COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Agricultural Sciences		
ACADEMIC UNIT	Biosystems & Agricultural Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	BAE_804	**SEMESTER**	8th
COURSE TITLE	**ALTERNATIVE & RENEWABLE ENERGY SOURCES 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	
	Tutorials	0	
	Laboratory	2	
	TOTAL	**5**	**5**
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES:	There are no prerequisite courses.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek .-For Erasmus students in English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
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*

In the course, the student seeks to become familiar with the methods of utilizing Renewable Energy Sources that exist spontaneously in the natural environment so that he/she is able to assess the relevant processes from a technical, economic and social point of view.

Upon completion of the course, students will have:

1. The ability to recognize the need of using Renewable Energy Sources and their role in the energy requirements of Greece and the rest of the world.
2. Knowledge of the structure and mode of operation of the main energy production systems from renewable energy sources.
3. Knowing the steps of locating a wind farm in an optimal way in a region. He/she will know all the basic calculations for presenting a comprehensive study application of a wind farm. 4. How to use tools to calculate the expected electricity and to know its optimization methodologies.

5. The possibility of designing (dimensioning) a small autonomous energy wind system.
6. Knowledge of the safety and operation requirements of an autonomous and networkconnected renewable system.
7. Knowledge of the structure, functional characteristics and the possibility of designing (dimensioning) Hydroelectric systems.
8. Knowledge of the structure and functional properties of geothermal heating pumps.
9. The knowledge of the structure, the functional characteristics and the possibility of designing (dimensioning) a biomass unit.
10. The knowledge of the structure, the functional characteristics and the possibility of the design (dimensioning) of solar thermal power plants.
11. The possibility of comparing the advantages and disadvantages of the various technologies of renewable energy sources. Finally, the possibility to propose the best technologically advanced solution for a specific case of energy saving from RES.

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…*
	…….

In general, upon completion of this course the student will have further developed the following general skills (from the list above):
Search, analysis and synthesis of data and information, using the necessary technologies
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Respect for the natural environment
Exercise criticism and self-criticism

(3) SYLLABUS

The subject of the theoretical part of the course consists of the following sections which are developed in thirteen teaching weeks:

1. Definition, Perspectives, Benefits and necessity of RES. European RES promotion legislation.
2. Introduction to the wind potential of an area.
3. Introduction of wind energy, types of Wind Turbines, location and calculation of energy efficiency of wind farms. Hybrid power generation systems.
4. Introduction to hydroelectric power, small hydroelectric systems, technologies of hydroelectric plants. Location and calculation of energy efficiency of a small Hydroelectric project.
5. Geothermal Energy, introduction to geothermal energy, geothermal fields, Geothermal heat exchangers, low-depth geothermal systems.
6. Biomass, Introduction to Biomass, Prospects and Benefits of Biomass, Possibility of Exploitation, Technologies. Garbage biomass and waste fuel.

7. Bioethanol, gasification and pyrolysis of biomass, biogas production, biohydrogen, biodiesel, biochar and its significance into attaining a carbon negative balance.
8. Solar Thermal Applications, Solar thermal energy systems (domestic, central), energy production systems, thermal energy storage.
9. Wave energy. Nature of wave energy. Production of mechanical and electrical power from wave energy. Types of machines.
10. Tidal energy, oceanic energy, surface and subsurface current energy exploitation.
11. Design of active solar collectors. Types of semiconductor materials and photon conversion efficiency.
12. Green Roofs
13. Environmental advantages and implications of RES applications.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face deliveries. Laboratory exercises in Physical Chemistry
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of ICT (power point) in Teaching • Use of ICT (power point) in Laboratory Training • Use of ICT in Communication with students (Learning process support through the electronic 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*	
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. The laboratories participate by 30% in the final grade. In order to be examined in theory, the student must have completed all the laboratories and have been successfully examined in them. 2. The main assessment criteria focus on understanding and correlating the knowledge that students gain from the course with other knowledge. Particular emphasis is placed on whether they have developed the ability to apply this knowledge to crop selection and to assess the impact of these changes on the environment. Emphasis is also placed on demonstrating critical ability and justifying the choices they make in each problem. 3. Evaluation is dynamic. It mainly involves problem solving. is done orally or in writing or with a combination of the two, with or without pre-examination on the basic principles of the course, with or without exculpatory advances and with other test or inventive methods, depending on the composition of the dynamics and the needs of the audience. 4. The above are done in the Greek language. For foreign language students (eg Erasmus students) conducted in English

Activity	*Semester workload*
Lectures	39
Tutorials	26
Writing short reports of laboratory exercises	13
Final Exams	3
Study hours and preparation for the laboratory exercises and the final examination	44
Course total	**125**

(5) RECOMMENDED LITERATURE

Suggested bibliography:

- Βιβλίο [45451]: Αιολική και Άλλες Ανανεώσιμες Πηγές Ενέργειας, Βιομάζα - Γεωθερμία - Υδατοπτώσεις, Λιώκη-Λειβαδά Ηρώ,Ασημακοπούλου Μαργαρίτα Λεπτομέρειες
- Βιβλίο [59363478]: Ήπιες Μορφές Ενέργειας (2η έκδοση), Παπαϊωάννου Γ. Λεπτομέρειες
- Βιβλίο [41963205]: ΑΝΑΝΕΩΣΙΜΕΣ ΠΗΓΕΣ ΕΝΕΡΓΕΙΑΣ, ΑΣΗΜΑΚΟΠΟΥΛΟΣ Δ., ΑΡΑΜΠΑΤΖΗΣ Γ., ΑΓΓΕΛΗΣ - ΔΗΜΑΚΗΣ Α., ΚΑΡΤΑΛΙΔΗΣ Α., ΤΣΙΛΙΓΚΙΡΙΔΗΣ Γ. Λεπτομέρειες
- Βιβλίο [59385727]: Συστήματα παραγωγής ηλεκτρικής ισχύος από ανανεώσιμες πηγές ενέργειας, Gilbert M. Masters, Επιστ. Επιμ.: Γ. Παπαδάκης Λεπτομέρειες
- Βιβλίο [14613]: Ηπιες Μορφές Ενέργειας Ι - Περιβάλλον και Ανανεώσιμες Πηγές Ενέργειας, Καπλάνης Σωκράτης Λεπτομέρειες
- Βιβλίο [41963205]: ΑΝΑΝΕΩΣΙΜΕΣ ΠΗΓΕΣ ΕΝΕΡΓΕΙΑΣ, ΑΣΗΜΑΚΟΠΟΥΛΟΣ Δ., ΑΡΑΜΠΑΤΖΗΣ Γ., ΑΓΓΕΛΗΣ - ΔΗΜΑΚΗΣ Α., ΚΑΡΤΑΛΙΔΗΣ Α., ΤΣΙΛΙΓΚΙΡΙΔΗΣ Γ. Λεπτομέρειες
- Βιβλίο [2091]: ΗΛΙΟΘΕΡΜΙΚΕΣ ΕΓΚΑΤΑΣΤΑΣΕΙΣ, ΣΤΑΜΑΤΗΣ Δ. ΠΕΡΔΙΟΣ Λεπτομέρειες
- Βιβλίο [22701]: Διαχείριση της αιολικής ενέργειας, Β' Έκδοση, Καλδέλλης Ιωάννης Κ. Λεπτομέρειες

-Complementary bibliography:

- Σ. Παπαθανασίου, "Ανανεώσιμες Πηγές Ενέργειας: Σύνδεση Εγκαταστάσεων Παραγωγής στα Δίκτυα Διανομής", ΕΜΠ, 2009