# COURSE OUTLINE

## (1) GENERAL

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|---|---|---|---|
| **SCHOOL** | Agricultural Sciences | | |
| **ACADEMIC UNIT** | Agricultural | | |
| **LEVEL OF STUDIES** | UNDERGRADUATE | | |
| **COURSE CODE** | AGRI_606 | **SEMESTER** | 6th Semester |
| **COURSE TITLE** | Renewable Energy in Agriculture | | |

| **INDEPENDENT TEACHING ACTIVITIES** *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits* | **WEEKLY TEACHING HOURS** | **CREDITS** |
|---|---|---|
| Course delivery | 2 | |
| Tutorial | - | |
| Laboratory course | 2 | |
| **TOTAL** | 4 | 5 |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | |

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| **COURSE TYPE** *general background, special background, specialised general knowledge, skills development* | Specialized general knowledge |
| **PREREQUISITE COURSES:** | No prerequisite courses |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek. |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | Yes (English) |
| **COURSE WEBSITE (URL)** | |

## (2) LEARNING OUTCOMES

**Learning outcomes**

*The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.*

*Consult Appendix A*

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course is a key introductory lesson on renewable energy and related technologies. The aim of the course is:

Presenting, updating and educating students on issues related to the use of Renewable Energy Sources (RE) in Agriculture in order to understand the dynamics and value of renewable energy sources and to identify methods and strategies for the use of renewable energy sources in agricultural holdings in the context of the sustainable management of rural ecosystems. More specific objectives are:

- To substantiate the necessity and potential of exploitation of renewable energy sources
- Present and analyze the various renewable energy technologies with examples and system analysis.
- To enable the student to make preliminary planning (dimensioning of renewable energy systems) especially in agricultural applications.

Students, after completing the course, will:

- Have proven knowledge and understanding of issues related to the use of Renewable Energy

Sources (RE) in Agriculture.

- Have the ability to collect and interpret relevant data to form judgments that include reflection on related issues with renewable energy sources.
- They are able to communicate ideas and solutions for renewable energy sources to both qualified and non-specialized audiences.
- Have developed the skills needed to acquire knowledge in order to continue further studies with a high degree of specialization in this particular subject.
- By explaining the concepts and using practical examples and exercises, students develop the necessary skills to bridge the gap between knowledge and the ability to design renewable energy systems to meet specific energy needs

**General Competences**

*Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

| | |
|---|---|
| *Search for, analysis and synthesis of data and information, with the use of the necessary technology* | *Project planning and management* |
| *Adapting to new situations* | *Respect for difference and multiculturalism* |
| *Decision-making* | *Respect for the natural environment* |
| *Working independently* | *Showing social, professional and ethical responsibility and sensitivity to gender issues* |
| *Team work* | *Criticism and self-criticism* |
| *Working in an international environment* | *Production of free, creative and inductive thinking* |
| *Working in an interdisciplinary environment* | *……* |
| *Production of new research ideas* | *Others…* |
| | *…….* |

Upon completion of this course, the student will develop the following general competencies (from the list above):

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Autonomous Laboratory Work / Teamwork
- Working in an interdisciplinary environment
- Promoting free, creative and inductive thinking

## (3) SYLLABUS

The content of the course is theoretical and is distributed as follows:

1. **Energy sources.** Energy needs. Energy conversions. Solar radiation. Wind energy. Geothermal energy. Hydroelectric, wave and tidal energy. Other renewable and “soft” energies. Energy needs of agriculture.

2. **Fossil fuels and conventional energy sources**. Energy and natural resources, Greenhouse effect, greenhouse gas emissions

3. **Energy from the sun.** Collection systems and methods for the analysis of solar radiation - Solar collectors. Types, function, performance grades, calculations. - Installations for heating water for use, space heating and drying of agricultural products with solar panels. - The solar collector for space cooling, water pumping and electricity generation. Heat storage methods.

4. **Production of heat and electricity from solar energy**. Direct production of electricity from solar energy - photovoltaic conversion. Types of photovoltaic systems and related components. Measurements and Estimation of Solar radiation Power. Photovoltaic systems performance. Agri-voltaics

5**. Wind energy**. Mechanical and electrical power generation systems from the wind. - Observing and measuring sizes during wind turbine operation.

6. **Biomass**. Sources of biomass. Biomass collection and management. Thermodynamic conversion by combustion. Thermochemical conversion. Biochemical conversion. Cogeneration of heat and electricity (CHP). Biomass potential estimation for bioenergy production, Biofuels for transport.

7. **Energy crops.** Designing of pilot crops with adaptation to the prevailing agricultural techniques, Planting and management of crops, Economic assessment of the production of energy crops by cost analysis of the various stages of production and management of the crop. Environmental assessment

of energy crops

8. **Geothermy**. Geothermal fields, Technologies for the exploitation of geothermal energy for the production of electricity and space heating. District heating. Heat pumps

9. **Hydrodynamic energy and electricity generation**. Small hydroelectric projects

10. **Physics of non-conventional energy sources**. Energy saving-rational use of energy. Hydrogen as a fuel. Fuel cells. Financial analysis of energy systems. Directions for the development of energy sources in the future.

11. **Climate change and impacts on agriculture**. Greenhouse Effect. European Green Deal

12. **Economic and technical consideration of renewable energy sources**. Energy economics and the energy system

13. **Field trips**

Laboratory exercises:

- Solar energy applications (thermal collector efficiency, efficiency charts, etc.)
- Electricity generation from photovoltaic systems
- Production of biofuels from energy crops
- Use of biofuels to produce mechanical work and heat and electricity
- Combined heat and power plant based on the potential of agricultural residues
- Calculation of electrical/thermal energy from agricultural crop residues

## (4) TEACHING and LEARNING METHODS - EVALUATION

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|---|---|
| **DELIVERY**<br>*Face-to-face, Distance learning, etc.* | Face-to-face (theoretical teaching),<br>Laboratories with exemplary solution of representative problems. |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**<br>*Use of ICT in teaching, laboratory education, communication with students* | Use of ICT (PowerPont Presentations) in teaching and communication with students.<br>Use of an e-learning platform (e-class). |

**TEACHING METHODS**

*The manner and methods of teaching are described in detail.*
*Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*

*The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*

| ***Activity*** | ***Semester workload*** |
|---|---|
| Lectures (2 contact hours per week x 13 weeks) | 26 |
| Laboratory exercises (2 contact hour per week × 6 weeks) with personal reports | 12 |
| Individual - group work / projects, Study hours, project writing and preparation for final exams | 84 |
| Final examination | 3 |
| ***Course total (25 hours workload per credit unit)*** | ***125 hours total workload*** |

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|---|---|
| **STUDENT PERFORMANCE EVALUATION**<br>*Description of the evaluation procedure*<br><br>*Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other*<br><br>*Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | 1. Course attendance - Participation in the classroom<br><br>2. Laboratory exercises that require information synthesis by the student.<br><br>3. Projects that require information synthesis and critical thinking by the student (30% in the final overall grade).<br>4. Written final examination of all material including " multiple choice " questions, questions requiring relatively short answers and solving exercises (70% in the final overall grade). Minimum portable grade: 5.<br>5. All of the above are taking place in the Greek language and for the foreign students (eg ERASMUS students) in English. |

## (5) ATTACHED BIBLIOGRAPHY


1. Bradford t. Οικονομικά της ενέργειας και ενεργειακό σύστημα: Τεχνολογικές διαστάσεις, αγορές και προτάσεις πολιτικής. Εκδόσεις Α. Παπαζήσης 2021. ISBN: 9789600237962
2. Κ. Μπαλαράς – Α. Αργυρίου – Φ. Καραγιάννης. Συμβατικές & ήπιες μορφές ενέργειας. ΣΕΛΚΑ - 4Μ ΕΠΕ **2006.** ISBN: 960-8257-23-9
3. John Twidell and Tony Weir , "Renewable Energy Resources", 3rd Edition **2015**, Routledge, Taylor & Francis Group, Abingdon UK. ISBN-13: 978-041558438-8
4. Gilbert M. Masters, Επιστ. Επιμ.: Γ. Παπαδάκης. Συστήματα παραγωγής ηλεκτρικής ισχύος από ανανεώσιμες πηγές ενέργειας, ΠΕΔΙΟ ΕΚΔΟΤΙΚΗ,ΔΙΑΦΗΜΙΣΤΙΚΗ ΚΑΙ ΡΑΔΙΟΤΗΛΕΟΠΤΙΚΩΝ ΠΑΡΑΓΩΓΩΝ Α.Ε. **2016**. ISBN: 978-960546743-2
5. Α. Δημάκης, Γ. Αραμπατζής, Δ. Ασημακόπουλος, Α. Καρταλίδης, Γ. Τσιλιγκιρίδης. Ανανεώσιμες Πηγές Ενέργειας. Δυναμικό & Τεχνολογίες. Εκδόσεις Σοφία 2015. ISBN: 978-960-6706-76-9