



PERSONA CIÈNCIA EMPRESA  
UNIVERSITAT RAMON LLULL

## COURSE: CHEMICAL AND ENGINEERING LABORATORY II

**SUBJECT MATTER:** Analytical Chemistry

**MODULE:** Specific Technology

**PROGRAM:** Degree in Chemical Engineering

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### GENERAL FEATURES

**Type:**  Basic Formation,  Compulsory,  Elective

Final Degree Project,  Internship

**Duration:** Semestral

**Semester / s:** 4

**Number of ECTS credits:** 5

**Language / s:** Spanish, Catalan, English

### DESCRIPTION

#### SHORT DESCRIPTION AND JUSTIFICATION

Analytical Chemistry experimentation laboratory, which presents:

- Conventional methods of analysis: volumetric and gravimetric techniques,
- Instrumental methods of analysis: electrochemical techniques, spectrophotometric and chromatographic techniques.

#### COMPETENCES

- Be able to perform experiments with conventional and instrumental methods of analysis to achieve their requirements **(CB1, E5)**.
- Be able to identify, formulate and solve experimental problems in the field of Analytical Chemistry **(CB2, E7)**.
- Be able to analyze, integrate and interpret data and information from the field of Analytical Chemistry **(CB3, E8)**.
- Be able to design processes and experimental analysis to achieve the requirements of these **(E10)**.
- Be able to assess the risks in the use of chemical and biological substances **(E11)**.
- Be able to communicate effectively both orally and in writing **(CB4)**.
- Capacity for analysis, design, simulation and optimization of processes and products **(TE2)**.

#### PREVIOUS REQUIREMENTS

According to teaching planning and current academic regulations.



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### CONTENTS

#### 1. CONVENTIONAL METHODS OF ANALYSIS

- 1.1. Gravimetric methods
- 1.2. Volumetric methods

- Precipitation
- Acid-base
- Complexometric
- Redox

#### 2. INSTRUMENTAL METHODS OF ANALYSIS

- 2.1. Electrometric methods

- Potentiometric titrations
- Conductimetric analysis

- 2.2. Molecular absorption spectrophotometry UV-VIS

- 2.3. Chromatography

- High performance liquid chromatography (HPLC)
- Gas chromatography (HRGC)

### METHODOLOGY

### LEARNING ACTIVITIES

Learning Activities	Hours	ECTS Credits	Competences
Lectures	-	-	-
Case and Problem-Solving Sessions	-	-	-
Seminars	-	-	-
Practical and Lab Work	100	3,7	CB1, E5, CB3, E8, E10, E11, CB4, TE2
Presentations	5	0,2	CB4
Personal Study	27	1	CB2, E7, CB3, E8, E10, E11, CB4, TE2
Assessment Tasks (Exams, Continuous Assessment...)	3	0,1	CB2, E7, CB3, E8, E10, E11, CB4, TE2
<b>TOTAL</b>	<b>135</b>	<b>5</b>	



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### TEACHING METHODOLOGY

Laboratory is divided into two blocks:

#### I) Conventional Methods of analysis:

The student perform 8 practices individually. These practices are the following aqueous determinations:

- Gravimetric determination of iron
- Volumetric methods:
  - o Precipitation: chlorides by Mohr.
  - o Acid-base: carbonate and acetic acid.
  - o Complexometric: aluminum with EDTA
  - o Redox; Iron with dicromate, Copper iodometrically and Permanganate with oxalate

#### II) Instrumental Methods of analysis:

The practices of Instrumental Analysis methods Block are performed in groups of 2-3 students:

- Electrometric methods
  - o Potentiometric titrations: acid-base, chlorides and fluorides
  - o Conductimetric analysis
- Molecular absorption spectrophotometry UV-VIS
- Chromatography
  - o High performance liquid chromatography (HPLC)
  - o Gas chromatography (HRGC)
- Food analysis:
  - o Proteins by Kjeldahl method.
  - o Grease by Soxhlet method.

The student has a predetermined interval of time to perform each of the practices.

For each of the practices it is provided a brief description of the method to follow, previously available (*Moodle* platform), which the student must complete with the reading of the literature.

The experimental results and observations must be recorded in the **Laboratory notebook**. The laboratory notebook must be available to teaching-assistants and the laboratory professor for its revision.

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For each of the practices on conventional methods of analysis the student must submit the result of the determination. For practices of Instrumental Analysis methods **worksheets/reports** in groups are developed and delivered.

Each group will conduct an **oral presentation** of the results and conclusions obtained in one of the practices of instrumental Analysis methods made during the course.

Direct contact with teaching-assistants and the professor can develop in students the ability to evaluate the experimental results. Furthermore, this contact in the laboratory allows assessing the performance of the course and the adequacy of its progress in achieving their educational objectives. Moreover, students can make their inquiries in the professor's office individually or in groups.

### ASSESSMENT

#### ASSESSMENT METHODS

Assessment methods	Weight	Competences
Final Exam	10%	CB2, E7, CB3, E8, E10, TE2
Midterm Exam/s	-	-
Continuous Assessment Activities	10%	CB2, E7, TE2
Reports and Presentations	30%	E10, CB4, TE2
Lab or Field Work	50%	CB1, E5, CB3, E8, E11, CB4, TE2
Projects	-	-
Host Student Evaluation	-	-
Participation	-	-

#### LEARNING OUTCOMES

- The student must demonstrate ability to apply the described experimental methods (→ E5, CB1, TE2).
- The student must demonstrate the ability to interpret the results and observations made in the individual or group experiments (→ E7, CB2, TE2).
- The student must demonstrate ability to solve problems that arise during the experiments (→ E7, CB2, TE2).
- The student must demonstrate the ability to assess the analytical possibilities offered by the Conventional and Instrumental methods of analysis (→ E8, CB3, TE2).
- The student must demonstrate the ability to perform calculations and statistical treatment to evaluate the quality of the results (→ E8, CB3, TE2).
- The student must demonstrate the ability to design experiments in the laboratory (→ E10, TE2).
- The student must demonstrate the ability to prevent environmental and safety risks (→ E11, TE2).



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- The student must demonstrate the ability to prepare reports of the practices carried out, as well as keeping a complete, traceable and detailed laboratory notebook (→ CB4, TE2).
- The student must demonstrate the ability to orally communicate the experimental work carried out (→ CB4).

### QUALIFICATION

The grade of this course is obtained:

<b>Final exam</b>	10%
<b>Practical activities:</b>	
<b>Continuous Assessment activities</b>	10%
<b>Reports and presentations</b>	30%
<b>Lab work</b>	50%

**Continuous Assessment activities** include attitude, attendance and initiative shown by students in the laboratory.

**Reports and presentations** include the Laboratory notebook and the oral presentation. The **Lab work** includes both the results of the practices of conventional methods of analysis and the results of *worksheets/ reports* of the practices of instrumental methods of analysis. While performing the experimental work it is evaluated the student's ability to assess risks in the use of chemical and biological substances.

If the **final exam** grade is less than 4 points or **practical activities** are less than 5, the first call will be failed (usually June). To overcome it in subsequent calls should be made complementary practices and / or exams. In any case, it will still considering the grades from other evaluation systems.



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### ASSESSMENT OF THE COMPETENCES

Competences	Assessment methods	Observations (grading system)
Be able to perform experiments with conventional and instrumental methods of analysis to achieve their requirements <b>(CB1, E5)</b> .	Final exam Continuous Assessment Activities Lab work	Mean results from conventional methods practices (block I) and instrumental methods practices (block II)
Be able to identify, formulate and solve experimental problems in the field of Analytical Chemistry <b>(CB2, E7)</b> .	Final exam Continuous Assessment Activities Lab work	Practical activities grade (90% Final grade)
Be able to analyze, integrate and interpret data and information from the field of Analytical Chemistry <b>(CB3, E8)</b> .	Final exam Lab work	Final exam
Be able to design processes and experimental analysis to achieve the requirements of these <b>(E10)</b> .	Final exam Reports and Presentations	Laboratory notebook
Be able to assess the risks in the use of chemical and biological substances <b>(E11)</b> .	Lab work	Assessment during experimental work (Continuous Assessment Activities, attitude and initiative)
Be able to communicate effectively both orally and in writing <b>(CB4)</b> .	Reports and Presentations Lab work	Oral presentation
Capacity for analysis, design, simulation and optimization of processes and product. <b>(TE2)</b>	Final exam Reports and Presentations Lab work	Final grade of the course

### BIBLIOGRAPHY

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- David Harvey. Química Analítica Moderna. 1ª Edición. Ed. Mc Graw Hill. Madrid. 2002
- Judith F. Rubinson, Kennet A. Rubinson. Química Analítica Contemporanea. Ed. Prentice Hall. México. 2000.
- J.J. Lagowski, C.H. Sorum. Introduction to Semimicro Qualitative Analysis. . Ed. Prentice-Hall, Inc. 1991.
- Daniel C. Harris. Anàlisi Química Quantitativa. Ed. Reverté, S. A. 2006.



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### **DOCUMENT HISTORY**

#### **PREVIOUS REVISIONS**

December 2017 (Dra. Judith Báguena)

September 2016 (Dra. Judith Báguena)

February 2016 (Dra. Judith Báguena)

June 2012 (Dra. Judith Báguena)

June 2011 (Dra. Judith Báguena)

June 2010 (Dra. Judith Báguena)

#### **CURRENT REVISION**

December 2018 (Dra. Judith Báguena)