Universidad Zaragoza

**Academic Year/course: 2021/22**

# 66106 - Case Studies of Industrial Applications

## Syllabus Information

**Academic Year:** 2021/22
**Subject:** 66106 - Case Studies of Industrial Applications
**Faculty / School:** 100 - Facultad de Ciencias
**Degree:** 539 - Master's in Nanostructured Materials for Nanotechnology Applications
**ECTS:** 6.0
**Year:** 1
**Semester:** First semester
**Subject Type:** Compulsory
**Module:**

# 1. General information

## 1.1. Aims of the course

This course aims to provide the students with some key tools to apply the knowledge gained about Nanoscience, understanding the market possibilities, the competitive advantages of technological innovation, the real difficulties when launching a new product or setting up a company, and, generally speaking broadening their perspective regarding nanotech applications. In addition, this is the first opportunity to achieve a greater degree of specialisation, once the different applications of nanomaterials have been explored.

The students will become familiar with real cases of practical applications and get to know highly specialised experts.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDG) of the Agenda 2030 of the United Nations (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of learning outcomes of the subject provides training and competence to contribute to some extent to the achievement of O9. Industry, innovation and infrastructures. More specifically, they will create action to enhance research, foster innovation and upgrade industrial technologies.

## 1.2. Context and importance of this course in the degree

A very important contribution is this course is made by different speakers from the industrial world in areas from electronic to biomedical applications. In their presentations they will explain how their companies harness nanomaterials to provide added value to their products. This will give our students first hand knowledge of the real scientific, financial, social, marketing, etc. difficulties involved in launching a nanodevice or a particular application of nanostructured materials onto the market.

The course will provide a realistic view of selected applications of Nanotechnology but also of the difficulties involved in developing them into commercial products. Students will be able to improve their communication skills by direct interaction with professionals from different disciplines. It will also give them a first opportunity of professional networking, by putting them in contact with important companies that might in the future be interested in recruiting well-trained and highly specialised people in areas connected to Nanoscience and Nanotechnology.

## 1.3. Recommendations to take this course

The ?*Case studies of Industrial Applications*? course is obligatory and is equivalent to 6 ECTS credits or 150 student work hours. The course is given in the first term of the academic year.

The objective of this module is that the students analyse and understand real Nanotechnology applications in our everyday lives. In order to achieve this objective, various speakers from the industrial sector will show how their companies make use of Nanotechnology in their production lines and end products. In addition, this module also addresses other important points related to the implementation of Nanotechnology. These range from awareness of the potential risk of nanomaterials on health, environment and sustainability and a general view of protective measures (Nanosafety aspects) to practical aspects regarding the launching of a new nanotech product (e.g. patent rights and intellectual property).

As the whole course is taught in English, students need to have an upper-intermediate level in the language: minimum level B1 in the European Common Framework Language Reference, but preferably level B2. Level B1 is reached when the student is able to understand the main points of clear, standard-language texts when covering known matters - whether in terms of work, study or leisure; when able to cope in most situations which the student encounters during a trip to places where the language is spoken; when able to write simple, coherent texts on familiar topics or those in which the student has an interest; and when able to describe experiences, happenings, wishes and ambitions as well as briefly justify opinions or explain plans. B2 is achieved when the student is able to understand the main ideas of complex texts that deal with both specific and abstract topics, even if these are technical - though within the field of specialisation; when able to communicate

with native speakers with the degree of fluency and ease such that the communication takes place without effort on either side; and when able to write clear, detailed texts on diverse subjects as well as defend a point of view on general topics - giving the pros and cons of the different options.

# 2. Learning goals

## 2.1. Competences

**After completing the course, the student will be competent in the following skills:**

- Assess the importance of the nanotech product market.

- Appreciate the potential of Nanotechnology as a horizontal discipline capable of incorporation into numerous production processes.

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- Realize the difficulties and practical challenges involved in launching a new nanotechnology device or application of nanostructured materials onto the market.

- Recognise the difficulties and the scientific, financial, social, marketing, etc. challenges involved in launching a nanodevice or a particular application of nanostructured materials onto the market.

- Communicate and interact with professionals from different disciplines.

## 2.2. Learning goals

**The student, in order to pass the course, will have to show her/his competence in the following skills:**

- Identify the differential characteristics and competitive advantages that the application of the nanoscale can give particular commercial products.

- Identify the difficulties existing for the advances achieved in the laboratory to be put into practice.

- Be aware and describe a variety of products on the market (textile, motor, pharmaceutical, energy, health, technological, construction, etc.) based on nanostructured materials.

- Recognise the design factors in high tech nano-products and the characteristics which make them successful commercially.

- Recognize possible unwanted effects of nanomaterials on health, environment and sustainability and how these effects can be eliminated or minimized.

## 2.3. Importance of learning goals

This module aims to provide a bridge between the nanotechnology concepts that the students learn in other modules and their practical realization as commercial processes or products. In a way, the goal is to make the student much more aware of the real life presence of the discipline they are studying. Herein, students receive hints that should help them to understand the state of the market prior to the insertion of a nanotech product, identify the opportunity, design the product or process to fill that gap and be aware of the steps needed for technological and commercial implementation. The case studies method (around10 case studies from different areas: pharmaceutical industry, motor, textile, cosmetics, biotechnology, sensor manufacturing, etc.) will help them to develop innovative ideas and draft a basic plan for their practical implementation.

# 3. Assessment (1st and 2nd call)

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

**The student will prove that he/she has achieved the expected learning results by means of the following assessment tasks.**

For students choosing **CONTINUOUS ASSESSMENT** (attendance to at least 80% of this module lectures is required):

> Students by groups (2) will develop a hypothetical nanotechnology product or application that could in principle be manufactured and sold commercially. A written report must be presented describing the implementation process for a product in the market, evaluating not just the scientific difficulties and technological limitations but also giving a basic assessment of the potential market for the product and discussing technological, financial and social aspects related to its implementation. The novelty of the idea and/or its practical application will be highlighted, in comparison with existing solutions in the macro and nano realms.
>
> Important aspects that will be evaluated include the originality of the topic chosen, the review of the state of the art in the area (including patents), the identification of the niche market, the technological viability of the proposed idea will be assessed and the consideration given to the main factors (production costs, availability of raw materials, viability of

proposed fabrication and characterization methods) , etc.

The report must be a minimum of 25 pages long and a maximum of 40 pages long (times new roman 12 and including the figures or schemes that accompany the text). Plagiarism (the illicit copying of another person's work, especially written content, for presentation as one's own) is not allowed. In addition to the written report, a public presentation of the product will be made in front of a board of examiners. The presentation will last a maximum of 15 minutes and will be followed by a debate.

The 85% of mark will take into account both the quality of the written report, oral presentation and its defence.

The remaining 15% of the mark will be obtained from the periodic tutorials about the progress of the project with the lecturers involved.

For students that did not pass the continuous assessment or wish to increase their mark, the **Global Assessment** comprises:

A written exam (15% of the mark) related to nanosafety, scalability and intellectual property issues.

A written report of the "nanoproduct" along the same lines just described for regular students and its oral presentation and defence in front of a board of examiners (85% of the mark).

A minimum qualification of 4 out of 10 is needed in each of the two parts to pass the subject. In any case, the average over the two sections must be at least 5 out of 10 to pass the subject. Plagiarism (the illicit copying of another person's work, especially written content, for presentation as one's own) is not allowed.

# 4. Methodology, learning tasks, syllabus and resources

## 4.1. Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. Mainly, invited talks from high level specialists in their fields will provide students with real cases of application of nanotech devices in the market. Through critical analysis of case studies, the students will appreciate the advantages, limitations and difficulties in the use of novel nanotechnology developments in different industries.

Students are expected to participate actively in the class throught the semester. Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials. Further information regarding the course will be provided by the coordinator of the course on the first day of class.

## 4.2. Learning tasks

**This is a 6 ECTS course organized as follows:**

• **Lectures**. Nanosafety and Scalability Topics will be presented, analysed and discussed through lectures of 50 minutes. The lecturers will provide the students with notes, handouts or summaries of class content prior to the beginning of the class (preferably via Moodle) along with the recommended reading for more in-depth understanding of the topic.

• **Practical Case Studies**. Invited speakers will explain how their companies harness nanomaterials to provide added value to their products through lectures lasting, depending on the topic, between one to two 50-minute sessions.

• **Assignment**. Students by groups (2-3 people) will develop a hypothetical nanotechnology product or application that could in principle be manufactured and commercialized. They will prepare a comprehensive report and submit a written copy at the end of the course and will do an oral presentation.

• **Autonomous work**. Students are expected to spend about 75 hours to study theory, solve problems and work on the assignments.

• **Tutorials.** Teacher’s office hours allow students to solve questions and discuss unclear course contents. The module coordinator will supervise the assignment type "case study" for which each group will prepare a written report and an oral exposition. It is advisable to come with clear and specific questions to tutorials.

**Note:** The teaching and evaluation activities will be carried out in person unless, due to COVID-19, the provisions issued by the competent authorities and by the University of Zaragoza oblige to carry out virtually.

## 4.3. Syllabus

The course will address the following topics:

- Nanosafety

- Scalability
- Intellectual Property
- Case Studies of Industrial applications of nanomaterials in automotive, consumer goods, healthcare, energy and environmental related sectors.

## 4.4. Course planning and calendar

The course is given in the afternoon and the calendar for classes and exam dates will be published prior to the beginning of each academic year in the web site of the Faculty of Science. Furthermore, the google calendar for this course will be shared with the students for a more efficient and effective communication.

This course starts in the mid of October and develops together with courses 66111 "Assembly and Fabrication of Nanostructures" and 66112 "Preparation of Nanostructured Materials" .

Further information concerning the timetable, classroom, assessment dates and other details regarding the invited talks and topics for the case studies, will be provided on the first day of class by the coordinator of the course.

Additionally, the student can set up regular appointments for office hour consultation.