

**COURSE DATA****Data Subject**

<b>Code</b>	34203
<b>Name</b>	Organic chemistry I
<b>Cycle</b>	Grade
<b>ECTS Credits</b>	4.5
<b>Academic year</b>	2012 - 2013

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
1108 - Degree in Chemistry	Faculty of Chemistry	2	First term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
1108 - Degree in Chemistry	9 - Organic chemistry	Obligatory

**Coordination**

<b>Name</b>	<b>Department</b>
MARCO VENTURA, JUAN ALBERTO	325 - Organic Chemistry
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**SUMMARY**

Organic chemistry is the branch of chemistry that studies the structure and reactivity of carbon compounds, generally known as organic molecules. These molecules are the most essential compounds for life, such as lipids, carbohydrates, amino acids, proteins and nucleic acids. Organic molecules are also many substances we come into direct contact, such as fuels, adhesives, paints and textile fibers. A large group of organic compounds are those that have pharmacological activity and which are the basis of medicines. Pesticides, herbicides, fertilizers and agriculture have changed and preservatives have helped to change our eating habits. However, not all organic compounds are beneficial, many of them are harmful either to health or the environment and therefore must continue to develop compounds with improved properties to replace those that have problems.

Knowledge of the structure and reactivity of organic compounds is intended to pave the way for the preparation of compounds that retain all their beneficial properties while minimizing undesirable side effects.

The study of organic chemistry is based on the knowledge acquired in the subjects of Chemistry I and Chemistry II first year. Since, from this knowledge will be carried out systematic study of the functional



groups characteristic of organic compounds, it is advisable to have overcome the above subjects before approaching the study of Organic Chemistry I. This course along with Organic Chemistry II and III form the theoretical foundations of Organic Chemistry Module mandatory Degree in Chemistry and must be treated as a whole to show the full picture of the domain.

The objectives to be achieved in this subject can be summarized in the following points:

- Seat the student's knowledge about the structure and bonding in organic compounds. Studying different types of representation of organic molecules.
- Apply the general rules of nomenclature for organic compounds.
- To study the stereochemistry of organic compounds and appropriate naming rules.
- Identify the different functional groups present in organic molecules.
- To study the reactivity of different functional groups containing only carbon-carbon bonds
- Study methods for obtaining these functional groups.
- Study the mechanisms of the most important reactions that are involved in these functional groups.
- Design synthesis of organic compounds from certain starting materials and involving more than one reaction step.

## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

The study of organic chemistry is based on knowledge acquired in the subjects of General Chemistry I and General Chemistry II.

## OUTCOMES

### 1108 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Solve problems effectively.
- Toma de decisiones.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.
- Comunicación oral y escrita en las lenguas nativas.
- Trabajo en un equipo de carácter interdisciplinar y/o en un contexto internacional.
- Razonamiento crítico.



- Capacidad de gestión de la información.
- Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.
- Learn autonomously.
- Demonstrate the ability to adapt to new situations.
- Creatividad.
- Liderazgo.
- Motivación por la calidad.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.
- Interpret the variation of the characteristic properties of chemical elements according to the periodic table.
- Demonstrate knowledge of the main types of chemical reaction and their main characteristics.
- Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry.
- Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.
- Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.
- Recognise and analyse new problems and plan strategies to solve them.
- Evaluate, interpret and synthesise chemical data and information.
- Handle chemicals safely.
- Handle the instrumentation used in the different areas of chemistry.
- Recognise and evaluate chemical processes in daily life.
- Develop sustainable and environmentally friendly methods.
- Relate chemistry with other disciplines.

## LEARNING OUTCOMES



In this subject there will be approached the following results of learning contained in the document of Degree, inside the Chemical Organic matter:

- 1.- To demonstrate knowledge of the principal aspects of terminology and organic nomenclature. (CE1)
- 2.- To understand the structural properties and the reactivity of the compounds and of the functional organic groups applying them to the solution of synthetic and structural problems. (C16, C21, CE2, CE4, CE6, CE7, CE23, CE26)
- 3.- To elucidate the structure of the organic simple compounds, using spectroscopic technologies. (CE8, CE19)
- 4.- To explain in an understandable way phenomena and processes related to the Organic Chemistry. (C1, C2, C12, CE13)
- 5.- To acquire and to use bibliographical information and technology referred to the organic compounds. (C13, CE16)
- 6.- To write and to exhibit in the native language with correction (C8)
- 7.- To realize effectively the tasks assigned as member of an equipment with perspective of kind (C7, C9, C18, C19)
- 8.- To demonstrate knowledge of sustainable methodologies in organic chemistry. (CE25)
- 9.- To demonstrate skill to manipulate chemical reagents and organic compounds safely. (CE17)
- 13.- To take decisions with rigor. (C6, C15, C17)
- 14.- To demonstrate critical reasoning. (C12)
- 15.- To demonstrate autonomous learning. (C16)
- 16.- To solve problems with rigor. (C5, C20, CE14, CE15)

These results of learning have to allow that on having finished the subject the student has to be capable of acquiring the following skills:

#### To acquire skills

- To represent organic molecules using the most common methods of representation.
- Recognize the stereochemistry of organic compounds.
- Apply the rules of nomenclature.
- Identify organic functional groups.
- Deduct the physical properties of different compounds depending on the structure containing the functional group.
- Know the reactivity characteristics of each of the functional groups that are on this subject.
- Know the main methods of obtaining the different functional groups.
- Understand and learn to use the mechanisms of reaction and logical interpretations of the reactions studied.
- Learn to design simple synthesis

#### Social Skills



- Reason, argue and memorize the basics.
- Ability to work in groups
- Ability to solve problems through the integrated application of knowledge.
- Ability to express orally in a precise and clear.
- Ability to express oneself in writing in an organized way.
- Read and understand texts written in English on the subjects studied.

## DESCRIPTION OF CONTENTS

### 1. Structure and reactions of organic molecules.

Functional groups: centers of reactivity. Types of organic reactions: homolytic reactions and heterolitic. Acidity and basicity in organic compounds. Nucleophilicity and electrophilicity in organic compounds. Kinetics and thermodynamics of a reaction. Profiles and reaction mechanisms. Reaction intermediates. Isomerism: Constitutional Isomerism and their types. Determination of the molecular formula. Elemental analysis. Mass spectrometry.

### 2. Alkanes and cycloalkanes.

Linear and branched alkanes. The system of nomenclature of alkanes. Structural and physical properties of alkanes. Rotation of single bonds, conformations. Diagram of potential energy. Rotation in ethane. Rotation butane. Nomenclature and physical properties of the cycloalkanes. Tension ring and structure of cycloalkanes. The cycloalkane cyclohexane as an example of stress-free angle. Substituted cyclohexanes. Higher cycloalkanes.

### 3. Reactions of Alkanes: Bond dissociation energies, and relative reactivity halogenation.

Force liaison alkanes: radicals. Structure of alkyl radicals: hyperconjugation. Chlorination of methane: chain radical pathway. Other free radical halogenations methane. Halogenation of other alkanes. Combustion and relative stability of alkanes.

### 4. Stereoisomerism.

Chiral molecules. Optical activity. Absolute configuration: RS naming system. Absolute configuration: a historical note. Fischer projections. Molecules with multiple stereocenters: diastereomers. Meso compounds. Stereochemistry in chemical reactions. Resolution.

### 5. Alkenes.

Nomenclature of alkenes. Isomers E / Z alkenes. Physical properties of alkenes. Index of hydrogen deficiency. Relative stability of the double bonds: heat of hydrogenation. Addition reactions to alkenes. Catalytic hydrogenation. Stereochemistry of the hydrogenation reaction. Nucleophilic character of the pi bond: electrophilic addition of hydrogen halides. Relative stability of carbocations and regiochemistry of addition (Markovnikov rule). Synthesis of alcohols by acid-catalyzed hydration: thermodynamic control.





Electrophilic addition of halogens to alkenes. Stereochemistry of the reaction. Hydroboration-oxidation, anti-Markovnikov hydration stereospecific. Synthesis oxaciclopropanos (epoxides) peroxy-carboxylic acid oxidation. Dihydroxylation neighborhood without. Oxidative burst: ozonolysis. Radical addition, formation of anti-Markovnikov products. Dimerization, oligomerization and polymerization of alkenes.

## 6. Alkynes.

Nomenclature of alkynes. Properties and Bonding in alkynes. Stability of the triple bond. Acidity of terminal alkynes. Reduction of alkynes: relative reactivity of the two pi bonds. Electrophilic addition reactions to alkynes. Anti-Markovnikov additions to triple bonds.

## 7. Delocalized $\pi$ -systems.

Electron delocalization in the allyl system. Allylic carbon reactivity. Conjugated dienes. Addition reactions. Diels-Alder. Electrocyclic reactions. Introduction to UV-Vis spectroscopy.

## 8. Benzene and other cyclic polyenes.

Nomenclature of benzene derivatives. Structure and resonance energy of benzene: an introduction to the concept of aromaticity. Molecular orbitals of benzene. Polycyclic benzenoid hydrocarbons. Other cyclic polyenes, Hückel's rule.

## 9. Reactivity of benzene derivatives.

Electrophilic aromatic substitution. Halogenation of benzene. Nitration and sulphonation of benzene. Alkylation and Friedel-Crafts acylation. Activation and deactivation of the benzene ring by the substituents. Inductive effect of alkyl groups leader. Guiding effect of the substituents conjugated with the benzene ring. Disubstituted benzenes electrophilic substitution. Benzyl carbon reactivity.

## WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	34,00	100
Other activities	11,00	100
Development of group work	5,00	0
Study and independent work	62,50	0
<b>TOTAL</b>	<b>112,50</b>	



## TEACHING METHODOLOGY

The subject is raised so that the student is the protagonist of his own learning and is structured as follows:

- **Pedagogic material.** - From the beginning of course(year) the students will have the pedagogic material corresponding to the course.
- **Lectures** .- A class or two per item to be devoted to discuss with students the most complicated or those who have had more difficulty. These classes are supplemented by personal study time.
- **Classes of problems** .- In these classes will be held on the specific application of the knowledge students have acquired in the lectures. Students must, previously having worked the problems to be solved. Solving these problems will be held at times by the teacher and in other cases by the students well in group or individually.
- **Tutoring** .- They will be 11 meetings in total distributed uniformly along the course(year), being 1 hour(o'clock) the duration each one the above mentioned meetings. In them, the teacher will evaluate the global process of learning of the students, which one will have organized before in subgroups of work. In the meetings tutorships there will be gathered the works that have been entrusted by the teacher to the mentioned subgroups. Equally, the tutorships will serve to solve all the doubts that could have arisen along the classes and it(he,she) will orientate the students on the most useful methods of work for the resolution of the problems that could appear them.
- **Organic Chemistry Seminar** .- 6 seminars will be carried out along the semester, in the dates that will turn out to be gathered in the calendar of the course. The above mentioned seminars will be dedicated to a deeper discussion of topics which content makes a more detailed study suitable: acidity and basicidad in Organic Chemistry, estereoquímica, aromaticity and application of the technologies of espectroscopia UV-VIS and spectrometry of masses. After the discussion of every topic there will be carried out the resolution of some practical problems of the same one.

## EVALUATION

The evaluation of the learning will be carried out of constant form on the part of the teacher. The different paragraphs that will be evaluated are the following ones:

1.-Direct evaluation of the teacher (10 points): In this one evaluation there will be born in mind different aspects, between(among) which it is necessary to stand out:

- Assistance and reasoned and clear participation in the raised discussions.
- progress in the use of the language typical of the organic chemistry.
- Resolution of problems and exposition(approach) of doubts.
- Critical spirit.

2.-Seminars of Organic Chemistry and Tutorships (globally 20 points): The note of every student in this paragraph will have in consideration:



- Assistance.
  - Content and presentation in writing of the exercises(fiscal years) entrusted by the teacher every subgroup of work. The qualification will be a global note for the subgroup and every member of the same one will be calculated of equal way.
- To receive qualification in this paragraph, it will be a necessary credit been present a minimum of 4 seminars and 6 tutorships.

3.- Examinations (70 points): it will be realized in the date indicated by the Faculty(Power) and will be common to all the groups of the subject. It will consist of theoretical - practical questions related to the matter explained during the educational period of the same one. The global pass in the subject will take necessarily implied the credit obtained in the examination a minimal punctuation of 30 points on the 70 total ones.

In the evaluation of the second round, there will be kept the qualification obtained in the continued evaluation (point 1-" direct Evaluation of the Teacher and Point 2-" Seminars of Organic Chemistry and Tutorships ") of the first round and it(he,she) will proceed to evaluate again the part corresponding to the Point 3 - "Examinations"-

## REFERENCES

### Basic

- P. Y. Bruice Química Orgánica Pearson Prentice Hall (2008), 5ª edición en castellano.
- P. Y. Bruice Fundamentos de Química Orgánica Pearson Prentice Hall (2007), 1ª edición en castellano.
- L. G. Wade. Química Orgánica. Pearson Prentice Hall (2004), 5ª edición en castellano.
- K. P. C. Vollhardt. "Química Orgánica Estructura y Función". Ediciones Omega, S.A. (2008), 5ª edición en castellano.
- J.McMurry. Química Orgánica Cengage Learning Editores. S. A. (2008) 7ª edición.
- H. Hart, L.E. Craine, D.J. Hart, C. M. Hadad. Química Orgánica. Mc Graw-Hill (2007). 12ª edición en castellano.
- S. Ege. Química Orgánica. Editorial Reverté (1998).
- E. Primo Yúfera. Química Orgánica Básica y Aplicada. Ed. Reverté (1994).





### Additional

- F. A. Carey. Química Orgánica. McGraw-Hill (2006).

E. Quiñoá Cabana y R. Riguera Vega. Cuestiones y Ejercicios de Química Orgánica. Mc Graw-Hill (2004).

W. R. Peterson Formulación y Nomenclatura Química Orgánica. Eunibar.

E. Quñoa Cabana y R. Riguera Vega. Nomenclatura y representación de los compuestos orgánicos. S. A. McGraw-Hill/Interamericana de España (2005).