COURSE OUTLINE

1. GENERAL

SCHOOL	AGRICULTURAL SCIENCES		
ACADEMIC UNIT	AGRICULTURE		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	AGR_700	**SEMESTER OF STUDIES**	7th
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**
Lectures	3	
Seminars	1	
Total	4	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background, specialised general knowledge, skills development
PREREQUISITE COURSES:	No prerequisite courses
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, teaching can also be done in English in the case of foreign students attending the program.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBPAGE (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 Georgia.
- 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*
Teamwork	*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 and 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
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
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 impact on agriculture
12. Economic and Scientific Consideration and Analysis of Renewable Energy Sources
13. Educational excursions (2)

Workshop (Indicative exercises):

- Exercises for the production of fuel from energy crops
- Exercises in Biofuel use to produce heat and power

- Exercises in photovoltaic electricity generation
- Exercises in the cogeneration unit based on the potential of agricultural residues

4. TEACHING AND LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT (powerpoint) in teaching, Workshops with exemplary problem solving.
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*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.* *Specifically, defined evaluation criteria are given, and if and where they are accessible to students.*	1. Course attendance - Participation in the classroom 2. Workshop exercises that require information synthesis by the student. 3. Projects that require information synthesis and critical thinking by the student, 30% weightiness in the final overall grade. 4. Written final examination of all material including "right / wrong" questions and questions requiring relatively short answers. Minimum passing grade: 5. 5. All the above are taking place in the Greek language and for the foreign students (eg ERASMUS students) in English.

Activity	***Semester workload***
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week × 13 weeks) with personal reports	13
Final examination (3 contact hours)	3
Individual - group work / projects, Study hours, project writing and preparation for final exams	70
Course total	***125 hours total workload***

5. ATTACHED BIBLIOGRAPHY

1. John Twidell and Tony Weir, "Renewable Energy Resources", 3rd Edition **2015**, Routledge, Taylor & Francis Group, Abingdon UK. ISBN-13: 978-041558438-8.

2. 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

3. Κ. Μπαλαράς – Α. Αργυρίου – Φ. Καραγιάννης. Συμβατικές & ήπιες μορφές ενέργειας. ΣΕΛΚΑ - 4Μ ΕΠΕ **2006.** ISBN: 960-8257-23-9