1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
ΚΩΔΙΚΟΣ ΜΑΘΗΜΑΤΟΣ	2606008	**SEMESTER**	6
COURSE TITLE	RENEWABLE ENERGY SOURCES – SMART GRIDS		
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 credit*		**WEEKLY TEACHING HOURS**	**CREDITS (ECTS)**
Lectures		2	4
Laboratory		2	
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Degree-Specific Course (SPC)		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.electronics.teipir.gr/index.php/en/2016-02-01-10-11-06/2016-02-01-10-12-32/undergraduate-curriculum/6th-semester		

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*

Upon successful completion of this course module students possess advanced knowledge, skills and competences in the subject of Renewable Energy Sources – Smart Grids (RES – SG) that enable them to:

- know the scientific principles and basic operating types of RES,
- compare the technical characteristics and performance of main RES subsystems,
- analyze solar and wind data on specific geographical position,
- optimize a photovoltaic (PV) and wind park/system (WT) under specific conditions,
- present all the appropriate calculations of PV and Wind study applications, in details,
- calculate the expected electric energy of RES using optimization methods,
- understand the basic terms and parameters of electric power systems,
- know the general issues of Distributed (Dispersed or Embedded) Generation (DG),

- explain the technical issues of the integration of DG in Distribution Networks,
- describe the operational, technical, environmental, economic advantages of a Microgrid as basic structure of a Smart Grid,
- know the origins and technology platform of Smart Grids including smart electricity meters analysis

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Production of free, creative and inductive

3. COURSE CONTENT

Lectures:

The aim of this course is to introduce the students to the Renewable Energy Sources scientific area, to provide the main design techniques, to explain the calculation and energy study tools, and finally to support the understanding of their usage in the new –so called- smart electric grids.

1. Photovoltaic systems and solar energy use
2. Study of system components of photovoltaic systems
3. Evaluating the operation of a photovoltaic system – Evaluation of energy parameters
4. Wind power plants and utilization of wind energy
5. Study of system components of wind power plants
6. Evaluating the operation of a wind power plant – Evaluation of energy parameters
7. Electric power systems configuration an parameters
8. Distributed generation and RES integration in a Smart Grid
9. Smart grids: Fundamentals of design and analysis

Laboratory Experiments:

1. MATLAB overview
2. Simulation software platform of PV, WT, DG-SG
3. Experiments and quantities measurements of real RES systems

4. Application of simulation calculations for sizing
5. Smart grids: Fundamentals of design and analysis

4. TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to face, Distance learning, etc.</td><td>Face to face lectures</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Use of electronic presentation with multimedia content in class,
• Student support through the course webpage and the departmental e-learning platform,
• Electronic communication of instructors and students, through the course webpage and by e-mail.
• Use of Matlab / Simulink simulation software in the lab.</td></tr>
<tr><td>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</td><td>Lectures, Laboratory experiments, project and study.

<table>
<tr><th>Activity</th><th>Semester workload (hours)</th></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Study for lectures</td><td>26</td></tr>
<tr><td>Laboratory experiments</td><td>26</td></tr>
<tr><td>Report on lab experiments</td><td>26</td></tr>
<tr><td>Study and preparation for exams</td><td>16</td></tr>
<tr><td>Course Total</td><td>120</td></tr>
</table>
</td></tr>
<tr><td>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..</td><td>Student evaluation is performed in the language of instruction.

Final course grade = Lectures part grade x 60% + Laboratory part grade x 40%

<u>Lectures part grade:</u>
Final written exam includes development questions and problem solving questions. Students are provided with a concise mathematic formulae consultation list. It is consisted of various difficulty level questions. On each question the respective mark is stated. The chapters to be examined are announced on the beginning of the semester. During the test, the students can curry any book or notes.

<u>Laboratory part grade:</u>
• Oral evaluation in the lab, on a weekly basis (20%)
• Tests on every experiment/exercise or team project, (80%)</td></tr>
</table>

5. ATTACHED BIBLIOGRAPHY

Essential reading

1. Asimakopoulos D., et al., "Renewable Energy Sources – Potential and various technologies", SOFI publications, 1st ed., Thessaloniki, 2015.

Recommended Books

2. N. Hatziargyriou, *"Microgrids: Architectures and Control"*, Wiley-IEEE Press, 1st ed., 2014.

3. Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE).

4. S. Kaplanis, "Sustainable Energy sources I, II, III", ION publications, 1st ed., Athens, 2004.

5. J. Kaldellis, "Wind energy management", Stamoulis Ed., Athens, 2010.

6. G. Vokas, "Energy Storage and Saving", TEI Piraeus & OPEN University, 1999.