



Universitat de Lleida

DEGREE CURRICULUM  
**GENERAL AND ORGANIC  
CHEMISTRY**

Coordination: VILLORBINA NOGUERA, GEMMA

Academic year 2020-21

## Subject's general information

|   |   |               |                  |                  |               |
|---|---|---------------|------------------|------------------|---------------|
| <b>Subject name</b>   | GENERAL AND ORGANIC CHEMISTRY   |               |                  |                  |               |
| <b>Code</b>   | 101600  |               |                  |                  |               |
| <b>Semester</b>   | ANUAL CONTINUED EVALUATION  |               |                  |                  |               |
| <b>Typology</b>   | <b>Degree</b>   | <b>Course</b> | <b>Character</b> | <b>Modality</b>  |               |
|   | Bachelor's Degree in Biotechnology  | 1             | COMMON           | Attendance-based |               |
| <b>Course number of credits (ECTS)</b>  | 10.5  |               |                  |                  |               |
| <b>Type of activity, credits, and groups</b>                                    | <b>Activity type</b>  | <b>PRALAB</b> |                  | <b>PRAULA</b>    | <b>TEORIA</b> |
|   | <b>Number of credits</b>  | 1.2           | 0.4              | 3                | 5.9           |
|   | <b>Number of groups</b>   | 6             | 8                | 2                | 1             |
| <b>Coordination</b>   | VILLORBINA NOGUERA, GEMMA   |               |                  |                  |               |
| <b>Department</b>   | CHEMISTRY   |               |                  |                  |               |
| <b>Teaching load distribution between lectures and independent student work</b> | Contact hours Non-contact hours<br>Master lesson 47 80<br>Problem session 40 73,5<br>Laboratory 16<br>Computer classroom 2                                |               |                  |                  |               |
| <b>Important information on data processing</b>                                 | Consult <a href="#">this link</a> for more information.   |               |                  |                  |               |
| <b>Language</b>   | Catalan (Organic Chemistry) / Spanish (General Chemistry)   |               |                  |                  |               |
| <b>Distribution of credits</b>  | 129 hores de dedicació a teoria<br>115,5 hores de temps total per problemes<br>16 hores pràctiques de laboratori<br>2 hores pràctiques aula d'informàtica |               |                  |                  |               |

| Teaching staff                       | E-mail addresses         | Credits taught by teacher | Office and hour of attention |
|--------------------------------------|--------------------------|---------------------------|------------------------------|
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| VILLORBINA NOGUERA, GEMMA            | gemma.villorbina@udl.cat | 6,5                       |                              |

## Subject's extra information

### PERSONAL PROTECTIVE EQUIPMENT (PPE) for the practical sessions

It is **MANDATORY** that students have the following personal protective equipments (PPE) in the course of teaching practices.

- Laboratory coat UdL unisex
- Safety glasses
- Chemical protection gloves

The PPE can be purchased at UdL's ÚDELS store

Center for Cultures and Cross-Border Cooperation - Cappont Campus

Carrer de Jaume II, 67 low

25001 Lleida

<http://www.publicacions.udl.cat/>

For more information, check the product listings: <http://www.biotechnologia.udl.cat/en/pla-formatiu/equipament.html>

For other protection equipment (for example, caps, respiratory masks, etc.), they will depend on the type of practice to be performed. In this case, the responsible professor will inform if the use of these specific PPE is necessary.

Not carrying the PPE described or not complying with the general security regulations detailed below will mean that the student can not access the laboratories or have to leave the same.

## GENERAL SAFETY RULES IN LABORATORY PRACTICES

- Maintain the place of performance of clean and tidy practices. The work table must be free of backpacks, folders, coats ...
- In the laboratory you can not come with shorts or short skirts.
- Bring closed and covered shoes during the performance of the practices.
- Bring long hair always collected
- Keep the cords fit to protect against spills and spills of chemical substances.
- Do not carry wide bracelets, pendants or sleeves that can be trapped by the equipment, assemblies ...
- Avoid wearing contact lenses, since the effect of chemicals is much greater if they are introduced between the contact lens and the cornea.
- Do not eat or drink in the laboratory
- Smoking is prohibited within laboratories
- Wash your hands whenever you have contact with a chemical and before leaving the laboratory.
- Follow the teacher's instructions and consult any questions about security

## Learning objectives

The basic training of future Biotechnologists necessarily includes the understanding of the chemical concepts and the acquisition of abilities for its application to the practical cases that will be found in their professional future and in other subjects of degree's syllabus. It is precisely the basic training -which makes it possible to construct an essential conceptual framework that is indispensable- that distinguishes a university degree from a person who has undergone practical studies of applied guidance (training cycles).

## Significant competences

### Transversal competences:

#### 1.1 Capacity for professional performance

- Analyze specific situations and understand and define problems
- Apply knowledge acquired, manage properly the available resources.
- Analyze data numerically
- Select and manage the available written information sources related the professional activity
- Use the existing informatics tools as a support to develop of them professional activity
- Work alone and in teams

- Value the integral training, personal motivation, mobility

### 1.2. Communication capacity

- Use of the right terminology
- Write reports with the right information
- Discuss and argue.
- Communicate in different languages (Catalan and Spanish)

### 1.3. Technology transfer ability.

- Analyze and evaluate the social and ethical implications of professional activity
- Have a critical and innovative spirit.
- Recycle in new technological advances through continuous learning.
- Analyze and evaluate the environmental implications in professional activity
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### **Specific competences:**

- Understand and know how to apply the chemistry basic concepts as matter and energy conservation
- Understand the concept of dissolution and the ways to express its concentration
- Use of chemical balance to know the spontaneity of chemical processes
- Application of chemical balance and constant concept to predict the final state of acid-base systems (pH calculation, precipitation and complexation)
- Know the organic nomenclature, isomers, structure-properties relationships and organic reactivity.
- Distinguish different concepts with correction
- Know how to read and interpret the problem statements
- Apply formulas properly, with the corresponding units, and interpret the obtained results
- Relate the chemical knowledge acquired with the knowledge of mathematics, physics and biology received.
- Familiarize with elemental chemical laboratory tools

## Subject contents

### **THEORETICAL CONTENTS:**

#### **I. INTRODUCTION TO CHEMISTRY.**

1. Role of chemistry to contemporary society
2. Material states
3. Mol concept
4. Solutions. Concentration expression
5. Stoichiometry and chemical reactions
6. Chemical reactions types (acid/base, precipitation and redox)
7. The gas laws

#### **II. ATOMIC AND MOLECULAR STRUCTURE.**

1. Atomic structure. Periodic system
2. Chemical bond. Lewis structures
3. Valence shell electron pair repulsion theory (VSEPR)
4. Intermolecular forces

#### **III. CHEMICAL EQUILIBRIUM.**

1. Introduction to thermodynamics
2. First law
3. Thermodynamics
4. Standard enthalpy of reaction. Gibbs law
5. Spontaneity and second law
6. Gibbs energy
7. Spontaneity conditions and equilibrium
8. Ideal gas constant
9. Displacement of chemical equilibrium. Le Chatelier's principle
10. Chemical equilibrium in heterogeneous systems

#### **IV. ACID-BASE EQUILIBRIUM.**

1. Arrhenius concept
2. Brønsted-Lowry acid-base concept
3. Water autoionization and pH scale
4. Hydrolysis
5. Acid-base equilibrium approach
6. Buffer solutions
7. pH measurement. Indicators
8. Acid-base titration
9. Polyprotic acids
10. Lewis acid-base concept

#### **V. PRECIPITATION AND COMPLEXATION EQUILIBRIUMS.**

1. Solubility and precipitation
2. Complexation

#### **VI. ORGANIC CHEMISTRY NOMENCLATURE**

1. Organic functional groups
2. Hydrocarbons nomenclature: saturated, unsaturated, lineal, branched and cyclic. Alkyl radicals
3. Nomenclature of substituted compounds: substitutive, radicofunctional. Trivial names of some compounds
4. Aromatic compounds nomenclature

#### **VII. ISOMERISM**

1. Isomer classification
2. Conformational isomer
  - 2.1 Lineal alkane conformational isomers
  - 2.2 Cyclic alkane conformational isomers
1. Configurational isomers
  - 3.1 Optical rotation. Optical active molecules
  - 3.2 Chirality.
  - 3.3 Enantiomers. Absolut configuration. Racemic mixtures
  - 3.4 Fisher projection. Absolut configuration in a Fisher projection. *D*- and *L*- notation
1. Molecules with more than one stereocenter. *Meso* compounds
2. Resolution of enantiomers
3. *Z*- and *E*- notation

### VIII. STRUCTURE-PROPERTY RELATIONSHIP

1. Hydrocarbon: chemical structure and chemical and physical properties
2. Halogenated compounds: structure, polarity and properties
3. Alcohols: structure, polarity, properties and hydrogen bond
4. Carbonyl compounds. Bond polarity and properties
5. Carboxylic acids and derivatives: intermolecular interactions and properties
6. Amines: structure, polarity and properties
7. Aromatic compounds: symmetry and properties

### IX. REACTIVITY

1. Terminology and basic concepts of Organic chemistry reactivity: reaction types, electrophiles and nucleophiles,...
2. Oxidation and reduction reactions with different functional groups
3. Nucleophilic substitution reactions
4. Elimination reactions. Zaitsev rule
5. C-C bond addition reactions. Markovnikov rule
6. C=O bond addition reactions. Hemiacetals and acetals
7. Alpha carbon addition
8. Electrophilic substitution reactions

**PRACTICE ACTIVITIES:**

**Laboratory session 1.** Preparing standard solutions and titration. Determination of Acetic Acid in vinegar and redox titration

**Laboratory session 2.** Separation of a mixture of organic compounds

**Laboratory session 3.** Production of flavours by Fischer esterification

**Computer session.** Use of the GINY and EQUIL software



## Methodology

- Master classes, alternating face-to-face and non face-to-face sessions
- Problems and questions discussion with small groups.
- Laboratory sessions with the aim of knowing the laboratory safety procedures and the techniques useful for the subject.
- Computer session with simulation of chemical equilibrium and molecular geometry.
- Alternative activities will be carried out for all those activities that cannot be carried out normally due to the current situation

## Development plan

The two parts, "General Chemistry" and "Organic Chemistry" will be developed in parallel. In the theory part problems and questions will be recommended, that will be discussed in the small group sessions.

## Evaluation

La qualificació final prové de tres fonts globals: nota de teoria i problemes de la part de *Química General* (45%); nota de teoria i problemes de la part de *Química Orgànica* (45%); i pràctiques (10%). Per a superar l'assignatura es requereix una nota mínima de 5 sobre 10 en cadauna de les fonts.

### Part de *Química General*:

En cada examen de la part de *Química General*, el 50% de la nota provindrà de la prova tipus test (sobre teoria i exercicis curts) i l'altre 50% provindrà de la prova tipus exposició (problemes). Per aprovar l'assignatura, cal un mínim de 3 en la part de teoria i en la part de problemes en els examens finals d'abril i juny. Els temaris dels successius examens són acumulatius.

La nota de la part de *Química General* en la primera convocatòria d'abril s'obté a partir de la nota de l'examen del primer parcial ( $p_1$ ) al novembre i la del final al gener ( $gen$ ) com a la màxima puntuació entre:

$$0.25 \times p_1 + 0.75 \times gen$$

$$1.00 \times gen$$

La nota de la part de *Química General* en la segona convocatòria de juny s'obté a partir de la nota de l'examen del primer parcial ( $p_1$ ) i la de juny ( $jun$ ) com a la màxima puntuació entre:

$$0.25 \times p_1 + 0.75 \times jun$$

$$1.00 \times jun$$

### Part de *Química Orgànica*

La primera convocatòria de la part de Química Orgànica tindrà dos exàmens: un parcial (gener) i un segon examen acumulatiu de tota l'assignatura a l'abril.

La nota de la part de *Química Orgànica* en la primera convocatòria (per a ser combinada amb la nota de la part de *Química General*) s'obté a partir del 30% de la nota del primer parcial ( $p_1$ ) i el 70% de la del final a l'abril ( $abr$ ).

La segona convocatòria de *Química Orgànica* es farà al juny i tindrà una única nota (la d'aquell examen) que correspondrà al 45% de la nota final de l'assignatura.

Els alumnes que no hagin superat l'assignatura globalment en la primera convocatòria, però tinguin una part (sigui *Química Orgànica* o *Química General*) amb major o igual a 5,00, poden triar entre mantenir la nota de la part aprovada i examinar-se de la part suspesa o bé examinar-se de les dues parts en la segona convocatòria.

If due to the current situation some activity cannot be developed normally, alternative activities will be carried out in

order to evaluate them according to their corresponding qualification weight.

## Bibliography

### Basic bibliography:

#### General Chemistry

- ATKINS & JONES. *Principios de Química. Los caminos del descubrimiento*. 3ª Edició. Editorial Médica Panamericana. Buenos Aires, **2006**.
- BRILLAS, E. *Fonaments de la termodinàmica electroquímica y cinética* - Barcanova, **1992**.
- BUTLER, I.S.; GROSSER, A.E. *Problemas de química general* - Reverté, **1979**.
- CHANG, R. *Principios esenciales de Química General* - McGrawHill, **2006**.
- CLARET, J.; MAS, F.; SAGUÉS, F. *Termodinàmica Química i Electroquímica* - Llibres de l'Índex. Universitat. Barcelona, **1996**.
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- MAHAN, B.H. *Química. Curso universitario*. Fondo educativo interamericano. Bogotá, **1977**.
- MASTERTON, W.L.; HURLEY, C.N. *Principios y Reacciones* – Thomson, Paraninfo. Madrid, **2001**.
- PEIDRÓ, J. *Problemas de química para el primer ciclo : un método didáctico, activo, para aprender a resolver problemas*, 3 vol. EUB, Barcelona, **1996**.
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- WHITTEN, K.W.; DAVIS, R.E.; PECK, M.L. *Química General*. 5ª Ed.- McGraw Hill, **1998**.

#### Organic Chemistry

- ATKINS R.C. *Organic Chemistry: a brief course* – McGraw-Hill **2001**
- BRUICE P.Y. *Química Orgànica* - Pearson Prentice-Hall **2008**
- CAREY, F. A. *Química Orgànica* - McGraw-Hill: Madrid, **2006**
- H.HART, D.J.HART, L.E.CARRIE. *Química Orgànica* - McGraw-Hill-Interamericana. Mexico. **2007**
- MCMURRY, J. *Química Orgànica* - International Thomson: México, D.F., **2008**
- SOLOMONS T. W. *Organic Chemistry* - John Wiley & Sons **2004**
- WADE L.G. *Química Orgànica* – Pearson Educación **2004**

### Extra bibliography:

#### General Chemistry

- LEVINE, I. *Fisicoquímica* 5a. edició. McGraw Hill. Madrid, **2004**
- HARRIS, D.C. *Anàlisi química quantitativa*. (6ª edició). Editorial Reverté, **2006**

#### Organic Chemistry

- CAREY, F.A.; SUNDBERG, R.J. *Advanced Organic Chemistry PART A Structure and Mechanisms Part B Reactions and Synthesis* - Plenum Press: New York, **1990**
- ELIEL, E. L.; WILEN, S. H.; MANDER, L.N. *Stereochemistry of Organic Compounds* - John Wiley & Sons New: York, **1994**
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