



ADVANCED ORGANIC CHEMISTRY

26035 - ADVANCED ORGANIC CHEMISTRY (2024-25)

General

Code: 26035

Lecturer responsible:

RAMON DANGLA, DIEGO JOSE

Credits ECTS:

6,00

Theoretical credits:

1,40

Practical credits:

1,00

Distance-base hours:

3,60

Departments involved

- **Dept:** ORGANIC CHEMISTRY

Area: ORGANIC CHEMISTRY

Theoretical credits: 1,4

Practical credits: 1

This Dept. is responsible for the course.

This Dept. is responsible for the final mark record.

Study programmes where this course is taught

- [DEGREE IN CHEMISTRY](#)

Course type: COMPULSORY (Year: 3)

Competencies and objectives

Course context for academic year 2024-25

In the course of Advanced Organic Chemistry student knowledge about the mechanisms of fundamental reactions in organic chemistry is improved. This includes the study of intermediates in the reactions: carbocations, carbanions, carbenes, nitrenes, radicals, etc. Photochemical reactions are introduced, and the set of pericyclic reactions, oxidation and reduction, focused toward their application in organic synthesis is also increased. Natural Products are also studied in the course, including the structural aspects, biosynthesis, synthesis and reactivity of the most important natural products. Among natural products studied are: carbohydrates, derivatives from the acetate route, terpenes, steroids, derived from the shikimate pathway, amino acids, polypeptides, proteins, nucleic acids and alkaloids.

Generic Degree Course Competences

- **CG1** : Desenvolupar la capacitat d'anàlisi, síntesi i raonament crític.
- **CG2** : Demostrar capacitat de gestió/direcció eficaç i eficient: esperit emprenedor, iniciativa, creativitat, organització, planificació, control, presa de decisions i negociació.
- **CG6** : Aprendre de manera autònoma.

Specific Competences:>>Theoretical

- **CE18** : Relacionar les propietats macroscòpiques amb les d'àtoms i molècules individuals, incloent macromolècules (naturals i sintètiques), polímers, col·loides i altres materials.
- **CE19** : Identificar l'estructura i reactivitat de les principals classes de biomolècules i la química dels principals processos biològics.
- **CE4** : Conèixer els tipus principals de reacció química i les seues principals característiques associades.
- **CE7** : Conèixer les lleis de la cinètica del canvi químic i les seues aplicacions, incloent-hi la catàlisi i els mecanismes de reacció.
- **CE9** : Reconèixer la naturalesa i comportament dels grups funcionals en molècules orgàniques. Conèixer les principals rutes de síntesis en química orgànica.

Specific Competences:>>Ability

- **CE24** : Demostrar el coneixement i comprensió dels fets essencials, conceptes, principis i teories relacionades amb les àrees de la química
- **CE25** : Resoldre problemes qualitatiu i quantitatiu segons models desenvolupats prèviament.
- **CE26** : Reconèixer i analitzar nous problemes i planejar estratègies per a solucionar-los.
- **CE27** : Interpretar, avaluar i sintetitzar dades i informació química.
- **CE28** : Reconèixer i implementar bones pràctiques científiques de mesurament i experimentació.
- **CE30** : Utilitzar amb seguretat reactius, instruments i dispositius d'aplicació en química.
- **CE31** : Dur a terme procediments estàndards de laboratoris implicats en treballs analítics i sintètics, en relació amb sistemes orgànics i inorgànics.
- **CE32** : Utilitzar instrumentació química estàndard per a identificació, quantificació, separació i determinació estructural.
- **CE33** : Monitoritzar mitjançant l'observació i mesura de les propietats químiques, successos o canvis, recopilant la informació adequada.
- **CE35** : Interpretar les dades procedents d'observacions i mesures en el laboratori.
- **CE37** : Valorar els riscos en l'ús de substàncies químiques i procediments de laboratori, així com gestionar adequadament els residus que es generen.
- **CE38** : Utilitzar correctament els mètodes inductiu i deductiu en l'àmbit de la química.
- **CE39** : Reconèixer i valorar els processos químics en la vida diària.
- **CE40** : Relacionar la química amb altres disciplines.

Exclusive skill taught in this course

No data

Learning outcomes (Training objectives)

No data

Specific objectives stated by the academic staff for academic year 2024-25

Expand the student's knowledge about the mechanisms of organic reactions, as well as their application in organic synthesis. Study of structural aspects, biosynthesis, synthesis and reactivity of the most important natural products.

Content and bibliography

Content for academic year 2024-25

PROGRAM OF THEORY

SYNTHESIS AND REACTION MECHANISMS

T1. Carbocations (I). Nomenclature and structure. Carbenium ion stability. Reactivity of carbenium ions. Aromatic carbocations. Formation and reactivity of carbenium ions. Two-electron bonds and three centers. Nonclassical cations. Ion pairs and reactivity.

T2. Carbocations (II). Addition and elimination reactions. Mechanisms. Functionalization of olefins by addition reactions in carbonyl compounds. Addition to alkynes and allenes. Orientation effects in elimination reactions. Stereochemistry of E2 reactions.

T3. Carbanions (I). Acidity of the hydrocarbons. Structure and factors affecting the stability of the carbanions. Reactivity of carbanions. Formation and alkylation of ketone enolates. Alkylation of aldehydes and of carboxylic acid derivatives. Enamines and imines anions. Conjugate additions of enolates.

T4. Carbanions (II). Aldol condensation: General, regiochemistry, stereochemistry and intramolecular condensation mechanism. Condensation reactions of imines. Acylation of enolates. Phosphorus and sulfur ylides.

T5. Carbenes and nitrenes. Structure and stability of carbenes. Generating carbenes. Reactions of carbenes: addition, insertion and transposition. Nitrenes. Transpositions to electron deficient nitrogens.

T6. Radicals. Generation and characterization of free radicals. Mechanisms of radical reactions: substitution reactions; addition reactions; intramolecular reactions; transpositions and fragmentations.

T7. Photochemistry. General principles: photochemical excitation; electronic transitions. Photochemical reactions: photochemical reactivity of the ketones; photochemistry of olefins and aromatics.

T8. Pericyclic reactions. Main cycloaddition reaction and their applications in organic synthesis: Diels-Alder; 1,3 dipolar additions; [2 + 2]-cycloadditions. Sigmatropic transpositions: ene reactions; thermal elimination reactions.

T9. Oxidation reactions. Oxidation of alcohols to aldehydes, to ketones and to carboxylic acids. Adding oxygen to carbon-carbon double bonds. Breaking carbon-carbon bonds. Oxidation of ketones and aldehydes. Allylic oxidation.

T10. Reduction reactions. Hydrogen addition. Hydrides of Group III: reduction of the carbonyl group and other functional groups. Group IV hydrides. Reductions with metals in solution. Reductive deoxygenation of carbonyl compounds.

NATURAL PRODUCTS

T11. The chemistry of natural products. General aspects. Biosynthesis and determining biosynthetic sequences. Nature of biosynthetic reactions. Mechanistic considerations in biosynthetic processes.

T12. Amino Acids. General aspects and properties. Synthetic methods for racemic and chiral compounds. Reactivity and derivatives.

T13. Polypeptides and proteins. General aspects. Sequencing of peptides and proteins. Synthesis of polypeptides. Structure of peptides and proteins.

T14. Carbohydrates. General aspects. Definitions and classification. Structure and conformational analysis. Reactions of the carbonyl group of the monosaccharides: nucleophilic reactions and oxidation reactions. Reactions of hydroxyl groups on monosaccharides. Oligosaccharides and polysaccharides.

T15. Natural products derived from acetate: Via del acetilpolimalonato. Fatty acids and related compounds: synthesis and biosynthesis. Arachidonic acid cascade: prostaglandins, leukotrienes, thromboxanes and prostacyclins.

T16. Terpenes. Classification. Techniques of structural elucidation. Biosynthesis of terpenes. General aspects of monocyclic and bicyclic monoterpenes. Acyclic and cyclic sesquiterpenes. Diterpenes: synthesis of vitamin A. Triterpenes: squalene. Tetra and polyterpenes: general aspects.

T17. Steroids. Structural features. Determination of stereochemistry of steroids. Steroids of biological interest. General aspects of steroid biosynthesis. Total synthesis of cholesterol.

T18. Compounds derived from the shikimate pathway. Shikimic acid biosynthesis. Chemical synthesis and reactivity. Tryptophan biosynthesis and related compounds. Gallic acid biosynthesis, depsids and gallotannins. Folic acid biosynthesis. Phenylalanine, hydroxycinnamic acid derivatives and lignin.

T19. Nucleic acids. Nucleosides and nucleotides: an overview and synthesis. Deoxyribonucleic acid, ribonucleic acid.

T20. Alkaloids. Introduction. Biosynthesis. Ergot alkaloid derivatives ornithine, lysine, phenylalanine, tyrosine, tryptophan, etc. General aspects. Determination of alkaloid structures: degradative and reductive methods.

PROGRAM FOR LABORATORY ACTIVITIES

Practice 1 (P1-3h): Synthesis of (S) -2-hydroxy -3- methylbutanoic acid.

Practice 2 (P2-3h): Aromatic electrophilic substitution. Synthesis of 4,4' -di -tert - butylbiphenyl.

Practice 3 (P3-3h): Horner - Wadsworth- Emmons reaction. Preparation of ethyl cinnamate .

Practice 4 (P4-3h): Mannich Reaction: Synthesis of indol alkaloid Gramina .

Related links

No data

Advanced organic chemistry. Part A : Structure and mechanisms

Author(s): Carey, Francis A.

Issue: New York : Springer, 2007;

ISBN: 978-0-387-68346-1

Category: Básico

Advanced organic chemistry. Part B : Reaction and synthesis

Author(s): Carey, Francis A.

Issue: New York : Springer, 2007;

ISBN: 978-0-387-68354-6

Category: Básico

Carbohydrate chemistry

Author(s): Davis, Benjamin G.

Issue: New York : Oxford University Press, 2003;

ISBN: 0-19-855833-3

Category: Complementario

March's advanced organic chemistry : reactions, mechanisms, and structure

Author(s): Smith, Michael B. ; March, Jerry

Issue: Hoboken, NJ : John Wiley & Sons, 2013;

ISBN: 978-0-470-46259-1 (cartoné)

Category: Complementario

Natural products : the secondary metabolites

Author(s): HANSON, James Ralph

Issue: Cambridge : The Royal Society of Chemistry, 2003;

ISBN: 0-85404-490-6

Category: Complementario

Química orgánica avanzada

Author(s): Ballesteros García, Paloma

Issue: Madrid : Universidad Nacional de Educación a Distancia, 2013;

ISBN: 84-362-6799-0

Category: Complementario

Assessment

Assessment procedures and criteria 2024-25

Controls can not be make up, except in exceptional cases prior acceptance of proof (illness, accident, etc.).

The marks for the student in all activities of continuous assessment will be used to calculate the weighted average with the final exam in June, or in his case, that of July. There is a minimum grade on the final exam (4/10) and laboratory practices (4/10). Once this cut-off mark is reached, the weighted average will be the final grade for the course. If not, the students will not be able to pass the subject, being its final qualification the minimum between the note of the non-passed block or the value 4.0.

None of the proposed activities will be maintained form an academic year to the next, unless the teachers involved considered appropriate.

In the case of extraordinary evaluation (student with <12 credits plus the TFG to end its degree), this will include a) a statement to be agreed relating to Part 1 (mechanisms-synthesis) or 2nd part (natural products) of the subject (50%), and b) a written exam related to the complementary contents (part 2-natural products or part 1-mechanisms-synthesis, respectively). On both sides a cut-off mark of 4 points will be established.

The theoretical / practical work done must be original. The detection of copying or plagiarism will score of "0" in the corresponding test. The Department and Faculty management will be informed about this incidence. The reiteration in the conduct in this or another subject will entail the notification to the vice-rector corresponding of the offenses committed so that they study the case and sanction according to the legislation (Regulation of academic discipline of the official Centers of Higher Education and Technical Education dependent of the Ministry of National Education BOE 10/12/1954) and according to the Student Statute of the University of Alicante.

Description	Criteria	Type	Weighting system
Controls	Short tests (20 min) about about contents related to the group tutoring problems.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	24
Laboratories	In the laboratory: Attitude and aptitude of the student, respect for safety standards and the results achieved. General monitoring of the development of practice. In the lab notebook: Annotations of the methodology used, the results obtained and the issues raised.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	16
Seminar problems	Participatory workshops series problems. Resolution by the teacher and student in class.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	10
Final exam	Written exam. It will consist of questions of theoretical and practical covering all content taught in the course. It must meet a minimum standard of general knowledge in this paragraph, which is set at 4/10	FINAL TEST	50

Official exam dates for academic year 2024-25

Exam session	Date	Time	Group - Classroom(s) allocated	Comments
(C3) Periodo ordinario para asignaturas de segundo semestre y anuales	06/06/2025			
(C4) Pruebas extraordinarias para asignaturas de grado y máster	02/07/2025			

Academic staff



RAMON DANGLA, DIEGO JOSE
Lecturer responsible

THEORY CLASS: Groups: 1
LAB PRACTICALS: Groups: L1
GROUP TUTORIALS: Groups: T1



ALONSO VELASCO, DIEGO ANTONIO

LAB PRACTICALS: Groups: L2



BAEZA CARRATALA, ALEJANDRO

LAB PRACTICALS: Groups: L8.2



GONZALEZ GOMEZ, JOSE CARLOS

THEORY CLASS: Groups: 8

LAB PRACTICALS: Groups: L8.1

GROUP TUTORIALS: Groups: T8



GUIJARRO PASTOR, ALBERT

LAB PRACTICALS: Groups: L8.1



GUILLENA TOWNLEY, GABRIELA

LAB PRACTICALS: Groups: L1



SANSANO GIL, JOSE MIGUEL

LAB PRACTICALS: Groups: L2

Groups

THEORY CLASS

Group	Semester	Morning or afternoon session	Language	No. of enrolled students
Gr. 1 (THEORY CLASS) : 1	2S	Morning	Spanish	64
Gr. 8 (THEORY CLASS) : 8	2S	Morning	English	15





























LAB PRACTICALS
































Group	Semester	Morning or afternoon session	Language	No. of enrolled students
Gr. L1 (LAB PRACTICALS) : L1	2S	Morning	Spanish	32
Gr. L2 (LAB PRACTICALS) : L2	2S	Morning	Spanish	31
Gr. L8.1 (LAB PRACTICALS) : L8	2S	Morning	English	8
Gr. L8.2 (LAB PRACTICALS) : L8.2 INGLÉS	2S	Morning	English	8












GROUP TUTORIALS

Group	Semester	Morning or afternoon session	Language	No. of enrolled students
Gr. T1 (GROUP TUTORIALS) : T1	2S	Morning	Spanish	63
Gr. T8 (GROUP TUTORIALS) : T8	2S	Morning	English	16













THEORY CLASS

















Group	Start date	End date	Day	Start time	End time	Lecture room
1	27/01/2025	27/01/2025	LUN	10:00	11:00	A2/A01 
1	29/01/2025	29/01/2025	MIE	09:00	10:00	A2/A01 
1	03/02/2025	03/02/2025	LUN	10:00	11:00	A2/A01 
1	05/02/2025	05/02/2025	MIE	09:00	10:00	A2/A01 
1	10/02/2025	10/02/2025	LUN	10:00	11:00	A2/A01 
1	12/02/2025	12/02/2025	MIE	09:00	10:00	A2/A01 
1	17/02/2025	17/02/2025	LUN	10:00	11:00	A2/A01 
1	24/02/2025	24/02/2025	LUN	10:00	11:00	A2/A01 
1	26/02/2025	26/02/2025	MIE	09:00	10:00	A2/A01 
1	03/03/2025	03/03/2025	LUN	10:00	11:00	A2/A01 
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1	13/03/2025	13/03/2025	JUE	09:00	10:00	A2/A01 
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1	14/04/2025	14/04/2025	LUN	10:00	11:00	A2/A01 

Group	Start date	End date	Day	Start time	End time	Lecture room
1	05/05/2025	05/05/2025	LUN	10:00	11:00	A2/A01 
1	08/05/2025	08/05/2025	JUE	09:00	10:00	A2/A01 
1	12/05/2025	12/05/2025	LUN	10:00	11:00	A2/A01 
1	14/05/2025	14/05/2025	MIE	09:00	10:00	A2/A01 
1	15/05/2025	15/05/2025	JUE	09:00	10:00	A2/A01 
1	19/05/2025	19/05/2025	LUN	10:00	11:00	A2/A01 
1	22/05/2025	22/05/2025	JUE	09:00	10:00	A2/A01 
8	27/01/2025	27/01/2025	LUN	10:00	11:00	A2/C04 
8	29/01/2025	29/01/2025	MIE	09:00	10:00	A2/C04 
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8	27/03/2025	27/03/2025	JUE	10:00	11:00	A2/C04 
8	31/03/2025	31/03/2025	LUN	10:00	11:00	A2/C04 
8	02/04/2025	02/04/2025	MIE	09:00	10:00	A2/C04 
8	07/04/2025	07/04/2025	LUN	10:00	11:00	A2/C04 







Group	Start date	End date	Day	Start time	End time	Lecture room
8	09/04/2025	09/04/2025	MIE	09:00	10:00	A2/C04 
8	10/04/2025	10/04/2025	JUE	09:00	10:00	A2/C04 
8	10/04/2025	10/04/2025	JUE	10:00	11:00	A2/C04 
8	14/04/2025	14/04/2025	LUN	10:00	11:00	A2/C04 
8	05/05/2025	05/05/2025	LUN	10:00	11:00	A2/C04 
8	08/05/2025	08/05/2025	JUE	09:00	10:00	A2/C04 
8	12/05/2025	12/05/2025	LUN	10:00	11:00	A2/C04 
8	14/05/2025	14/05/2025	MIE	09:00	10:00	A2/C04 
8	15/05/2025	15/05/2025	JUE	09:00	10:00	A2/C04 
8	19/05/2025	19/05/2025	LUN	10:00	11:00	A2/C04 
8	22/05/2025	22/05/2025	JUE	09:00	10:00	A2/C04 


LAB PRACTICALS

Group	Start date	End date	Day	Start time	End time	Lecture room
L1	19/02/2025	19/02/2025	MIE	09:00	11:00	A2/A01 
L1	03/04/2025	03/04/2025	JUE	09:00	11:00	A2/A01 
L1	12/05/2025	12/05/2025	LUN	11:30	14:30	0041P1006 
L1	13/05/2025	13/05/2025	MAR	11:30	14:30	0041P1006 
L1	14/05/2025	14/05/2025	MIE	11:30	14:30	0041P1006 
L1	15/05/2025	15/05/2025	JUE	11:30	14:30	0041P1006 
L1	16/05/2025	16/05/2025	VIE	11:30	14:30	0041P1006 
L2	19/02/2025	19/02/2025	MIE	09:00	11:00	A2/A01 
L2	03/04/2025	03/04/2025	JUE	09:00	11:00	A2/A01 
L2	12/05/2025	12/05/2025	LUN	11:30	14:30	0041P1008 
L2	13/05/2025	13/05/2025	MAR	11:30	14:30	0041P1008 
L2	14/05/2025	14/05/2025	MIE	11:30	14:30	0041P1008 

Group	Start date	End date	Day	Start time	End time	Lecture room
L2	15/05/2025	15/05/2025	JUE	11:30	14:30	0041P1008 
L2	16/05/2025	16/05/2025	VIE	11:30	14:30	0041P1008 
L8.1	19/02/2025	19/02/2025	MIE	09:00	11:00	A2/C04 
L8.1	03/04/2025	03/04/2025	JUE	09:00	11:00	A2/C04 
L8.1	12/05/2025	12/05/2025	LUN	11:30	14:30	0041P1004 
L8.1	13/05/2025	13/05/2025	MAR	11:30	14:30	0041P1004 
L8.1	14/05/2025	14/05/2025	MIE	11:30	14:30	0041P1004 
L8.1	15/05/2025	15/05/2025	JUE	11:30	14:30	0041P1004 
L8.1	16/05/2025	16/05/2025	VIE	11:30	14:30	0041P1004 
L8.2	19/02/2025	19/02/2025	MIE	09:00	11:00	A2/C04 
L8.2	03/04/2025	03/04/2025	JUE	09:00	11:00	A2/C04 
L8.2	12/05/2025	12/05/2025	LUN	11:30	14:30	0041P1010 
L8.2	13/05/2025	13/05/2025	MAR	11:30	14:30	0041P1010 
L8.2	14/05/2025	14/05/2025	MIE	11:30	14:30	0041P1010 
L8.2	15/05/2025	15/05/2025	JUE	11:30	14:30	0041P1010 
L8.2	16/05/2025	16/05/2025	VIE	11:30	14:30	0041P1010 

GROUP TUTORIALS

Group	Start date	End date	Day	Start time	End time	Lecture room
T1	28/02/2025	28/02/2025	VIE	09:00	11:00	A2/A01 
T1	29/04/2025	29/04/2025	MAR	09:00	11:00	A2/A01 
T1	16/05/2025	16/05/2025	VIE	09:00	10:00	A2/A01 
T1	23/05/2025	23/05/2025	VIE	10:00	11:00	A2/A01 
T8	28/02/2025	28/02/2025	VIE	09:00	11:00	A2/C04 
T8	29/04/2025	29/04/2025	MAR	09:00	11:00	A2/C04 

Group	Start date	End date	Day	Start time	End time	Lecture room
T8	16/05/2025	16/05/2025	VIE	09:00	10:00	A2/C04 
T8	23/05/2025	23/05/2025	VIE	10:00	11:00	A2/C04 