Project/Teaching guide of the subject

Asignatura	SOSTENIBILIDAD Y EXCELENCIA – SUSTAINABILITY AND EXCELLENCE		
Materia	SOSTENIBILIDAD - SUSTAINABILITY		
Módulo	2. GESTIÓN Y OPTIMIZACIÓN DE LA PRODUCCIÓN Y SOSTENIBILIDAD - 2. MANAGEMENT AND OPTIMIZATION OF THE PRODUCTION AND SUSTAINABILITY		
Titulación	MÁSTER EN INGENIERÍA QUÍMICA MASTER IN CHEMICAL ENGINEERING		
Plan	542	Código	53745
Periodo de impartición	1er CUATRIMESTRE 1st SEMESTER	Tipo/Carácter	OB
Nivel/Ciclo	MASTER	Curso	1º
Créditos ECTS	6.0		
Lengua en que se imparte	INGLÉS - ENGLISH		
Profesor/es responsable/s	JUAN GARCÍA SERNA DANILO CANTERO SPOSETTI MARÍA CRISTINA GONZÁLEZ FERNÁNDEZ		
Departamento(s)	INGENIERÍA QUÍMICA Y TECNOLOGÍAS DEL MEDIO AMBIENTE		
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Fecha de revisión por el Comité de Título	16/07/2024		

1. Situation / Concept of the subject

1.1 Context

The subject "SUSTAINABILITY AND EXCELLENCE" forms in itself the subject "Sustainability" that is part of Module 2 "MANAGEMENT AND OPTIMIZATION OF PRODUCTION AND SUSTAINABILITY".

The industrial revolution led to acceleration 2.0, with a large number of machines that increased consumer goods and trade. Subsequently, since the 90s, the 3.0 acceleration motivated by Internet, opening of borders, etc. has been experienced. being the information and the experiences the base. In the last five years (2015 onwards) a new 4.0 acceleration is under way, where blockchain economy, collaborative work and innovation are the key.

Designing for this new moment and fulfilling the expectations of a tremendously accelerated, globalized and connected world requires understanding the basis of the philosophy of sustainability. In this context so current and so relevant the subject is framed.

The student will receive more than one challenge, one in particular will be the basis of the subject: "the creation of a sustainable product idea and its design to create the possible company".

1.2 Relation with other subjects

The subject of "Sustainability and Excellence" aims to expand the student's knowledge towards a practical level of creativity.

The subject has a direct relationship with:

- Chemical Product Engineering
- Control of Business Management

Indirectly this subject will help students to have a basis for the possible “Practicum" and the "Master's Thesis".

1.3 Prerequisites

This subject does not have specific prerequisites, only an open mind to be able to innovate and create.

2. Competences

2.1 General

CG07. Integrate knowledge and face the complexity of making judgments and decision making, based on incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

CG08. Lead and define multidisciplinary teams capable of solving technical changes and management needs in national and international contexts.

CG09. Communicate and discuss proposals and conclusions in multilingual, specialized and non-specialized forums, in a clear and unambiguous way.

CG11. Possess the skills of autonomous learning to maintain and improve the skills of chemical engineering that allow the continuous development of the profession.

2.2 Specific

CEO02. Direct and manage the organization of work and human resources applying criteria of industrial safety, quality management, occupational risk prevention, sustainability, and environmental management.

CEO04. Adapt to the structural changes of society motivated by factors or phenomena of economic, energetic or natural nature, to solve the problems derived and contribute technological solutions with a high commitment to sustainability.

CEO05. Direct and carry out verification, control of facilities, processes and products, as well as certifications, audits, verifications, tests and reports.

3. Objectives

That the student develops knowledge and skills in:

1. Sustainability, principles, disciplines and applications.
2. Excellence and its management.
3. Innovation, creativity and entrepreneurship.

More specifically the student will be able to:

- Know the meaning of the term "sustainability" within Chemical Engineering field and apply it to the processes and products.
- Develop creativity in the design of sustainable products and processes.
- Use tools that help in the development of innovative process and product solutions within the framework of sustainability.
- Manage sustainability excellence in the field of Chemical Engineering.
- Innovate in products, processes and production systems within the framework of Chemical Engineering.

4. Contents and/or thematic sections

The course consists of a fundamental thematic block of Sustainability. This block has three sections.

BLOCK 1: SUSTAINABILITY

Section 1. Basics in Sustainability (Topics 1, 2, 3 and 4)

Section 2. Sustainability Metrics (Topics 5 and 6)

Section 3. Case study: biorefinery (Topics 7)

Block 1. SUSTAINABILITY

a. Context and justification

See section 1.1.

b. Learning outcomes

The specific learning outcomes are developed next.

Outcome 1. Understand the deepness of the concept of sustainability

- See the difference between sustainability and sustainable development.
- Discover the origins of sustainability with the Brundtland report.
- Observe the difference views of the world and the society.
- Analyse other alternatives to the traditional economy.
- Find the possibilities of exponentiality when analysing an idea.
- Discover and think about the different sustainability policies worldwide and especially in Europe.

Outcome 2. Use the tools for sustainable design: Principles and Inspiring Disciplines

- Learn a sustainable philosophy to apply in chemical engineering designs.
- Get inspired by different novel disciplines within the green design.

Outcome 3. Measure and report for sustainability

- Overview the different sustainability metrics and weighting methods.
- Interiorise the different dimensions, categories and indicators to improve and achieve sustainability.
- Compare and analyse sustainability reports from different companies.

Outcome 4. Boost self-creativity and get ready for innovation

- Unleash the creativity.

- Differentiate among opportunity, idea and concept.
- Define the desired customer outcomes.
- Know the sequential and non-sequential steps for product creation.
- Know and use techniques for production invention.

Outcome 5. Know the basis for entrepreneurship to create a simplified business plan

- Identify strengths, weaknesses, opportunities, and threats.
- Carry out a canvas method to analyse the idea.
- Prepare a simplified business plan.

Outcome 6. Prepare and understand the operations of a biorefinery

- Develop a biorefinery concept.
- Prepare a biorefinery flow diagram and basic material and energy balances.

Outcome 7. Lab experience in innovation for a sustainable biorefinery

- Apply green chemistry and engineering to a biorefinery.
- Development of materials from biomass.
- Analyse the process using Objective Key Results (OKR).
- Write R&D reports.

c. Contents

In order to facilitate the achievement of the learning outcomes, the following contents, distributed by subject, will be taught during the course.

Topic 1. Sustainability concept

Sustainability and Sustainable Development. Brundtland report. World's acceleration. World's facts and figures. Vision of the product-based society. Impact and exponentiality.

Topic 2. From opportunity to a business plan

Opportunity, idea and concept. Fuzzy Front End. Strategies to find opportunities: brainstorming, job-mapping, ethnography, disruptive innovation. SWOT analysis. Business canvas. One-page business plan.

Topic 3. Sustainability strategies worldwide and in the European Union

Global Grand Challenges. Sustainable Development Goals (SDGs). Bioeconomy Strategy. European Green Deal. Circular economy action plan. EU Plastics Strategy. European industrial strategy. Chemicals strategy for sustainability. Zero pollution action plan. Biodiversity strategy to 2030.

Topic 4. Circular economy

Definition. Circular business models. Disruptive technologies for circular economy. Role of different industries. Chemical Industry Profile.

Topic 5. Green Chemistry & Green Engineering

History. Definition. Principles. Dimensions-Categories-Indicators and metrics. Case studies.

Topic 6. Sustainability metrics

IChemE sustainability metrics. BASF eco-efficiency Analysis. Global Reporting Initiative (GRI): universal and specific standards. GRI database case studies. GRI and the SDGs.

Topic 7. Biorefinery: a process industry for bioeconomy

Definition and concept. Types. Examples. Innovation in bioprocesses. Case study: conceptual biorefinery in the lab: organization of the work, experimentation, reporting objectives and key results (OKR).

d. Teaching methods

See section 5.

e. Working plan

The academic year consists of the equivalent of 15 working weeks.

A Sustainable Biorefinery Idea is developed through the "Case Study" methodology within the framework of this course.

The students will develop their own idea that might change the world.

To assist in the successful achievement of the final goal, teams must make several partial deliveries at various project milestones. The deliverables will be:

Week 4

Deliverable 1. Raw material analysis and biorefinery concept (TASK 1).

Report on the different options for biorefinery and opportunities discussed. Selection of the products and main process.

Week 7

Deliverable 2. One-page business plan (TASK 2)

Development of the biorefinery idea in a one-page business plan.

Week 8

Deliverable 3. Metrics analysis (TASK 3)

Report analysis of different companies, a process or processes.

Week 12

Deliverable 4. Biorefinery lab report (TASK 4)

Report on the biorefinery concept lab work.

Week 15

Deliverable 5. Simplified project of the sustainable biorefinery conceptual idea (TASK 5)

Electronic version of the project plan written in British English.

PROPOSED SIMPLIFIED PROJECT

The section of the proposed project plan will be:

1. SUMMARY
2. TARGET PROBLEM
3. INTRODUCTION
4. ALTERNATIVE SOLUTIONS and SELECTION
5. SWOT ANALYSIS
6. BUSINESS MODEL AND CANVAS
7. PRODUCT PORTFOLIO
8. PROCESS DESCRIPTION
    - 8.1. General description
    - 8.2. Raw materials
    - 8.3. Process Flow Diagram
    - 8.4. Prototyping and/or Mass and Energy Balances
9. SUSTAINABILITY METRICS

f. Assessment

The global assessment is carried out according to section 7.

g. Teaching materials

g1. Basic Bibliography

SUSTAINABILITY and METRICS

1. Heinrichs, H., Martens, P., Michelsen, G., Wiek, A., 2016. Sustainability Science an Introduction, 1st ed. 20. ed, Sustainability Science an Introduction. Springer Netherlands, Dordrecht. https://doi.org/10.1007/978-94-017-7242-6
2. Leal Filho, W., Marans, R.W., Callewaert, J., 2018. Handbook of Sustainability and Social Science Research, 1st ed. 20. ed, World Sustainability Series. Springer International Publishing, Cham. https://doi.org/10.1007/978-3-319-67122-2
3. Kaltenborn, M., Markus Krajewski, M., Kuhn, H. Sustainable Development Goals and Human Rights. Springer. 2020. https://doi.org/10.1007/978-3-030-30469-0
4. Global Reporting Initiative, https://globalreporting.org
5. Singularity university, https://www.su.org/
6. Sustainable Development Goals, https://sdgs.un.org/goals

CIRCULAR ECONOMY

1. P. Lacy, J. Long, W. Spindler, The circular economy handbook: Realizing the Circular Advantage, Palgrave macmillan, London, UK, 2019.
2. M.P.P. Pieroni, T.C. McAloone, D.C.A. Pigosso, Business model innovation for circular economy and sustainability: A review of approaches, J. Clean. Prod. 215 (2019) 198–216. https://doi.org/10.1016/j.jclepro.2019.01.036 .

GREEN CHEMISTRY and GREEN ENGINEERING

1. Han, B., Wu, T. Green Chemistry and Chemical Engineering, 2nd ed. Sustainability Science and Technology. Springer. 2019. https://doi.org/10.1007/978-1-4939-9060-3
2. Undo, P., Anastas, P.T., 2000. Green chemistry : challenging perspectives, Green chemistry : challenging perspectives, Green chemistry series. Oxford University Press, Oxford.

ENTREPRENEURSHIP

1. Mehregany, M., 2018. Innovation for Engineers Developing Creative and Entrepreneurial Success, 1st ed. 2018. ed. Springer International Publishing, Cham. doi:10.1007/978-3-319-66529-0
2. Osterwalder, A., 2010. Business model generation: a handbook for visionaries, game changers, and challengers , Strategyzer Series. Wiley, Hoboken, New Jersey.

g2. Additional bibliography

SUSTAINABILITY

1. Baldwin, C., 2015. The 10 principles of food industry sustainability, The 10 principles of food industry sustainability. Wiley Blackwell, West Sussex, England.
2. Bontempi, E., 2017. Raw Materials Substitution Sustainability, 1st ed. 2017. ed, SpringerBriefs in Applied Sciences and Technology. Springer International Publishing, Cham.
3. Brar, S.K., Sarma, S.J., Pakshirajan, K., 2016. Platform chemical biorefinery future green chemistry, Platform chemical biorefinery future green chemistry. Elsevier, Amsterdam, Netherlands.
4. Davim, J.P. (Ed.), 2017. Curricula for Sustainability in Higher Education, 1st ed. 2017. ed, Management and Industrial Engineering. Springer International Publishing, Cham. doi:10.1007/978-3-319-56505-7
5. Leal Filho, W., 2018. Implementing Sustainability in the Curriculum of Universities Approaches, Methods and Projects, 1st ed. 20. ed, Implementing Sustainability in the Curriculum of Universities Approaches, Methods and Projects, World Sustainability Series. Springer International Publishing, Cham.
6. Nelson, W.M., 2003. Green solvents for chemistry : perspectives and practice, Green solvents for chemistry : perspectives and practice, Green chemistry series. Oxford University Press, Oxford [etc.
7. P. Dicks, A., 2015. Green Chemistry Metrics A Guide to Determining and Evaluating Process Greenness, 1st ed. 2015. ed, Green Chemistry Metrics A Guide to Determining and Evaluating Process Greenness, SpringerBriefs in Green Chemistry for Sustainability. Springer International Publishing, Cham.
8. Vaz Jr., S., 2018. Biomass and Green Chemistry Building a Renewable Pathway, 1st ed. 20. ed, Biomass and Green Chemistry Building a Renewable Pathway. Springer International Publishing, Cham.

ENTREPRENEURSHIP

1. Gardetti, M.A., Muthu, S.S. (Eds.), 2018. Sustainable Luxury, Entrepreneurship, and Innovation, 1st ed. 2018. ed, Environmental Footprints and Eco-design of Products and Processes. Springer Singapore, Singapore. doi:10.1007/978-981-10-6716-7
2. Duening, T.N., 2015. Technology entrepreneurship : taking innovation to the marketplace , 2nd ed. ed. Elsevier, London, England.
3. Sahlman, W.A., n.d. How to write a great business plan, How to write a great business plan, Harvard business review classics. Harvard Business Press, Boston, Mass.
4. Barón Pladevall, A., n.d. Manual del "Financial Business Plan" : todo lo que hay que saber sobre la financiación y la confección del plan financiero : (incluye aplicación Excel para su ejecución), Manual del. Barcelona.
5. How to draw up a business plan, 1996. , How to draw up a business plan, Tacis. Office for Official Publications of the European Communities, Luxembourg.

h. Resources required

The course is developed using the case study methodology, in a pragmatical way. Therefore, all resources are oriented to help the student to develop the proposed case of a sustainable idea.

h1. Topics prepared in a presentation fashion (PowerPoint or Keynote)

The presentation of the different topics to the students is done by several means, one of them being the slide presentations in electronic format.

The presentations have been prepared as an aid to the class and are delivered in "pdf" format to the students before or during the teaching of the subject in question.

h2. Explanatory videos in ChemEng Tutorials

Check *"ChemEng Tutorials" channel:*

https://youtu.be/AwzkvcFlnlQ

The videos are available on demand with a link on the "Campus Virtual" and in this teaching guide.

h3. TED video links

TED is an extraordinary platform. Selected video links are included in the Campus Virtual.

Examples of these videos used in the subject are:

- Janine Benyus: Biomimicry's surprising lessons from nature's engineers, 2005. https://www.ted.com/talks/janine_benyus_biomimicry_s_surprising_lessons_from_nature_s_engineers
- Janine Benyus: Biomimicry in action, 2009. https://www.ted.com/talks/janine_benyus_biomimicry_in_action
- William McDonough: Cradle to cradle design, 2005, https://www.ted.com/talks/william_mcdonough_cradle_to_cradle_design
- Sir Ken Robinson: Do schools kill creativity?, 2006. https://www.ted.com/talks/sir_ken_robinson_do_schools_kill_creativity
- Hans Rosling: The magic washing machine, 2010. https://www.ted.com/talks/hans_rosling_the_magic_washing_machine
- Rory Sutherland: Perspective is everything, 2011.

https://www.ted.com/talks/rory_sutherland_perspective_is_everything

h4. Previous examinations

Written examinations from past academic courses are available in the Campus Virtual.

h5. Campus Virtual – Subject's website

The Moodle platform is used as an LMS (Learning Management System).

The page is divided into well-differentiated sections by topic:

A. News
B. Surveys: active and finished
C. Topic presentations
D. Case Study
E. Videos and self-learning references
F. Tools (links)
G. Examinations from previous years

h6. Software

- Office 365 – Institutional account provided by UVa
- Microsoft Teams and OneDrive
- Teams or a similar UVa-licenced software for videoconference

i. Scheduling

The subject has 6.0 ECTS corresponding to 60h in-person and 90h of students work.

The time is distributed in three parts:

Theory	*Practical lessons*	*Seminars*
20h	20h	20h

THEORETICAL LESSONS

The theory lessons of the course (2h/lesson) are distributed within 10 class-days of the course. In these seminars the professor will give lectures direct or inverse.

Topic 1. Sustainability concept (4 h)

Topic 2. From opportunity to a business plan (4 h)

Topic 3. Sustainability strategies worldwide and in the European Union (4 h)

Topic 4. Circular economy (4 h)

Topic 5. Green Chemistry & Green Engineering (4 h)

Topic 6. Sustainability metrics (4 h)

Topic 7. Biorefinery: a process industry for bioeconomy (4 h)

SEMINARS

The seminars of the course (2h/seminar) are distributed within 10 class-days of the course. In these seminars the students will share and discuss their ideas with their classmates and the professor/s.

PRACTICAL LESSONS

The practical lessons (2h/practice) will be carried in the computer and in the laboratory of the "Grupo de Tecnologías a Presión (PressTech)" of the "Instituto de Bioeconomía de la Universidad de Valladolid" or with materials to workout. These practices are distributed within 10 class-days of the course.

CHARGE (ECTS)	*PERIOD OF TIME SCHEDULED**
THEORY	1 to 15 week*
SEMINARS	1 to 15 week*
PRACTICE	1 to 15 week*

*Commonly the theory/seminar/practice will alternate sequentially unless other required

5. Teaching methods and methodological principles

The subject is eminently participatory with a horizontal knowledge between student and teacher.

The fundamental objective of the applied teaching method is that the student gains curiosity about the changing world in which we live and its relationship with sustainability and, obviously, with Chemical Engineering.

The methodological principle that will guide this course will be *"The student can be a creative entrepreneur based in sustainability as the philosophy for design. Failures and difficulties are not punished and, on the contrary, they are rather valued as part of the creative process".*

The CASE-STUDY methodology will be used, although in this case it can really be called SUSTAINABLE BIOREFINERY PROJECT PLAN.

Part of the subject will be complemented with a FLIPPED CLASSROOM, where the students will receive material and can interact with different questionaries. Professors will analyse this material to focus the class in the most difficult parts identified.

j. Face-To-Face Activities (in class)

j1. Master Classes

Throughout the theoretical classes the contents are developed taking into account the skills and abilities that the student should acquire.

The classes are presented using PowerPoint or Keynote presentations that the students have previously available to download from the subject's website in the Campus Virtual.

Student participation is encouraged at all times during the class.

j2. Practical classes

The practical classes target the student to learn and acquire capabilities with different tools important to develop sustainable business ideas. For example, a biorefinery concept in lab practice. The students will experiment in the laboratory in biorefinery operations.

Within these classes the students develop their ideas further with the assistance of the teacher.

j3. Seminars

The students are asked to develop their own sustainable business idea.

The work is carried out alone, although the students interact in the seminars.

j4. Face-to-face tutorials on-line assignment

The students can raise the doubts in the preparation of the business plan or any other question they might have.

To encourage the use of the tutorials an on-line Excel file is used, shared by all students and teachers. Each week the teacher indicates the free tutoring "slots" and the students sign up.

j5. Final exam

Students will take a final exam in the computer.

j6. Partial evaluations

Some partial evaluation may be carried out to check the degree of learning by favouring continuous assessment, particularly a work on GRI metrics.

j7. Presentation and defense of the project

They must make a presentation of the project of between 7 and 10 minutes and an oral defence.

k. Non Face-to-Face Activities (at home or somewhere else)

k1. Project Plan

The students will develop their own business idea and prepare the Business Plan.

k2. Virtual contact with the teacher

Using the Campus Virtual, e-mail, LinkedIn or any other means.

k3. Virtual aula

All the content of the course is available in the Campus Virtual UVa:

http://campusvirtual.uva.es

k4. Flipped material classroom

All the flipped material and questionaries will be available on the Campus Virtual UVa:

http://campusvirtual.uva.es

Microsoft Forms may also be used.

6. Dedicational time of the student to the subject

FACE-TO-FACE ACTIVITIES	HOURS	NON FACE-TO-FACE ACTIVITIES	HOURS
Theory	20	Tasks 1+2+3+4	30
Practice	20	Task 5	30
Seminars	20	Study and autonomous work individual (and flipped material if any).	30
Laboratories	0		
Tutorial service	0		
Evaluation (out of the official examination period)	0		
Total face-to-face activities	60	Total non face-to-face activities	90

7. System and characteristics of the evaluation

INSTRUMENT/ PROCEDURE	VALUE IN FINAL MARK (%)	REMARKS
TEST	25%	WRITTEN It may consist of several questions and/or a problem resolution to be developed on the contents of the subject during the course after finishing each of the lessons or group of lessons *(continuous evaluation).*
	10%	ORAL DEFENSE (around Task 5) It will be considered: clarity in presentation, simplicity and defence of the idea
TASKS	2.5%	Task #1. Raw material analysis and biorefinery concept
	2.5%	Task #2. One-page business plan
	10%	Task #3. Metrics analysis
	15%	Task #4. Biorefinery lab report
	20%	Task #5. Simplified project of the sustainable biorefinery conceptual idea
ATTITUDE IN CLASS	10%	PARTICIPATION It will be considered: participation in class, generation of ideas, attitude and relation with the other classmates and use of the class main/optional materials.
	5%	FLIPPED CLASSROOM It will also be specifically considered the work and responses on the flipped material if any (if will be added in participation otherwise).
MARK CRITERIA		

• Ordinary call:
  ○ As per specification in the table.
• Extraordinary call:
  ○ A minimum mark of 4.0 is required in the written test (exam) to pass.		

- The available assignments marks and attitude in class marks will be preserved to calculate the final mark. The final mark will consider:
  - Task 1 *(3.1%)*, Task 2 *(6.25%)*, Task 3 *(9.38%)*, Task 4 *(12.5%)*
  - Oral defence *(6.25%)*
  - Attitude in class *(12.50%)*
  - Extraordinary written test (examination) *(50%)*

8. Final remarks

No extra remarks.