ORGANIC CHEMISTRY II

Code: 1770019
Course: 3º
1st four month term
Mandatory

Activity	Number of hours/group	Groups
Theory classes	27.0 (2 h per week)	2[a] + 1[b]
Seminars	4.0 (2 sessions)	8 + 1
Laboratory classes	48.0 (2 blocks)[c]	8 + 1
Exam	2.0	8 + 1

[a] One morning group and one afternoon group. [b] This group is going to receive classes in English in the morning. [c] The first block is going to be given at the beginning of the four-month term and the second block is going to be give at the end of the four-month term.

PROGRAMME OF LABORATORY CLASSES.

BLOCK 1

Lab Class 1. Separation of a mixture by extraction
Lab Class 2. Butyl bromide
Lab Class 3. *t*-butyl Chloride
Lab Class 4. Cyclohexen
Lab Class 5. Diphenylmethanol

BLOCK 2

Lab Class 6. Synthesis of Camphor
Lab Class 7. Synthesis of Isoamyl acetate
Lab Class 8. Synthesis of Parcetamol and derivatives
Lab Class 9. Synthesis of Acetanilide
Lab Class 10. Synthesis of *p*-Nitroaniline
Lab Class 11. Synthesis of Acetanilide
Lab Class 12. Chlorination of Acetanilide
Lab Class 13. Synthesis of Nitroestyrene
Lab Class 14. Reaction of Diels-Alder (9,10 dihydroanthracene -9,10-succinic anhydride)

NOTE: All students must carry out the same lab classes.

PROGRAMME OF THEORY CLASSES.

Chapter 1. Structural Elucidation of Organic Compounds by Spectroscopy Techniques.- Introduction.- Hydrogen Spin-Spin splitting patterns.- Introduction to carbon-13 NMR.- Introduction to Mass Spectrometry.- Interpretation of combined spectra.- Examples 5 hours

Chapter 2. Amines. Structure and Reactivity.- Structure and Classification.- Physical properties.- Preparation.- Reactivity.- Basicity. Salt formation.- Alkylation.- Transformation into amides.- Reactions with nitrous acid.- Hofmann Elimination. 4 hours

Chapter 3.- Carboxylic acid derivatives.- Benzene structure.- Aromaticity. Rule of Hückel.- Physical Properties.- Obtention of benzene.- Carcinogenic effect of aromatic compounds. Benzopyrene.- Aromatic electrophilic substitution. Mecanism.- Halogenation.- Deuterium or tritium substitution.- Nitration.- Sulfonation.- Friedel-Crafts Alkylation and acyltion.- Reactivity and director effects of EAS in benzene derivatives.- Arenes. Physical properties and industrial sources.- Preparation.- Reactions. 5 hours

Chapter 4. Heterocycles. Structure and reactivity.- Structure and Classification of heterocycles.- π-Electron rich heterocycles. Pyrrole, furan and thiophene. Aromatic electrophilic substitution.- π-Electron poor Heterocycles. Pyridine. Aromatic nucleophilic substitution.- Condensed heterocycles with benzene.- Heterocycles with more than one heteroatom. 3 hours

Chapter 5. Reactivity of Carbonylic Compounds via Enols and Enolate Ions.- Introduction to reactions *via* carbanions.- α-Halogenation.- Aldolic condensation.- related condensations.- Nitroaldolic reaction.- Alkylation of enolates. 4 hours

Chapter 6. Reactions of Bifunctional Carbonylic Compounds.- The role of bifunctional carbonylic compounds in the formation of C-C bonds.- Dicarboxylic acids, cetoacids and α,β-unsaturated carbonylic compounds. Structure and preparation. Claisen Condensation.- Malonic ester synthesis.- Acetoacetic ester synthesis.- Conjugated addition to α,β-unsaturated carbonylic compounds. 2 hours

Chapter 7. Dienes.- Diene classification.- Allenes: Structure and isomery.- Conjugated dienes. Structure and stability.- Addition reactions. Conjugated additions.- Diene polymers: Natural and synthetic rubbers. 2 hours

Chapter 8. Pericyclic Reactions.- Classification.- Phase and symmetry of molecular orbitals. Frontier molecular-orbital Theory.- [4+2] and [2+2] cycloaddition reactions.- Explanation of Cycloadditions by Frontier molecular-orbital theory.- Diels-Alder reaction. Stereoselectivity and regioselectivity.- Woodward-Hoffman rules for cycloadditions. 2 hours

METHODOLOGY

Theory classes:

Attending hours: 27 (2 hours per week).
Methodology of teaching-learning: Exposition classes supported on multimedia (Power Point presentations, videos, Web pages) and other type of

teaching materials (portable and paper office documents, obtained from *webCT* platform of the University of Seville).

Seminars:

Attending hours: 4 (2 sessions of 2 hours allocated along the four-month term).

Methodology of teaching-learning: The seminars consists in dynamic activities in which the teacher plays as chairman and the student gives and exposition and resolves exercises previously proposed by the teacher. These exercises are delivered at the beginning of the sessions.

Laboratory classes:

Attending hours: 48 (2 blocks of 24 hour, in sessions of 3-consecutive hours per day. The first block is going to be carried out at the beginning of the term and the second one at the end of the term, according to the schedule approve in Junta de Centro)

Methodology of teaching-learning:

The students are going to achieve experiments forecasted in the Practical Programme of the subject. All the experiments are individually being carried out in the laboratory. Before starting the experimentation, the teacher in charge will remind the safety rules, give broad information about the development of the experiments, as well as general advices about them. A manual with specific safety rules and experimental details of every laboratory experiment is going to be purchased to the students. Before every experiment, the student must fill up a basic test about theoretical-practical aspects of experiment to be achieved. The student has to own a laboratory note-book in which he will write down the outcome of the experiments. During achievement of the experiments, the student has to prepare a report where he will collect theoretical basis, laboratory diary, and result discussion including comments about aspects related to IR and ^{1}H NMR spectroscopic data of the synthesized compounds. Furthermore, the teacher in charge is going to be supervising the different laboratory places, checking glassware assemblies, solving doubts and asking questions. In any time, the student may ask for help from the teacher. Furthermore, the student can use *webCT* virtual platform in order to obtain any complementary material related to experimental development o the subject: basis of basic operations in laboratory, video and pictures, web links and bibliography as well as models for report presentation and laboratory diaries.

webCT platform is going to be used in the teaching organization of the subject. This virtual platforms providing the students any teaching material needed for theory classes and seminars.

EVALUATION AND GRADING CRITERIA

A) The continuous evaluation system of the subject is based on the following topics:
   1) The overcoming of Laboratory Classes, being attendance mandatory.
   2) The overcoming of the theory block of the subject in a written test which should be done before the final exam.

3) The average grade of the continuous evaluation of seminars. Seminar attendance is mandatory. Each session is going to be scored from 0 to 10. No attendance to one of them will lead to a score of zero in that session.

Taking into account these topics, the global grade of the subject is obtained in accordance with the following equation*: global mark = (0,65 x Written test score) + (0,05 x Seminar score) + (0,30 x Lab classes score).*

B) The evaluation system by attendance at a final exam (*FE*) in the first call. In this case, the global grade of the subject is obtained in accordance with the following equation*: Global mark = (0,70 x Written test score) + (0,30 x Final Lab Exam)*. The minimum required mark in the final exam or written test and in the lab classes must be 5 points (in a range from 0-10).

The subject will be passed with a global score of 5 points.

The seminar and lab class marks will be preserved for the 2nd call (september) and 1st call of the following cours (december) whereas theory block grade will be preserved only for the 2nd call (september).

Evaluation and grading of the laboratory part of the subject (Laboratory classes):

Attendance at lab classes is mandatory in continuous evaluation. The student who attends at laboratory classes can approve the subject if he gets at least 5 points. The evaluation criteria to be applied are:

A) A practical block formed by:
   1. A continuous evaluation that corresponds to 30% rate of the grade for the lab part of subject, in which supervisor will check the knowledge of student on the theoretical and experimental aspects of the reactions that students will performs. The yields, purity and physical constants of the synthesised compounds, the skill to do instrumental laboratory assemblies, the answers to the supervisor's questions during the laboratory classes and the reports of each experiment achieved by the student will be considered. The report delivery is mandatory to pass the laboratory classes.
   2. A practical exam lab in which student has to achieved an assigned Organic Chemistry Laboratory operation corresponding to 30% of the grade of the laboratory part of the subject.

B) A written test corresponding to 40% of the grade of the laboratory part of the subject, and consisting in a questionnaire of the experimental and theoretical aspects related to the experiments performed.

Both parts must independently be approved before to do the average mark which will give rise to the grade of the laboratory part of the subject. The marks of Laboratory marks is obtained in agreement with the following equation: *Global Mark = Part A x 0.6 + Part B x 0.4*.

BIBLIOGRAPHY

General bibliography

Title	Authors	Year	Ed.	ISBN
Organic Chemistry	L. G. Wade, Whitman	2003	5	9780130338327

Organic Chemistry	Paula Yurkanis Bruice	2004	4	9780131407480
Organic Chemistry: Structure and Function	K. Peter C. Vollhardt and Neil Eric Schore	2009	6	9781429204941
Organic Chemistry	T. W. Graham Solomons, Craig B. Fryhle	2009	10	9780470401415

Specific bibliography

Title	Authors	Year	Ed.	ISBN
Introduction to Spectroscopy: A Guide for Students of Organic Chemistry	Donald L. Pavia, Gary M. Lampman and George S. Kriz	2000	3	9780030319617
Organic structures from spectra	L.D. Field, S. Sternhell, J. R. Kalman	2008	4	9780470319260
Cuestiones y Ejercicios de Química Orgánica	E. Quiñoá, R. Riguera	2004	2	84-481-4015-X
Problemas Resueltos de Química Orgánica	F. García Calvo-Flores, J. A. Dobado Jiménez	2007	1	978-84-9732-458-8
Nomenclatura de Sustancias Químicas	W. R. Peterson	2013	3	9788429176049
Nomenclatura y Representación de los Compuestos Orgánicos	E. Quiñoá Cabana	2005	2	9788448143633
Handbook of Chemical Formulas & Nomenclature	S. Symms, J. Heflin	2012	1	978-81-323-0629-0

Other teaching tools

Use of Virtual Teaching Platform of the University of Seville (webCT).