,0 | 60.00 |

**Total learning time:** 150 h

## CONTENTS

### 1. Presentation. Basic concepts. Stoichiometry. Solutions

**Description:**
Description:
First, a presentation of the subject in which he speaks to students of the course objectives, the program of the lectures, seminars and practical. Shows the system of assessment and communication as will teachers - students so that they get all the information on the subject.

This was tackled Theme 1:
- Structure of atoms. Atomic number and atomic mass.
- Isotopes. Natural atomic mass.
- Molecules. Molecular formula. Molecular mass. Formula weight.
- Mol. Avogadro's number.
- Ions. State or oxidation number.
- Chemical reactions: chemical equation. Matching chemical equations.
- Stoichiometric ratio and stoichiometric ratio. Stoichiometric calculations.
- Solutions as chemical reagents, concentration units. Preparation of solutions. Solubility. Solubility of gas in liquid. Neutralitzations

**Related activities:**
Exercises and problems I. Dissolutions. Stoichiometric calculations.
Practical 1. The chemical laboratory. Safety regulations. Waste management. Measurement in chemistry. Techniques and measurements in the laboratory. Preparation of solutions.
Optical techniques in chemistry: refractometry and polarimetry. Partial exam.
Final exam.
Laboratory exam.

**Full-or-part-time:** 22h
Practical classes: 3h
Laboratory classes: 5h
Self study : 14h

### 2. Ionic equilibria in aqueous solution

**Description:**
This content is working Theme 2:
- Acid-base equilibria. Acidity and basicity constants.
- PH buffer solutions. Predominant species in solution.
- Curves of acid-base titration.
- Redox processes. Galvanic cells.
- Potential for a battery.
- Electrode potential. Metal corrosion.
- Electrolysis.

**Full-or-part-time:** 26h
Practical classes: 7h
Laboratory classes: 3h
Self study : 16h

### 3. Atomic and molecular structure. Covalent bond

**Description:**
content english

**Full-or-part-time:** 23h
Practical classes: 9h
Laboratory classes: 2h
Self study : 12h

### 4. ORGANIC COMPOUNDS, ORGANIC FORMULATION, ISOMERY.

**Description:**
This content covers:

Theme 5. Organic compounds. Organic formulation.
- Introduction to organic compounds. The carbon atom.
- Formulation and nomenclature of hydrocarbons.
- Formulation and nomenclature of compounds with functional groups.
- Polymers and Biopolymers.

Theme 6. Isomerism.
- Concept and type of isomerism.
- Structural isomerism: string, position, function.
- Stereoisomerism: geometric optics.
- Conformational analysis.

**Related activities:**
Exercises and problems V. Formulation and nomenclature in organic chemistry. Exercises and problems VI. Isomerism.
Practice 3. Optical techniques in chemistry: refractometry and polarimetry. Midterm exam.
Final exam.
Exam on formulation and nomenclature in organic chemistry. Laboratory exam.

**Full-or-part-time:** 32h
Practical classes: 13h
Laboratory classes: 1h
Self study : 18h

### 5. INTERMOLECULAR FORCES. STATES OF MATTER. PHYSICAL PROPERTIES

**Description:**
Topic 7. Intermolecular forces. States of aggregation of matter. Physical properties.
- States of aggregation of matter. Changes of state.
- Types of intermolecular forces.
- Types of substances according to the interaction forces between particles.
- Comparison of physical properties between organic compounds.

**Related activities:**
Exercises and problems VII. Intermolecular forces.
Practice 6. Physical properties and chemical reactions of organic compounds.

Final exam.
Laboratory exam.

**Full-or-part-time:** 16h
Practical classes: 5h
Laboratory classes: 1h
Self study : 10h

## 6. ORGANIC REACTIONS

**Description:**
Theme 8. Organic reactions.
- Acidity and basicity of organic compounds.
- Structure and Reactivity.
- Nature of organic reactions.Nucleophilic and electrophilic reagents.
- Classification of organic reactions.
- Substitution reactions.
- Addition reactions.
- Reactions of elimination.
- Condensation Reactions.
- Polymerization.
- Organic reactions of oxidation-reduction.

**Related activities:**
Practice 5. Acid -basic titration.
Practice 6. Physical properties and chemical reactions of organic compunds.
Final test.
Laboratory test.

**Full-or-part-time:** 19h
Practical classes: 4h
Laboratory classes: 3h
Self study : 12h

## 7. BIOMOLECULES

**Description:**
Theme 9. Biomolecules.
- Carbohydrates.
- Lipids.
- Amino acids, peptides and proteins.
- Nucleic acids.

**Related activities:**
Final Exam.

**Full-or-part-time:** 12h
Practical classes: 4h
Self study : 8h

## ACTIVITIES

### EXERCISES AND PROBLEMS

**Description:**
Exercises and problems are done in the classroom in medium-sized groups. Students have to work on the problems selected by the teacher. There are 7 problem sessions of 1 or 2 hours per session.
I. Dissolutions. Stoichiometric calculations.
II. Acid-base equilibrium.
III. ELECTROCHEMISTRY. Electrochemistry.
IV. Atomic and molecular structure.
V. Formulation and nomenclature of organic chemistry.
VI. Isomerism
VII. Intermolecular forces.

**Material:**
Notes and collection of problems for each of the topics available on the Atenea virtual campus. Collection of exercises solved step by step

**Delivery:**
Assessment exercises and questionnaires to be submitted through the Atenea virtual campus.
The average of the evaluation deliverables of the exercises and problems represents 10% of the final grade.

**Related competencies :**
CE11. Describe the physical and chemical properties of the materials used in the field of optics and optometry.

CE07. (ENG) The ability to understand and manage basic laboratory materials and techniques.
CE05. (ENG) The ability to understand the structure of matter, the chemical processes of solutions and the structure, properties and reactivity of organic compounds. The ability to understand the composition and structure of the molecules that make up living beings. The ability to understand the transformation of certain biomolecules into others. The ability to study the molecular basis of the storage and expression of biological information. The ability to apply biochemical knowledge to the eye and the process of vision.

CG4. Critically reflect on the clinical, scientific, ethical and social issues involved in the professional practice of optometry, understand the scientific foundations of optics and optometry and critically evaluate terminology, clinical trials and research methods related to optics and optometry.

**Full-or-part-time:** 14h
Practical classes: 14h

## LABORATORY PRACTICES

**Description:**
The practical sessions are held in the Chemistry and Optical Materials Laboratory, TR8 building, 1st floor. Students work in pairs and each practical session lasts 2 hours. It is compulsory to wear a lab coat for the practical sessions.
1. The chemical laboratory. Safety regulations. Waste management. Measurement in chemistry.
2. Techniques and measurements in the laboratory. Preparation of solutions.
3. Optical techniques in chemistry: refractometry and polarimetry.
4. Oxidation-reduction. Electrolysis.
5. Acid-base titration.
6. Physical properties and chemical reactions of organic compounds.

**Material:**
Students are provided with a script for each of the practices and also have videos available
for prior preparation or for subsequent evaluation of the practices. The scripts are available on the Atenea virtual campus and the videos are hosted on UPCommons and are accessible through the Atenea virtual campus.

**Delivery:**
Practice 1 is assessed by individually answering two questionnaires. One on safety and waste management (50%) and one on laboratory material (50%).
Practices 2, 3, 4 and 5 are assessed by handing in a report in pairs following the template indicated in the practice script.
Practice 6 is assessed by individually answering a questionnaire in Atenea about the reactions presented in the script.
The average of the practice deliverables represents 10% of the final grade.

**Related competencies :**
CE07. (ENG) The ability to understand and manage basic laboratory materials and techniques.
CG16. Participate effectively in both single-discipline and multidisciplinary work groups on projects related to optometry.

CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

CT3. Teamwork. To be able to work as a member of a multidisciplinary team, either as a base member or undertaking managerial decisions aiming at developing projects from a practical and responsible standpoint, adopting commitments given the available resources

**Full-or-part-time:** 14h
Laboratory classes: 14h

## PARTIAL EXAM

**Description:**
Individual completion in the medium-sized classroom of exercises, problems and questions from topics 1-4.
The exam lasts 60-90 minutes.

**Material:**
To prepare for the test, students have notes, presentations and exercises on the content of the topics being assessed, available on Atenea. They cannot be brought on the day of the test.
To take the test, they are provided with the statements of the exercises and a periodic table for assessments, and they need a calculator.
The score for each exercise is reported in the statement.

**Delivery:**
Students submit the written exam. It represents 20% of the final grade.
An official decision with correction criteria is available on the day of the exam review.

**Full-or-part-time:** 1h
Practical classes: 1h

### LABORATORY EXAM

**Description:**
Individual implementation in the laboratory of one of the experiences (chosen at random) that the students have previously carried out.

**Material:**
On the day of the exam, students will be provided with their practice scripts and data tables from the laboratory.
They must bring a calculator, graph paper and a ruler. The use of a lab coat is mandatory.

**Delivery:**
At the end of the experimental exercise, students must submit a report with the related questions indicated by the professor.
It represents 10% of the final grade.

**Full-or-part-time:** 1h
Laboratory classes: 1h

### FINAL EXAM.

**Description:**
Individual completion in the medium-sized classroom of exercises, problems and questions from topics 1-9 (except formulation).
The exam lasts 2 hours.

**Material:**
To prepare for the test, students have notes, presentations and exercises on the content of the topics being assessed, available on Atenea.
They cannot be brought on the day of the test.
To take the test, they are provided with the statements of the exercises and a periodic table for assessments. They need a calculator.
The score for each exercise is reported in the statement.

**Delivery:**
Students submit the written exam. It represents 40% of the final grade.
An official decision with correction criteria is available on the day of the exam review.

**Full-or-part-time:** 2h
Practical classes: 2h

### ORGANIC FORMULATION AND NOMENCLATURE EXAM

**Description:**
Individual performance of exercises in the classroom on formulation and nomenclature of organic chemistry.

**Material:**
To prepare for the test, students have the notes, presentations and exercises for topic 5 available on Atenea.
They cannot be brought on the day of the test.
To take the test, they are provided with the statements of the exercises.
The score for each exercise is indicated in the statement.

**Delivery:**
Students submit the written exam. It represents 10% of the final grade.
An official decision with correction criteria is available on the day of the exam review.

**Full-or-part-time:** 1h
Practical classes: 1h

## GRADING SYSTEM

The final grade (NF Final) is the sum of the following partial grades: NF Final = 0,4 NEF + 0,20 NEP + 0,10 NEL + 0,10 NL + 0,10 NEFN + 0,1 NQP
NEF: final examination mark.
NEP: mark for the partial examination.
NEL: laboratory examination mark. NL: laboratory mark.
NEFN: mark for the organic formulation and nomenclature examination. NQP: mark for questions and problems.

The final exam consists of questions on concepts associated with the learning objectives of the subject in terms of knowledge or understanding, and a set of application exercises. It is given 2 hours to complete.
The partial exam consists of questions on concepts associated with the learning objectives of the subject in terms of knowledge or understanding of the first part of the syllabus (topics 1-4) and a set of application exercises. See
1-1.5 hours are allowed for their completion.
The organic formulation and nomenclature test consists of a list of formulas and names of organic compounds and functional groups that students must complete with the corresponding name or formula.
The laboratory grade will be the average mark of the practical reports and/or questionnaires. In order to qualify for a mark, both attendance and the preparation of the report or the answer to the corresponding questionnaire will be compulsory.
The laboratory exam will consist of the experimental performance of one of the experiments that the students have carried out in the laboratory and the presentation of the corresponding report.
The qualification of questions and problems will be the average mark of the deliverables of each of the classes of exercises and problems.

The competence CT02. Sustainability and social commitment is assessed through laboratory practice P1 (50%) and the laboratory score NL (50%). Competence CT03. Effective oral and written communication is assessed through the NL and NEL average score.

Students who fail the subject with a mark of 3,5 or higher will have the option of recovering it through a re-evaluation exam. The re-evaluation will consist of a written test in which the theoretical contents of the subject will be evaluated with a weight of 80% of the mark and a written test of laboratory contents with a weight of 20% of the mark. This laboratory content test will not be necessary if the laboratory practice reports (NL) and the laboratory practice exam (NEL) have been passed during the course, maintaining in this case the course mark with a weight of 20%. This re-evaluation will be carried out according to the general conditions established each academic year by the Academic Regulations of the UPC's Bachelor's and Master's Degree courses (NAGRAMA) and the specific conditions established by the Faculty of Optics and Optometry of Terrassa. Students and

## EXAMINATION RULES.

- It is a necessary condition to obtain the final grade of this subject to take all the tests.
- In order for the NL grade to be weighted in the final grade, it is compulsory to have a minimum of 75% in attendance and evaluation of the practical laboratory classes.
- There are two attempts for the Formulation and Organic Nomenclature exam. It is necessary to get at least a 4 in this formulation test in the first attempt in order to be weighted in the final grade. If this is not the case, you will have to take the Formulation and Organic Nomenclature exam again, which will be held on the same day as the final exam, and then the grade of this second attempt will be weighted in the final mark of the course, if it is higher than the grade of the first attempt.

In the case of partial or total copying in any of the assessments of the subject, the provisions of the Academic Regulations of the UPC bachelor's and master's degree courses will be applied:
"Irregular actions that may lead to a significant variation in the grade of one or more students will constitute a fraudulent performance of an assessment act. This action will lead to the descriptive grade of failure and a numerical grade of 0 for the evaluation act and the subject, without prejudice to the disciplinary process that may arise as a result of the acts carried out. If the student considers the decision to be incorrect, he/she may lodge a complaint with the director or dean of the faculty or school and, if the response is not satisfactory, he/she may lodge an appeal with the rector.
The total or partial reproduction of academic or research work, or its use for any other purpose, must have the explicit authorisation of the authors.
It shall be the responsibility of the director or dean of the faculty or school to resolve any allegations regarding aspects not included in the regulations.

## BIBLIOGRAPHY

**Basic:**
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## RESOURCES

**Other resources:**
- Links to websites
- UPC Video Library of the Resource Group for the Teaching of Chemistry, teaching materials:
- Audiovisual materials showing basic procedures in the chemistry laboratory http://upcommons.upc.edu/video/handle/2099.2/1241 /> - Audiovisual materials on safety in the chemistry laboratory: http://upcommons.upc.edu/video/handle/2099.2/1240 />- Website on laboratory equipment: http://descartes.upc.es/adminmat/grediq/ />- UPC Audiovisual Support Material, video organic reactions: https://www.youtube.com/watch?v=JNmxX8IXo1Y />- MOOC ELI