Course guide
205261 - 205261 - Agrivoltaics: Photovoltaic Solar Energy for Sustainable Development

Last modified: 06/09/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 758 - EPC - Department of Project and Construction Engineering.

Degree: BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Macarulla Martí, Marcel

Others: Cebolla Alemany, Joaquim

TEACHING METHODOLOGY

This course will employ an interactive and comprehensive approach, aiming to actively engage students in their learning journey. A combination of lectures, in-class exercises, debates, and project-based learning will be utilized to cultivate a profound understanding of the subject matter while fostering the development of critical thinking and problem-solving skills.
Lecture sessions will establish a solid groundwork by delving into essential concepts of agriculture and photovoltaic energy. This groundwork will serve as a launching point for the exploration of synergies between these two domains, enabling a holistic analysis of their combined effects. The analysis will extend to various dimensions, including productivity, economic sustainability, and legislative implications. These lectures will be complemented by multimedia materials and real-world examples to enhance comprehension and relevance.
Active participation will be encouraged, allowing students to voice their perspectives, pose questions, and engage in constructive discussions. The Socratic method will be applied to prompt critical thinking and the exploration of complex topics through guided dialogue.
In-class exercises will bridge theory with practice, enabling students to apply their knowledge through calculations, simulations, and hands-on activities. Additionally, debates and discussions will facilitate an in-depth exploration of current issues in agrivoltaics, encouraging students to develop research skills and articulate their viewpoints effectively.
A fundamental aspect of the course is project-based learning. At the commencement, students will embark on a semester-long project focused on the topic of agrovoltaics. This project will foster interdisciplinary collaboration, nurture creative thinking, and facilitate practical problem-solving. The project topic will be decided at the beginning of the course through a discussion between teachers and students.
Assessment will be comprehensive, encompassing evaluation through quizzes, assignments, class participation, and project milestones. The methodology emphasizes not only conceptual understanding but also the application of knowledge to real-world scenarios.
Through the implementation of this methodology, an inclusive and participatory learning environment will be created, wherein students assume an active role in their education, thus fostering a profound and enduring connection to the subject matter and its implications for sustainable development.

LEARNING OBJECTIVES OF THE SUBJECT

The objectives of this course are:
- Understand the basics of agrivoltaics, including the interaction between agriculture and solar energy.
- Identify the benefits and challenges of agrivoltaics, both for agriculture and solar energy production.
- Learn about different types of agrivoltaic systems and their applications in different agricultural environments.
- Become familiar with the tools and technologies necessary to implement and maintain an agrivoltaic system.
- Understand the economic and financial aspects of agrivoltaics, including long-term costs and benefits.
- Learn about the legal and regulatory aspects of agrivoltaics, including the permits and licenses required to install and operate an agrivoltaic system.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	15,0	20.00
Self study	45,0	60.00
Hours large group	15,0	20.00

Total learning time: 75 h

CONTENTS

Module 1: Introduction to agrivoltaics

Description:
In this module, the concept of agrivoltaics and its significance within the realm of sustainable development will be delved into. The synergy between agriculture and solar energy production will be explored, while also explaining basic concepts of agronomy and photovoltaic energy. Essential concepts of agriculture and photovoltaic energy will be presented. This groundwork will serve as a launching point for the exploration of synergies between these two domains, enabling a holistic analysis of their combined effects. The benefits and challenges of combining agricultural practices with solar energy generation will be discussed. An engaging exercise involving a debate will encourage critical thinking and a deeper exploration of the impacts of agrivoltaics compared to traditional agriculture and solar energy methods.

Full-or-part-time: 4h
Theory classes: 4h

Module 2: Crops and agricultural practices in agrivoltaic systems

Description:
This module will spotlight options regarding crops and agricultural practices that align with agrivoltaic systems. It will present insights into factors that influence the compatibility of various crops within these environments. Additionally, students will learn about best practices that foster a harmonious coexistence between agriculture and solar energy generation. The exploration will encompass mutual benefits and successful case studies, cultivating an understanding of how the integration of crops and solar energy can culminate in heightened productivity and sustainable land use.

Full-or-part-time: 6h
Theory classes: 6h

Module 3: Solar photovoltaic technologies for agrivoltaics

Description:
A comprehensive overview of the diverse photovoltaic technologies employed in agrivoltaic systems will be provided in this module. Exploration of the various options available for harnessing solar energy within agricultural contexts will take place. Efficiency considerations and the performance of solar panels in agricultural settings will be delved into, with an understanding of the variables that impact their functionality. Coverage of solar tracking systems and their role in optimizing energy capture will also occur. Additionally, students will learn about energy storage solutions and effective load management strategies that contribute to optimal energy utilization.

Full-or-part-time: 8h
Theory classes: 8h

Module 4: Environmental, economic, and social aspects

Description:
Focusing on the broader impact of agrivoltaics, this module will delve into its environmental, economic, and social dimensions. Through analysis, positive ecological outcomes and potential challenges associated with agrivoltaic systems will be assessed. An economic evaluation will be engaged in, teaching students how to analyse investments in agrivoltaics. The regulatory framework, subsidies, and incentives that shape the solar energy landscape will also be discussed. Lastly, the module will explore the social implications and community involvement in agrivoltaic projects, recognizing their broader significance within local and societal contexts.

Full-or-part-time: 6h
Theory classes: 6h

Module 5: Implementation, maintenance, and future trends

Description:
In this module, participants will gain practical insights into the implementation and maintenance of agrivoltaic systems. The installation process will be covered, emphasizing safety protocols and considerations. Comprehensive monitoring and regular maintenance will be understood as necessary to ensure the continued efficiency and longevity of these systems. Problem-solving skills will be honed as common operational issues that may arise are addressed. Furthermore, emerging technologies and trends shaping the future of agrivoltaics will be explored, empowering students with a forward-looking perspective on this dynamic field.

Full-or-part-time: 6h
Theory classes: 6h

GRADING SYSTEM

The final grade depends on the following assessment criteria:
- 20% classroom deliverables
- 20% midterm deliverable
- 40% final deliverable
- 20% Presentation and vídeo

BIBLIOGRAPHY

Basic:
- Shiva, Gorjian Pietro Elia. Solar Energy Advancements in Agriculture and Food Production Systems . 1st Edition. Campana Paperback, 2022.