Course: Organic Chemistry I
Code: 18870
Location: Faculty of Sciences
Degree: Science & Engineering Program Boston University-Faculty of Science UAM
Level: BSc
Type: Compulsory subject
Number of credits: 6

COURSE TITLE

ORGANIC CHEMISTRY-I

1.1. Course number

CH203 (joint course with Boston University)

1.2. Content area

ORGANIC CHEMISTRY

1.3. Course type

Compulsory subject for BU students, optional for UAM students

1.4. Course level

Bachelor (second cycle)

1.5. Year

2nd

1.6. Semester

First

1.7. Credit allotment

6 ECTS credits

1.8. Prerequisites

BU students must have taken at least one of the following options:

Option 1: CH101 (General Chemistry 1) and CH102 (General Chemistry 2).
Option 2: CH101 (General Chemistry 1) and CH110 (General and Quantitative Analytical Chemistry).
Option 3: CH111 (Intensive General and Quantitative Analytical Chemistry 1) and CH112 (Intensive General and Quantitative Analytical Chemistry 2).

UAM students must have taken any of the following courses:

16476 (Química -Grado en Ciencias Ambientales-)
16535 (Química -Grado en Ingeniería Química-)
16575 (Química -Grado en Ciencias de la Alimentación-)
18201 (Química -Grado en Bioquímica-)
18422 (Química General –Grado en Nutrición, Biología ó Física-)

UAM students that have taken course 16348 (Química General -Grado en Química-) CANNOT take this course.

1.9. Minimum attendance requirement

Attendance to classes is strongly recommended. Absences which may result from illnesses, religious holidays, serious accidents, etc must be immediately notified to the Faculty coordinator. To receive full credit a student must document the reason for their absence (for example a signed and stamped doctor's note). Please note that having scheduled exams in another subject is not a valid excuse.

1.10. Faculty data

Faculty: Ernesto Brunet-Romero, Ana María Martín-Castro, Ramón Gómez-Arrayás.
Department of Organic Chemistry
Faculty of Sciences
Office – Module 01-602 (Prof. Brunet), 01-403 (Prof. Martín-Castro), 01-410 (Prof. Gómez-Arrayás)
Phone: +34 914973926/+34 914974717/+34 914973874
Email: ernesto.brunet@uam.es, martin.castro@uam.es, ramon.gomez@uam.es
Website:
https://moodle.uam.es/course/search.php?search=organic+chemistry+ch203
Office hours: 10h-17h appointment previously requested by email

1.11. Course objectives

(Taken from BU's Organic Chemistry I Syllabus)
Organic chemistry studies the properties of the compounds of carbon, which alone of all the chemical elements can form the numerous, strong, and directional bonds essential to the construction of biomolecules such as fats, carbohydrates, proteins and nucleic acids. This course focuses on gaining an understanding of the fundamental concepts of the science. Important learning

goals that the student will wish to achieve are: (1) familiarity with classical and quantum mechanical theories of bonding; (2) how to name organic compounds systematically; (3) the ability to deduce the structures of organic molecules by interpreting their nuclear magnetic resonance and infrared spectra; (4) developing an appreciation for the interplay of an organic molecule's three-dimensional structure and that molecule's chemical properties; (5) the ability to apply concepts of physical organic chemistry (e.g., thermodynamics and kinetics) to predict the properties and reactivity of organic compounds. A few reactions (acid–base, radical halogenation, addition to carbon–carbon multiple bonds, nucleophilic substitution and elimination) are covered. The relevance of organic chemistry to biological systems, medicine, environmental science and industry is discussed. In the laboratory portion of the course, students gain experience in conducting organic reactions, purifying products, and interpreting and reporting organic chemical phenomena.

1.12. Course contents

Lecture contents and schedule

Week (Date*)	Topic's name (entry)	Related info
37 (09/10-09/14)	Structure and Bonding in Organic Compounds (1)	1.1. Electronic structure. 1.2. Ionic and covalent bonding. Lewis theory and diagrams. Formal charges. 1.3. Inductive effects. Dipole moment. Polar covalent bonds. 1.4. Hybridization: σ and π bonding 1.5. Drawing organic molecules 1.6. Delocalization of π electrons. Resonance. 1.7. Resonance structures. Drawing resonance forms. 1.8. Non-equivalent resonance structures. Rules. 1.9. Aromaticity (MO theory). (sections 1.3-1.9, 1.12, 2.1-2.6, 15.3, 15.6 *McMurry*)

38 (09/17-09/21)	Polar Covalent Bonds: Acids and Bases (2)	2.1. Bronsted definition of acids and bases 2.2. Lewis definition of acids and bases 2.3. Organic acids and organic bases 2.4. Acid and base strength 2.5. Nucleophiles and electrophiles (sections 2.7-2.11 *McMurry*)
39 (10/24-10/28)	Structural determination (Mass spectrometry, Infrarred and Nuclear Magnetic Resonance Spectroscopy) (3)	8.1. Mass spectrometry: principles and interpretation. 8.2. Infrared spectroscopy and functional groups. 8.3. NMR: principles and spectral features (intensity, chemical shift and couplings), proton and carbon spectra, "2D in short" (sections 12.1-12.8, 13.1-13.13 *McMurry*, Moodle)
40 (10/01-10/05)	Laboratory	See below
41-43 (10/08-10/26)	Alkanes and Cycloalkanes (4)	3.1. Alkanes: Nomenclature. Structural isomers. 3.2. Alkanes: Chirality. Optical activity. Cahn-Ingold-Prelog rules. Enantiomers and diastereoisomers. Meso compounds. Conformational isomers. 3.3. Cycloalkanes: Nomenclature. *Cis/trans* isomerism. 3.4. Cycloalkanes: Stability and ring strain. Conformational isomers. 3.5. Representative examples and physical properties of alkanes and cycloalkanes. 3.6. Reactivity of alkanes: halogenation reaction (*a radical reaction*) (sections 3.1-3.7, 4.1-4.7, 5.3, 10.3 *McMurry*)
44-45 (10/29-11/02)	Haloalkanes (5)	4.1. Nomenclature. Representative examples. Physical properties. Polar covalent bonding. 4.2. Nucleophilic substitution reactions 4.3. Elimination reactions (sections 10.1-10.2, 11.1-11.12 *McMurry*)
45-46 (11/05-11/16)	Alcohols and epoxides (6)	7.1 Nomenclature. Representative examples. Physical properties (acidity and basicity revisited). 7.2 Reactivity: dehydration, oxidation, protection, epoxide aperture. (sections 17.1, 17.2, 17.6, 17.7, 18.5, 18.6 *McMurry*)

47-48 (11/19-11/30)	Alkenes and Dienes (7)	5.1. Nomenclature. *Cis/trans* isomerism. 5.2. Representative examples. Physical properties. 5.3. Relative stability. Catalytic Hydrogenation. 5.4. Electrophilic addition reactions: 5.4.1. Mechanism; carbocation stability; regiochemistry; stereochemistry. 5.4.2. Addition of hydrogen halides, halogens and water. 5.4.3. Hydroboration, epoxidation, dihydroxylation 5.5. Radical addition. 5.6. Conjugate dienes: electronic structure and stability 5.7. Electrophilic addition to conjugated dienes 5.8. Diels-Alder cycloaddition reaction. (sections 6.1-6.11, 7.2-7.5, 7.7, 7.8, 7.10 *McMurry*)
49-50 (12/03-12/14)	Alkynes (8)	6.1. Nomenclature. Representative examples. Physical properties. 6.2. Reactivity: catalytic hydrogenation; hydration. 6.3. Alkyne acidity: acetylide anions. 6.4. Alkylation of acetylide anions (sections 8.1, 8.3-8.8 *McMurry*)
51 (12/17-12/19)	Final remarks and exam	Discussions and final exam

(*) For 2012.

Laboratory contents and schedule

Date* (Week 40)	Experiment	Related info
40 (10/01-10/05)	Introduction	Safety & Preparation
	Isolation of the active principle from an analgesic pill	Recrystallization, melting point, NMR, IR.
	Preparation of acetyl salicylic acid (TLC test)	Heating & cooling, Reaction methods, Crystallization, TLC, NMR, IR.
	Synthesis of isopentyl acetate	Reflux, distillation, extraction & drying, NMR, IR.
	Lab exam (Make-up lab)	

(*) For 2012. Specified experiments are tentative and their schedule along the week will be flexible.

1.13. Course bibliography

- Organic Chemistry 7th Edition, by John McMurry (Brooks Cole)
- Solutions Manual by Susan McMurry (Brooks Cole)
- Pushing Electrons, by Daniel Weeks (Saunders) - Optional.
- Introduction to Organic Laboratory Techniques. A Microscale Approach, 3rd Ed. – BU custom edition, W.B. Saunders, 2000.
- Molecular Modeling Computer Programs.
- e-Learning UAM (Moodle)

2. Teaching methodology

1. **Theoretical Lectures and Discussions:** 42 sessions (4 per week).
3. **Laboratory practice:** 5 sessions, 1 week (5 h per session).
4. **Personal Tutorials**: recommended at least 3 per student (ca. 50 min per tutorial)

3. Student workload

		N. of hours	Percentage
Compulsory attendance	Theoretical Lectures & Discussions	42 h	73 h (49%)
	Other: Laboratory practice Lecture exam	25 h 4 h	
	Final exam	2 h	
Personal work	Weekly study (5.5 h per week) & Exam preparation	77 h	77 h (51%)
Total student workload: 25 h x 6 ECTS		**150 h**	

4. Evaluation procedures and weight of components in the final grade

Lecture exams (adapted from BU's Organic Chemistry I Syllabus)

Three 80-minute exams are administered on **F 5 Oct**, **F 2 Nov** and **F 30 Nov** (schedule and location to be announced at least two weeks in advance) in additional time to the lecture meeting time. All lecture exams are cumulative. Lecture exams are graded on a 10-point basis. Your lowest lecture exam score will be dropped in calculating your course grade. Thus, you may elect not to take one lecture exam because of illness or because you are unprepared. No make-up lecture exams are given for any reason: please do not ask to take a make-up lecture exam nor ask to take a lecture exam at other than the scheduled date and time. Do not make travel plans that conflict with the lecture exams.

Final exam (adapted from BU's Organic Chemistry I Syllabus to Spanish Law)

A cumulative 2-hour final exam is administered on the morning of **W 19 Dec** (exact time and location to be announced at least two weeks in advance). Final exam is graded on a 10-point basis. See the "Incompletes" section of this syllabus for policies concerning missed final exams.

Make-up exams (taken from Dresden w/BU's Organic Chemistry I Syllabus)

There are no make-up exams whatsoever.

Lab grades (adapted from Dresden w/BU's Organic Chemistry I Syllabus to Spanish Law)

The grade for the student performance at the laboratory is based on 3.5 points for pre-lab preparations, 4.5 points for experimental skill and ability to record observations about the experiments and 2.0 points for post-lab reports to be submitted for each of the assigned experiments. Part of your skill grade will be based on results (e.g. ability to obtain the product) and part will be based on your technique (adherence to safety rules, cleanliness and organizational skills) as assessed by your teaching fellows. Sometimes quizzes will be given at the start of lab and will count as part of the pre-lab preparation grade. Quizzes will be announced on the lab information sheet. The grade for the end-of-semester lab exam will count as much as one lab. Thus each student will have seven grades.

Make-up Labs (adapted from Dresden w/BU's Organic Chemistry I Syllabus)

Students are expected to perform all experiments. There are no make-up labs whatsoever in this abroad program since you are leaving the country right after the lab ends. Absences which may result from illnesses, serious accidents, etc must be immediately notified to the Faculty coordinator. To receive full credit a student must document the reason for their absence (for example a signed and stamped doctor's note). Please note having scheduled exams in another subject is not a valid excuse. A student who does not have a documented excuse will receive a maximum grade of 7.0 for the lab absence.

Grades (adapted from BU's Organic Chemistry I Syllabus to Spanish Law)

Course grades are calculated by the following formula:

$$\textbf{CH203 Grade} = (LE_1 + LE_2 + FE + Lab) / 4$$

where LE_1 and LE_2 are the scores of your two highest of three lecture exams, FE is the score of your final exam, and Lab is your lab score. All individual scores are based on 10 points. The maximum score is 10. The minimum score to pass is 5.0

Spanish grade ranges are:

Lowest (no pass): 0-4,9: Suspenso (SS).
Low (pass): 5,0-6,9: Aprobado (AP).
Intermediate-High: 7,0-8,9: Notable (NT).
Highest: 9,0-10: Sobresaliente (SB).

There are no extra-credit projects to offset poor performance on exams. Please do not ask to have the course grade you earn raised gratuitously because you fail to satisfy the GPA requirements of your program of study, scholarship, etc.

Incompletes (taken from Grenoble w/BU's Organic Chemistry I Syllabus)

Incomplete grades are not accepted in this abroad program, as you will be leaving the site at the end of the semester.

5. Other policies

Laboratory regulations (adapted from Dresden w/BU's Organic Chemistry I Syllabus)

Required Equipment: To reduce the risk of eye injury approved goggles or safety glasses with side shields or must be worn AT ALL TIMES in lab. Students ignoring this rule will receive a 1-point reduction in their grade and then will be asked to leave the laboratory if the infraction continues. Contact lenses may **never** be worn in the lab due to safety hazards. Students should own their own safety glasses. A lab coat is required. Closed-toe shoes, long pants, and long-sleeved shirts should be worn to lab. Your shirt and pants, or a lab coat, must cover you completely from neckline to shoes. Available safety information MUST be read prior to the first lab session. **All work should be recorded in a laboratory notebook with consecutively numbered pages. The notebooks will be requested to be turned in at the end of the last session and will not be returned to the students, who are the only responsible for having copies of all work submitted**. Appropriate notebooks will be provided by the laboratory staff.

Collaboration: Students are allowed and encouraged to talk about the laboratories together and to collaborate on understanding the material. **However, all work in preparing the pre-labs, observations and reports should be done individually**. No joint preparation of laboratory write-ups is allowed. Any student discovered copying from another student's lab, either past or present, will be taken before the Faculty as will the student whose lab was being copied. Do not "help" other students by handing them your completed lab. You will be held responsible if they copy it.

Attendance: Students must always attend the scheduled lab session. Punctuality is crucial as special instructions may be given at the start of lab. Attendance will be taken at the start of the lab and short quizzes may be given. Lab is an integral part of the course. Anyone not completing the laboratory portion of the course will receive an incomplete in the course (see make-up lab section of this syllabus).