COURSE DATA

Data Subject	
Code	36457
Name	Advanced Experimentation
Cycle	Grade
ECTS Credits	6.0
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	4	Second term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	13 - Experimentation Advanced	Optional

Coordination

Name	Department
GAVIÑA COSTERO, PABLO	325 - Organic Chemistry

SUMMARY

Advanced Experimentation is an optional subject of 8th semester of the degree in chemistry, which aims to the student strengthens skills in laboratory work in general, and in particular, to know to integrate the knowledge acquired in each of the different areas of Chemistry (analytical, inorganic, physics and organic). Moving one step further, intends that the student will be able to adapt a synthetic strategy aimed at the preparation of an organic compound to be used in other studies from other fields of chemistry, as well as to carry out proper analytical studies that allow to check its purity. For the realization of this course we rely on the knowledge acquired in all the subjects of chemistry course in the first three courses of the degree in chemistry.

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

• Strengthen the trainee's knowledge of the rules of safety, material handling and reagents and treatment of waste in a Chemistry lab, on the literature search and analysis of data.

• reinforce the skills of the student in the preparation, development and registration of experimental work in Chemistry (laboratory notebook, memory of the practice, reports etc.).

• increase the critical spirit necessary in any scientific activity.

• perform different synthesis of organic products.

• carry out the determination of compounds with the most appropriate analytical technique

• select the most appropriate experimental methodology depending on the level of concentration (majority compounds against those to trace level)

• develop the student's ability to resolve the problems that can occur in a Chemistry lab.

• develop the student's ability to analyze the results and draw conclusions.

• enhance the skills of the student to work in a team.

• encourage the expression both oral and written.

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 and use of the subject Advanced Experimentation is based on the knowledge acquired in the different subjects of laboratory subjects taught in the first years of the degree in Chemistry. It is also convenient to get overcome the basic theoretical subjects from each of the areas of the degree in chemistry.

OUTCOMES

1110 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation.
- Solve problems effectively.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.

- 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.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Handle chemicals safely.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

LEARNING OUTCOMES

The previous section includes the competences contained in the document VERIFICA. This subject addresses part of the learning results of the matter *Advanced Experimentation* that allow to acquire specific knowledge of chemistry, cognitive skills and general skills recommended by the EUROPEAN CHEMISTRY THEMATIC NETWORK (ECTN) for the Chemistry Eurobachelor® Label. The following table lists the learning outcomes acquired in the subject *Advanced Experimentation* related to the competences of the degree in Chemistry.

COMPETENCES AND COGNITIVE SKILLS	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Advanced Experimentation that contemplate the learning outcomes EUROBACHELOR®

Ability to demonstrate knowledge and understanding of the facts, concepts, principles and fundamental theories related to the topics mentioned above.	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry..(CE13).
Competences for the evaluation, interpretation and synthesis of information and chemical data.	Evaluate, interpret and synthesise chemical data and information..(CE16). Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20).
Competences to present and argue scientific issues orally and in writing to a specialized audience.	Relate chemistry with other disciplines.(CE26). Prepare reports, surveys and industrial and environmental projects in the field of chemistry..(CE27). Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate. (CG6). Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences..(CB4).
Ability to calculate and process data, related to information and chemistry data.	Solve qualitative and quantitative problems following previously developed models..(CE14). Recognise and analyse new problems and plan strategies to solve them..(CE15).

COMPETENCES AND COGNITIVE SKILLS RELATED TO THE PRACTICE OF CHEMISTRY	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Advanced Experimentation that contemplate the learning outcomes EUROBACHELOR®

Capacities to handle chemical products safely, taking into account their physical and chemical properties, including any risk associated with their use.	Handle chemicals safely..(CE17). Evaluate the risks in the use of chemicals and laboratory procedures..(CE21).
Capabilities necessary to perform standard laboratory procedures as well as to use instrumentation in synthetic and analytical works, in both cases in relation to both organic and inorganic systems.	Carry out standard experimental procedures involved in synthetic and analytical work, in relation to organic and inorganic systems..(CE18). Relate theory and experimentation..(CE22). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Capacities to monitor, observe and measure the chemical properties, facts or changes, and perform their registration (collection) and documentation in a systematic and reliable way.	Handle the instrumentation used in the different areas of chemistry.(CE19). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Ability to interpret data derived from observations and laboratory measurements in terms of their relevance, and relate them to the appropriate theory.	Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24). Relate chemistry with other disciplines.(CE26).
Ability to perform risk assessments of the use of chemical substances and laboratory procedures.	Understand the qualitative and quantitative aspects of chemical problems..(CE24). Develop sustainable and environmentally friendly methods.(CE25).

	Evaluate the risks in the use of chemicals and laboratory procedures..(CE21).

GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Advanced Experimentation that contemplate the learning outcomes EUROBACHELOR®
Calculation and arithmetic capabilities, including aspects such as analysis error, estimates of orders of magnitude, and correct use of the units.	Develop capacity for analysis, synthesis and critical thinking.. (CG1). Show inductive and deductive reasoning ability..(CG2). Solve problems effectively..CG4).
Competences in information management, in relation to primary and secondary sources, including information retrieval through on-line searches.	Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate..(CG6). Have basic skills in the use of information and communication technology and properly manage the information obtained.(CT2).
Ability to analyse materials and synthesize concepts.	Develop capacity for analysis, synthesis and critical thinking.. (CG1). Show inductive and deductive reasoning ability..(CG2).

	Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration..(CB3).
Skills related to information technology such as word processing, spreadsheet, recording and storage of data, internet use related to the subjects.	Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate..(CG6). Have basic skills in the use of information and communication technology and properly manage the information obtained.(CT2).
Interpersonal skills to interact with other people and get involved in team work.	Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5). Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional. (CG7). Demonstrate the ability to adapt to new situations..(CG9).
Study skills necessary for professional development. These will include the ability to work autonomously.	Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation..(CG3). Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5).

	Learn autonomously.(CG8). Demonstrate the ability to adapt to new situations..(CG9). Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.(CB5).
Ethical commitment to the European Code of Conduct: http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf	Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.(CG10). Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional. (CG7). Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration. (CB3).

DESCRIPTION OF CONTENTS

1. Seminar

Presentation of the subject, rules of operation of an integrated laboratory, explanation of the objectives, content and techniques.

2. Literature review

In computer classroom, students are intended to analyze the literature regarding the development of processes and determine both the experimental processes to be performed and the subsequent analyzes.

3. Organic Synthesis

The preparation of diverse organic compounds will be carried out departing from commercial reagents.

4. Inorganic Synthesis

Making use of the compounds prepared in the previous activity a series of synthesis will be carried out with different inorganic compounds.

5. Analytical determination

Determination of products of organic and inorganic synthesis, both majority compound as impurities, using analytical techniques most appropriate, according to the nature and level of concentration of such products.

6. Characterization of chemical-physical properties

There will be studied chemical-physical different properties of the prepared compounds.

7. Seminar

They will analyze and discuss the results obtained during the practical sessions

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	48,00	100
Theory classes	12,00	100
Study and independent work	90,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Work in the laboratory. The experiments are designed in such a way that basically should be performed in more than one lab session, by which the student must learn to distribute your time and organize.

For the purpose of enhancing the responsibility of the student in the proper functioning of the laboratory and team work will be assigned weekly small tasks for which the student will contribute to the smooth functioning of the same.

An important part in the lab work is the laboratory notebook and the drafting of memoranda and reports.

The student must analyze the results obtained in both the laboratory and in the calculations. We will analyze the results obtained by identifying the problems and how they have been resolved or could be used to solve. Therefore this stage aims to develop the capability for analysis of pupil, enhance the exchange of information and the team work.

Seminars. All laboratory sessions require a prior exchange of views Where the teacher and the students can solve the specific questions of that day's work. Work of the teacher in this stage is foster in students a positive attitude in scientific work, this has been a seminar at the beginning of each session. A seminar, at the beginning of the course, designed to make the presentation of the subject, operation of an integrated laboratory, explanation of the objectives, content and techniques to be used throughout the course.

It has designed a seminar, at the end of the practice sessions, where they will discuss the results obtained, the problems that have arisen and make reasoned proposals for solution.

EVALUATION

The academic performance of the student and the final grade of the subject will be performed, in a weighted and careful manner, accordingly to the percentages that are shown in each of the sections here-under evaluated. All grades will be based on the absolute score over 10 points. The different sections that will be evaluated are given as follow:

a) LABORATORY WORK (20%): the delivered material including experimental proposals, synthetic schemes and calculations to be employed for the experimental and / or analytical parts will be evaluated. Initiative, independence, skills in the work and the respect of safety and environmental standards in the laboratory, all these items will be assessed.

b) PRESENTATION OF RESULTS- WRITTEN MEMORY (40%): the students will present a written report with a maximum number that the professors of the subject will indicate in due time. Such a report will include all the scientific work done as well as the analysis, discussion of the results obtained and the final concluding remarks.

c) PRESENTATION OF RESULTS- ORAL PRESENTATION (40%): A summary of the written report will be presented in a 15-minute oral presentation, followed by a question and discussion section with the professors involved.

It is necessary to obtain a minimum of 4 points out of 10, in each section, in order to get the average final grade.

The second evaluation-call will include the presentation of the corresponding report as well as the oral presentation of the results obtained and presented in the given report.

REFERENCES

Basic

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- CELA, R. LORENZO, RA. CASAIS, MC. Técnicas de separación en química analítica, Madrid: Síntesis, 2002.640 p. ISBN: 9788497560283.
- SHOEMAKER, DP. GARLAND, CW. NIBLER. JW. Experiments in physical chemistry. 6ª Edición. New York: McGraw-Hill, 1996. 778 p. ISBN: 0-07-057074-4.
- RUIZ SÁNCHEZ, JJ. RODRÍGUEZ MELLADO, JM. MUÑOZ GUTIÉRREZ, E. SEVILLA, JM. Curso experimental en química física. Madrid: Síntesis, 2003. 144 p. ISBN: 9788497561280.
- CHEMBIOOFFICE ULTRA, perkinelmer (cambridgesoft) amplia selección de aplicaciones y funcionalidades que permite estudiar dibujar, formular, modelar y
  editar estructuras moleculares químicas y biológicas.

Additional

- Características de los compuestos (datos físicos, químicos, seguridad etc.):
  a) Inst. Nacional de Seguridad e Higiene en el Trabajo (Ministerio de Trabajo e Inmigración)
  b) Catálogo SIGMA-ALDRICH (Casa Comercial)
  c) CHEMnetBASE reúne una serie de Bases de datos como:
  1. Combined Chemical Dictionary (CCD)
  2. The Handbook of Chemistry & Physics
  d) Index Merck (libro que se puede encontrar en la biblioteca)

- MILLER, JN. MILLER, JC. Estadística y quimiometría para química analítica. 4ª edición, Madrid: Prentice hall, 2002. 296 p. ISBN: 9788420535142
- SKOOG, DA. WEST, DM. HOLLER, FJ. CROUCH SR. Fundamentos de química analítica. 8ª edición. Madrid: Paraninfo, 2005. 1196 p. ISBN: 9788497323338.
- SPIRIDONOV, VP. LOPATKIN, AA. Tratamiento matemático de datos fisicoquímicos. Moscú: Mir, 1973. 207 p. ISBN: mkt0004416619
- GIAMBERARDINO, V. Teoría de los errores. Caracas: Reverté Venezolana, 1980. 168 p. ISBN: 978-84-291-4009-5
- LEVINE, IN. Físico química. 4ª edición. Madrid: McGraw-Hill, 1996. 594 p. ISBN: 84-481-0617-2.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

1.- The contents initially indicated in the teaching guide are maintained.

Workload and temporary teaching planning

Regarding the workload:

The different activities described in the Teaching Guide are maintained with the intended dedication.

Regarding the temporary teaching planning:

The material to follow the theory/tutoring/classroom-seminar classes allows to continue the temporary teaching planning both in days and schedule, whether the teaching is face-to-face in the classroom or not.

Teaching Methodology

Regarding laboratory courses, the maximum face-to-face teaching will be lying in compliance with the rules of distance and occupation of spaces fixed by the academic authorities. In this sense, the teaching type "L" will be 100% face-to-face, and the teaching type "U" will be non-face-to-face and will be taught through the tools offered by the virtual classroom.

In the case of students confined to home due to COVID, as far as possible, the experimental sessions will be recovered.

The methodology used for non-face-to-face classes shall be:

Synchronously using virtual classroom tools (preferably Teams)

In all subjects

If there is a closure of the facilities for health reasons that totally or partially affects the classes of the course, they will be replaced by non-face-to-face sessions following the established schedules and using the tools of the virtual classroom.

In the case of students confined to home due to COVID, they will be ensured on-line teaching through Teams.

Evaluation

The evaluation system described in the Teaching Guide of the subject in which the various evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.

If there is a closure of the facilities for health reasons affecting the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the subject will remain unchanged, as set out in this guide.

References

The literature recommended in the Teaching Guide is maintained since it is accessible.