Universidad Zaragoza

Academic Year/course: 2021/22

60463 - Sustainable chemistry and catalysis

Syllabus Information

Academic Year: 2021/22
Subject: 60463 - Química sostenible y catálisis
Faculty / School: 100 - Facultad de Ciencias
Degree: 543 - Master's in Molecular Chemistry and Homogeneous Catalysis
ECTS: 2.0
Year: 1
Semester: Second semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

This course provides advanced training and specialized skills in the field of Sustainable Chemistry, introducing to the students the main principles and tools of this discipline and its practical application in important chemical processes. Among these principles, it should be stressed the use of renewable raw materials, "green" solvents and catalysts, as well as the optimization of energy resources. Furthermore, the course presents some tools to assess the degree of compliance with these principles in individual cases.

These approaches and objectives agree with the following Sustainable Development Goals (SDGs) of the United Nations Agenda 2030 (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the learning results of this subject provides training and competence to contribute to a certain extent to its achievement. Goal 4: Quality education, Goal 7: Affordable and clean energy, Goal 8: Decent work and economic growth, Goal 12: Responsible consumption and production and Goal 13: Climate Action.

1.2. Context and importance of this course in the degree

Sustainable Chemistry and Catalysis is an optional subject with 2 ECTS, taught in the spring semester. This course is part of the module, *Horizons in Molecular Chemistry and Catalysis*. The course provides training to carry out sustainable processes and to design environmentally friendly products. In addition, special emphasis is placed on Catalysis as a way to carry out effective and sustainable chemistry. In this regard, this course expands the competences of the compulsory subject, *Catalysis*, and it is complementary to the optional subject, *Asymmetric Catalysis*.

1.3. Recommendations to take this course

This course requires basic knowledge of chemistry and catalysis.

This subject is evaluated by continuous assessment; therefore, class attendance and daily work is crucial to pass the subject.

The lectures and evaluation of this subject will be carried out in the classroom, whenever possible. Otherwise, the lectures and the evaluation activities will be adapted to enable them to be carried out remotely, trying to maintain, as far as possible, the typology and criteria stablished here.

2. Learning goals

2.1. Competences

The student has acquired an advanced knowledge of the essential facts, principles and theories related to the Sustainable Chemistry, with special emphasis on current research topics.

The student is capable of using the vocabulary and terminology in the field of Sustainable Chemistry.

The student is able to apply the acquired knowledge in the design and synthesis of new molecules following the principles of "green chemistry".

The student is able to gather relevant information for the evaluation of the risks, toxicity and environmental impact of chemical products, in order to use them in a safe and responsible manner.

The student has acquired a general vision of the basic principles in catalysis, understanding the most important industrial and technological catalytic processes and the new tendencies in catalysis.

The student is able to integrate and evaluate research results in the area of *Molecular Chemistry and Catalysis*, and to discuss the data in a scientific fashion making cross-links with the theoretical knowledge.

2.2. Learning goals

To understand the principles of the Sustainable Chemistry and their application in the design of chemical processes.

To recognize the main types of renewable raw materials, their properties and applications.

To identify the important role of catalysis in a sustainable development.

To evaluate and compare the physico-chemical and toxicological properties of conventional and unconventional solvents.

To acquaint with low-impact environmental reaction methods and their applications.

To assess the degree of compliance with the principles of sustainable chemistry in a particular chemical process.

2.3. Importance of learning goals

The sustainability risks of our planet are widely recognized specially in terms of waste generation and availability of resources for a high-rate growing world population. In the current social, economic and political context, it is necessary to minimize the environmental impact associated with chemical processes and products, at both industrial and academic research level. These reasons indicate that training in *Sustainable Chemistry and Catalysis* is important at a post-graduate level within the framework of the *Master in Molecular Chemistry and Homogeneous Catalysis*, whose overall objective is to form highly qualified researchers in the fields of *Chemical Synthesis and Catalysis*. In particular, the master degree students will be capable of understanding and applying the principles of sustainable chemistry in the design of chemical products and processes, primarily at laboratory scale, respecting the environment, so that chemistry would be viewed as the solution rather that the problem.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

According to the evaluation regulations of the University of Zaragoza, the students can be evaluated either by a continuous evaluation or by a final global exam. In the event that the students decide to be evaluated by the both methods, continuous assessment and single global exam, the highest mark will prevail.

The student should demonstrate that they have attained the expected learning outcomes through the following assessment activities:

Continuous evaluation:

Weighted average of the following activities:

1.- Individual or group works, supervised by the lecturers (30%).

2.- A written exam consisting of theoretical/practical questions (70%). The students have the choice to look up the bibliography, in paper format, during the exam.

The students will pass the course if the 30 and 70 weighted average of the two assessments is equal or higher than 5.0. The students have the opportunity to improve the grades obtained in the continuous evaluation by undertaking the single global exam. And as indicated above, the highest mark will prevail.

Global Evaluation:

The students have the option to choose a non-continuous evaluation; these students and those who have no passed the continuous evaluation could carry out a global exam which will represent 100% of the final grade, either in the first or in the second call. The global exam will consist of a written assessment dealing with the main concepts described in the course and emphasized in the learning activities. Contrary to what was previously said for the exam corresponding to the continuous evaluation, on this occasion the student will NOT be able to consult any literature.

The number of official examination calls (two per registration) and their use will be subjected to the statements of the *Regulation of Permanence in Master Studies* and the *Regulation of the Learning Assessment* (https://ciencias.unizar.es/normativas-asuntos-academicos). The latest document will also regulate the general design and scoring criteria of the assessment activities, as well as the exam schedules and timetable for the post-examination review.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process designed for this course comprises participatory lectures, practical application exercises, seminars (could be given by professionals) and tutorials. The theoretical contents of the syllabus will be introduced, discussed and complemented with the solving of practical examples aimed at clarifying the concepts presented in each topic (*vide infra*).

In addition, the students should complete an individual or group written assignment on a subject related to the contents of the course, which should be agreed with the lecturers. This assignment requires a specialized bibliographic search related to the topic. The students will present it before their peers and lecturers; after the presentation, a discussion will take place.

4.2. Learning tasks

The course includes the following learning tasks:

- Participatory lectures.
- Practical application exercises and seminars.
- Supervised academic works.
- Individual or small-group tutorials.

Teaching and assessment activities will be carried out in the classroom with all students onsite unless, due to the health situation, the provisions issued by the competent authorities and the University of Zaragoza arrange to carry them out by telematics means or in a reduced rotating capacity.

4.3. Syllabus

The course will address the following topics:

Topic 1. Basic concepts of sustainable chemistry.

Topic 2. Sustainable Energy.

Topic 3. Reactions activated by unconventional methods.

Topic 4. Renewable raw materials.

Topic 5. Alternatives to conventional organic solvents.

Topic 6. Catalytic processes and industrial applications of green chemistry.

Note: The order can change, depending on the teaching and organizational needs.

4.4. Course planning and calendar

The scheduled activities will be carried out during the spring semester. The information about schedules, calendars and exams is available at the websites of the Sciences Faculty, https://ciencias.unizar.es/calendario-y-horarios, and the Master, http://masterqmch.unizar.es.

The presentation of assignments will be done according to the schedule that will be announced in advance.

Students will be provided with different teaching material either at reprography or through the University's virtual platform https://moodle2.unizar.es/add.