VNIVERSITAT DE VALÈNCIA

Course Guide
44609 Green chemistry

COURSE DATA

Data Subject	
Code	44609
Name	Green chemistry
Cycle	Master's degree
ECTS Credits	5.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
2218 - M.U. en Química	Faculty of Chemistry	1	First term

Subject-matter

Degree	Subject-matter	Character
2218 - M.U. en Química	4 - Green chemistry	Optional

Coordination

Name	Department
GRACIA EDO, LOURDES	315 - Physical Chemistry

SUMMARY

Green Chemistry is the orientation of chemistry, as a set of theoretical and applied knowledge, whose specific aim is the prevention of environmental contamination and the risks associated with chemical products, by introducing or stressing of clean and safe production processes and of less toxic and contaminant chemical products without reducing its contribution to wellness and technological progress.

Sustainable Chemistry must be considered as a part of Environmental Chemistry and endeavours to achieve the current and future prevention of contamination and risk problems originated by chemical substances, by analysing the origin of these problems. With the premises, the objectives of Green Chemistry are the following:

Reducing the generation and use of contaminants in the chemical process

Reducing the risky character of the chemical process

Reducing the noxious effect of the chemicals used by the production sectors or the final consumer.

Reducing the use of extinguishable and scarce raw materials.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

Prior knowledge of chemistry is required, at the level taught in the qualifications listed in the recommended profile for admission of candidates to the Masters Degree.

OUTCOMES

2218 - M.U. en Química

- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Be able to solve complex chemistry problems, whether in the academic, research or industrial application areas at a specialization or masters-level.
- Possess the necessary skills to develop multidisciplinary activities within the field of chemistry at the master's level.
- Be able to design, perform, analyse and interpret experiences and complex data in the environment of chemistry at a specialization level.
- Acquire advanced knowledge to assess the importance of chemistry in health, the environment, new materials and energy.
- Acquire the necessary advanced knowledge to assess the importance of chemistry in economic and social development in a context of specialization.

LEARNING OUTCOMES

Be able to valorise the role of Chemistry and its influence on the environment

Be able to valorise the important role of Green Chemistry in the search of more efficient and environmental friendly products and processes.

Identify the residues generated in the different steps of the chemical processes in order to proceed to its possible reuse or selective collection of toxic residues.

Describe the main sources of chemical products and their treatment for the transformation into added value materials.

Know the role of chemistry in the main sources of renewable energy and in the methods for energy storage.

Know the recycling processes of the main materials and metals.

Design, synthesise and perform effective analytical processes for obtaining and valorising products.

Use the different sustainable tools of Chemistry.

DESCRIPTION OF CONTENTS

1. Introduction

Objectives. Use of renewable sources of raw materials. Reduction of polluting substances: chemical substances (Atomic economy, Factor E) and energy. Reduction of the risk associated with substances with toxic, dangerous or aggressive nature: measures of toxicity. Environmental management systems. Legislation.

2. Use of renewable sources of raw materials

Chemical products from glucose. Chemicals from fatty acids. Polymers from renewable sources. Other products from renewable sources.

3. Renewable energy sources

Main renewable energy sources. Solar, eolic, hydroelectric and biomass. Other renewable energy sources. Energy storage systems.

4. Recycling

Waste recycling: paper, plastics, glass, batteries, common metals (Al, Pb,...), scarce metals (Au, Rh, Pd, Ta,...),...

5. Design of sustainable processes. Industrial examples

Factors to consider for the design of a sustainable process. Complete study. Industrial examples.

6. Catalysis: green concepts and applications.

- Basic concepts of catalysis. -Catalysis and Green Chemistry. -Influence of the catalytic processes in the E-Factor and the atomic efficiency. -Examples of the role of catalytic processes in Green Chemistry: Catalysis by acids and bases. Oxidations and catalytic reductions. Catalytic formation and C-C bonds. Enerioselective catalysis. -The reaction medium. -Biocatalysis. - Renewable materials and white biotechnology. -Integration of processes and catalytic cascades. -Catalysis for a green industry

7. Real-time monitoring.

Green Analytical Chemistry. Monitoring and treatment of data in real time. Portability of the instrumentation. New monitoring technologies.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	40,00	100
Tutorials	5,00	100
Seminars	5,00	100
Attendance at events and external activities	5,00	0
Development of group work	20,00	0
Study and independent work	25,00	0
Readings supplementary material	10,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	**125,00**	

TEACHING METHODOLOGY

The subject is designed so that the student is the protagonist of their own learning. From the beginning of the course students will have all the necessary teaching material and the teaching will be structured as follows:

• Lectures. - In these lessons, the basic concepts of the subject will be introduced. The active participation of the student will be encouraged through the approach of questions related to the application of concepts and knowledge previously acquired by the student.

• Tutorials. - They are proposed as discussion forums for the problems posed or for the resolution of the proposed exercises.

• Seminars. - The professor will propose tasks that will consist on the study of a practical case, related to some of the topics of the program that must be solved by groups of students and presented in an oral presentation.

• Visits. - Two companies particularly involved in this topic by their policy of environmental commitment (either in the field of waste treatment or in the implementation of sustainable industrial processes) will be visited.

EVALUATION

The evaluation of the course will be carried out in a continuous manner by the teacher throughout the course and will consist of the following sections.

● Direct evaluation of the teacher. 20% of the note shall direct evaluation of the professor in theoretical classes and problems and in the tutorials. This assessment shall take into account various aspects, which include:

- Attendance and participation reasoned and clear in the discussions raised.

- Progress in the use of the language of the subject.

- Problem solving and approach of doubts.

- Critical thinking.

- Delivery of exercises.

- Use of visits and seminars.

● Evaluation visits and seminars. Be taken into account the responses to the questionnaires raised them on visits and seminars. To this section you will be up 30% of the final note.

● Oral test. 50% of the mark will be obtained from an oral test that made the students of the assigned work. The skills such as problem solving, of content related to the matter that will be of such a nature that make the student to relate different aspects that appear on different topics of the course and even in different subjects will both be assessed.

REFERENCES

Basic

- M. Lancaster, Green Chemistry, An Introductory Text, Royal Society of Chemistry, Cambridge, 2002

- J. Clark, D. Macquarrie, Handbook of Green Chemistry and Technology, Blackwell, Oxford, 2002
- P. T. Anastas, J. C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, Oxford, 1998
- R. Mestres, Química Sostenible, Ed. Síntesis, 2011
- de la Guardia M. y Armenta S., Green Analytical Chemistry: Theory and Practice, Elsevier, Amsterdam, 2011.
- de la Guardia M. y Garrigues S. (ed), Challenges in Green Analytical Chemistry, RSC Publishing, Cambridge, 2011.
- Rothenberg, G., Catalysis. Concepts and Green Applications. Wiley-VCH, Weinheim, ISBN: 978-3-527-31824-7

Additional

- M. C. Cann, M. E. Connelly, Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000
- Revista Green Chemistry, 24 números año, Walter Leitner ed., RSC, desde 1999.
- R. L. Garrett, Pollution Prevention, Green Chemistry, and the Design of Safer Chemicals, en, S. C. DeVito y R. L. Garrett Ed., Designing Safer Chemicals, ACS Symposium Series, American Chemical Society, Washington, 1996

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

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 but the hours of dedication to each activity are changed, as shown in the following table

ACTIVITY	Hours	% To be attended

Theory classes	40.00	70-100
Tutorials	5.00	70-100
Seminars	5.00	70-100
Study and independent work	75.00	0
TOTAL	**125.00**	

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

Theory courses: Theory classes and classroom tutoring will tend to the maximum possible face-to-face teaching, always respecting the health restrictions that limit the capacity of the classrooms to 50% of their usual occupation. Depending on the capacity of the classroom and the number of students enrolled, some of the students may need to follow the classes synchronously in an auxiliary classroom. If this situation arises, students will attend the main classroom or auxiliary classroom for weekly rotary shifts (preferably in alphabetical order). However, the rotation system will be fixed once the actual enrollment data is known, guaranteeing, in any case, that the percentage of face-to-face teaching of all students enrolled in the subject is the same.

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

1. Synchronously using virtual classroom tools (Teams, Blackboard ...)

2. Asynchronously using locut power-point presentations or other virtual classroom tools

3. Resolution of exercises and questionnaires

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.

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, and it is complemented by notes, slides and problems uploaded to the Virtual Classroom as material of the course.