



PERSONA CIÈNCIA EMPRESA  
UNIVERSITAT RAMON LLULL

## COURSE: CHEMICAL AND BIOLOGICAL LABORATORY

**SUBJECT MATTER:** Chemistry

**MODULE:** Basic Formation

**PROGRAM:** Degree in Chemical Engineering

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### GENERAL CHARACTERISTICS

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

Final Degree Project,  Internship

**Duration:** Annual

**Semester/s:** 1 and 2

**Number of ECTS credits:** 6

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

### DESCRIPTION

#### SHORT DESCRIPTION AND JUSTIFICATION

Laboratory activity is a fundamental part of the work of the chemical professional and one of the essential ways of obtaining data in the profession.

The course pursues that the students acquire the basic knowledge of practical type that are applicable in a chemical and biological laboratory, which will be essential for the further development of other activities in the degree, as well as for their future professional life. Likewise, they will also acquire the proper language of these laboratories.

The course includes as essential the following contents: Safe handling of chemical products, biological agents, bio-sanitary samples and of the residues generated. Laboratory glassware. Basic operations of the chemical and biological laboratory.

#### COMPETENCES

- Be able to apply in a practical way the basic knowledge in Chemistry and Biology necessary for application in the field of Chemical Engineering. (E1, CB1)
- Be able to identify, formulate and solve basic problems in Chemistry, Biology in the fields of Chemical Engineering and Chemistry. (E7, CB2)
- To be able to assess the risks in the use of chemical and biological substances and the processes in which they are involved. (E11)
- Ability to understand and apply the basic knowledge principles of general chemistry, organic and inorganic chemistry and their applications in engineering. (FB4)

#### PREVIOUS REQUIREMENTS

According to planning of the teachings and current academic regulations.

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### CONTENTS

- **CHAPTER 1: SECURITY IN A CHEMICAL AND BIOLOGICAL LABORATORY**  
Basic work standards. Handling chemical products. Handling biological agents. Handling bio-sanitary samples. Biological safety levels in laboratories. Accidents
- **CHAPTER 2: RESIDUES IN A CHEMICAL LABORATORY AND IN A BIOLOGICAL LABORATORY**  
Residue minimization. Residue classification and handling.
- **CHAPTER 3: LABORATORY GLASSWARE**  
Glass composition and type of glass. Ground glass. Volumetric instruments. Cleaning and drying glassware.
- **CHAPTER 4: BASIC OPERATIONS IN A CHEMICAL LABORATORY**  
Solid crushing and homogenization. Weighing. Solid precipitation. Solid crystallization. Evaporation. Filtration and centrifugation. Solid, liquid and gas drying. Liquid-liquid extraction. Distillation. Reflux operations. Heating and temperature measurement. pH measurement. Determination of boiling point, refractive index and density.
- **CHAPTER 5: BASIC OPERATIONS IN A BIOLOGICAL LABORATORY**  
Extraction from the genetic material.  
Microscopy: Fresh observations and stains. Sterilization techniques. Macro and micro-organisms identification. Microorganisms isolation and culture. Genetic material extraction.

### METHODOLOGY

### LEARNING ACTIVITIES

Learning activities	Hours	ECTS Credits	Competences
Lectures	22	0,8	E1, CB1, E7, CB2, E11, FB4
Case and Problem-Solving Sessions	-	-	-
Seminars	8	0,3	E1, CB1, E7, CB2, E11, FB4
Practical and Lab Work	86	3,2	E1, CB1, E7, CB2, E11, FB4
Presentations	-	-	-
Personal Study	41	1,5	E1, CB1, E7, CB2, E11, FB4
Assessment Tasks (Exams, Continuous Assessment...)	5	0,2	E1, CB1, E7, CB2, E11, FB4
<b>TOTAL</b>	<b>162</b>	<b>6</b>	

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### **TEACHING METHODOLOGY**

The teaching methodology used in this course is based on different activities, including practical work.

The practical work is carried out in the laboratory and allows to discuss the different contents expressed in the course syllabus, both in the chemical field and in the biological field.

The practices that will be carried out in the chemistry laboratory will be about:

- Basic work standards and safety in a chemical laboratory, handling of chemicals and residues.
- Preparation of solutions with the use of volumetric instruments. pH measurement.
- Precipitation, filtration, washing and drying of solids.
- Evaporation, crystallization of solids and determination of water of crystallization.
- Titration
- Liquid-liquid extraction, liquid drying, evaporation at reduced pressure.
- Thin Layer Chromatography (TLC). Visualization under UV light
- Separation of liquids by distillation and refractive index measurement.
- Reactions at reflux.

The practices that will be carried out in the biology laboratory will be about:

- Use of light microscope.
- Obtaining microscope preparations. Fresh sample observations and samples staining methods.
- Application of sterilization techniques: autoclave, direct heat and filtration.
- Aseptic handling of microorganisms.
- Isolation and culture of microorganisms.
- Macro and micro-organisms identification from phenotypic characteristics.
- Evaluation of antibiotic production from microorganisms.

Each practice will consist of an explanation about the fundamentals of such practice, experimental work and a discussion of the results obtained. To promote the best achievement of the practices, the student will complete a worksheet for each practice in which there may be some questions to consider previous to the experimental work, a space to write the observations and data obtained during the experimentation and finally, some questions to discuss based on the data obtained during the experimentation. This worksheet will be given by the student at the end of the practice and it will be corrected by the professors.

The students will be able to have a copy of the worksheets, as well as the teaching material delivered by the professors and the bibliographic material for their personal study.

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### ASSESSMENT

#### ASSESSMENT METHODS

Assessment methods	Weight	Competences
Final exam	30%	E1, CB1, E7, CB2, E11, FB4
Midterm exam/s	-	-
Continuous Assessment Activities	-	-
Reports and Presentations	-	-
Lab or Field Work	70%	E1, CB1, E7, CB2, E11, FB4
Projects	-	-
Host Student Evaluation	-	-
Participation	-	-

#### LEARNING OUTCOMES

- The student must demonstrate his capability to apply in a practical way the basic knowledge of Chemistry and Biology necessary for the practice of Chemical and Biomolecular sciences. (→ E1, CB1, E7, CB2, FB4)
- The student must demonstrate he know apply properly the vocabulary proper to a chemical and biological laboratory. (→ E1, CB1, E7, CB2, FB4)
- The student must demonstrate his capability to assess risks in the use of chemical and biological substances. (→ E11, FB4)

#### QUALIFICATION

The course assessment will consider the qualifications obtained at the chemical laboratory (QFC) and at the biological laboratory (QFB). Both grades will be over 10 and will have a maximum value of 10. In order to pass the course, both grades must be greater than or equal to 4.

The chemical laboratory (QFC) grade will be obtained from the experimental work grade of the chemical laboratory (EWC) and the final exam of the chemical laboratory (FEC). Both grades will be over 10 and will have a maximum value of 10.

In order to pass, the experimental work grade of the chemical laboratory (EWC) must be greater than or equal to 4 and it will be calculated as the simple average of the different activities carried out in the experimental work in such laboratory (ACL). Each activity will be divided into two parts: the first corresponding to the work performed at the chemical laboratory (WCL) and the second one that will consist of a small questionnaire that the student must answer at the end of each activity (LQC). Both grades will be over 10 and will have a maximum value of 10. The grade of all the activities performed (ACL) will be the weighted average of the grades of the work performed at the chemical laboratory (WCL, 70%) and the grade of the

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small questionnaire answered at the end of each activity (LQC, 30%). The qualification of each activity (ACL) is calculated as follows:  $ACL = 0.7 WCL + 0.3 LQC$ .

The grade of the final exam of the chemical laboratory (FEC) will be the qualification obtained at the theoretical-practical final exam done by the student. In order to pass the course, the grade of such exam must be greater than or equal to 4.

The qualification of the chemical laboratory (QFC) will be the weighted average of the experimental work grade of the chemical laboratory (EWC, 70%) and the final exam grade of the chemical laboratory (FEC, 30%). If either of the two grades is less than 4, the grade from the chemical laboratory (QFC) will be the lowest of both. If both grades are equal to or greater than 4, the chemical laboratory qualification (QFC) is calculated:  $QFC = 0.7 EWC + 0.3 FEC$ .

The qualification of the biological laboratory (QFB) will be obtained from the experimental work grade of the biological laboratory (EWB) and the final exam grade of the biological laboratory (FEB). Both notes will be over 10 and will have a maximum value of 10

The experimental work grade of the biological laboratory (EWB) will be calculated as the simple average of the different activities performed during the experimental work of such laboratory. In order to pass, the experimental work grade must be greater than or equal to 4.

The grade of the final exam of the biological laboratory (FEB) will be the grade obtained in the practical final exam performed by the student. In order to pass, the exam grade must be greater than or equal to 4 in order to pass.

The qualification of the biological laboratory (QFB) will be the weighted average of the grade of the experimental work of the biological laboratory (EWB, 70%) and the grade of the final exam of the biological laboratory (FEB, 30%). If either of the two grades is less than 4, the grade from the biological laboratory (QFB) will be the lowest of both. If both grades are equal to or greater than 4, the biology laboratory (QFB) qualification is calculated:  $QFB = 0.7 EWB + 0.3 FEB$ .

Experimental activities with a grade lower than 4 may be resat before any final examination of the course, at the discretion of the professor. Such make-up activities must be requested prior to the exam and will have a maximum grade of 10. These, will take place when it would be possible and will consist of performing exactly the same practice, with the same duration in the laboratory. In case it would be necessary to compensate with another type of activity, the maximum grade will be weighted according to each particular case based on the professor's criterion.

If the grade of the chemical laboratory (QFC) and the grade of the biological laboratory (QFB) are lower than 4, the final grade of the course (FQ) will be the lowest. If the grade of the chemical laboratory (QFC) and the grade of the biological laboratory (QFB) are equal to or greater than 4, then the final grade of the course is calculated as the weighted average of the

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chemical laboratory grade (QFC, 70%) and the biological laboratory (QFB, 30%):  $FQ = 0.7 QFC + 0.3 QFB$ . Only if this grade is greater than or equal to 5 the course will be satisfactory.

In case of having failed at the first call, the grade of the passed part will be kept until the second call. If the failed part corresponds to the experimental work, it may be resat before the exam date of the next call, at the discretion of the professor, provided that the number of the failed practices is less than or equal to 2. In case of failing the second call, it will be needed to repeat the whole subject.

### **ASSESSMENT OF THE COMPETENCES**

For the evaluation of the E11 competence, the grade of the experimental work will be used as the indicator. For the evaluation of the E1/CB1, E7/CB2 and FB4 competences, the final grade of the subject will be used as the indicator.

### **BIBLIOGRAPHY**

Notes and other materials provided by the professors.

J. Martínez, A. Narros, M. de la Fuente, F. Pozas y V.M. Díaz Lorente; Experimentación en Química General; Thomson Editors; 1st edition, Madrid, 2006. ISBN: 84-9732-425-0.

### **DOCUMENT HISTORY**

#### **PREVIOUS REVISIONS**

#### **CURRENT REVISION**

February 22<sup>nd</sup> 2019. Dr. Raimon Puig de la Bellacasa Cazorla