COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	8003001	**SEMESTER**	3
COURSE TITLE	Green and Energy-aware Electronic Systems		

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 (ECTS)**
Lectures	4	6
E-learning	0	
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*	Scientific Area
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://ies.teipir.gr

(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, the students possess advanced knowledge, skills and competences that enable them to:

1. Know, understand and be able to analyze the processes of design, construction and assembly of modern electronic devices and systems as well as the inevitable trade-offs among involved quantities,
2. Know, understand and be able to analyze the complete life cycle of materials and devices used in modern electronic technologies, both from a technical and from an economic aspect,
3. Discriminate and comparatively assess critical factors and quantities in life cycle and recycling of electronic materials and products,
4. Make decisions under hypothetic yet realistic scenarios of design and production of modern electronic devices and end products, and at the same time assess the impact of their decisions

on the environment and on public health,

5. Understand and evaluate the impact of present and future public policies on materials and environment on the further development of technology and production,
6. Understand the interdisciplinary nature of environmentally sensitive technological development and collaborate with scientists and technologists of related fields towards a comprehensive problem handling.

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 thinking

(3) COURSE CONTENT

Lectures:

UNIT I: Introduction – Green Electronics.

Brief introduction. Industrial Ecology. Industrial Engineering. Selection of materials and adoption of procedures.

UNIT II: Industrial production of electronics and sustainable development.

Design and development steps in an industrial unit that manufactures electronic products, focusing on sustainable development.

UNIT III: Design, development and production models.

Models and standards for processes of design, development and production of electronic components, devices and end products / appliances.

UNIT IV: Low-power design in the micro-scale.

Low-power electronics design. Power reduction methods in CMOS design. Low-power Integrated Circuits design.

UNIT V: Low-power design in the devices scale.

Low-power processors design. Contemporary technologies and trends.

UNIT VI: Low-power design in the end products scale.

Energy autonomous systems. Intelligent metering and alarm systems. Biomedical applications based on low-power technologies.

UNIT VII: Alternative methods for design, development/ production and toxicity.

The toxicity as a metric for alternative methods of design, development and production and its impact on public health.

UNIT VIII: Life cycle of materials and products – End of life and recycling.

The notion of life cycle. Analysis of life cycle for materials and products. Recycling procedures and cost/profit analysis.

UNIT IX: Environmental legislation and decision making – Impact on public health.

Overview of the environmental legislation at the National / European / International level. Major research studies that document the impact of material and procedure selection on public health.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	• Face to face lectures in class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of electronic presentation with multimedia content in class, • Student support through the course webpage and the departmental e-learning platform (moodle), • Electronic communication of instructors and students, through the course webpage and by e-mail.
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*	Lectures, homework assignments / project, study.

Activity	***Semester workload (hours)***
Lectures	52
Study lecture material (on-line)	52
Homework assignments or project and report (individual or group)	52
Study and preparation for the exams	22
Visit a company / production plant / institution	2
Course Total	**180**

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*	Final course grade = 10% x Class participation + 40% x (Group) Project Report + 50% x Final written exam. <u>*Expected participation in learning activities:*</u> Students are expected to 1. participate in all lectures and other learning activities

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	planned for the specific semester (site visits or invited talks), 2. complete a project on a topic assigned by the instructor and related to the course contents, either independently or in groups, and submit a technical report on the results by the end of the semester, 3. prepare for and sit in the final written exam of the course. The exam covers all taught material. Students must prove mastery of the material through stating and interpreting definitions of all quantities, handling relations among quantities and assessing and interpreting tables and numerical data.

(5) ATTACHED BIBLIOGRAPHY

-Recommended Books:

1. Jan Rabaey, "Low Power Design Essentials," Springer – Circuits and Systems, 2009, ISBN 978-0-387-71713-5,
2. Sammy G. Shina, "Green Electronics Design and Manufacturing," McGraw-Hill, 2008, ISBN 0-07-164267-6 (e-book)
3. Lee H. Goldberg and Wendy Middleton, Eds., "Green Electronics / Green Bottom Line Environmentally responsible engineering," SCIENCE DIRECT, ISBN: 978-0-7506-9993-8
4. John X. Wang, "Green Electronics Manufacturing," CRC-Press, Francis & Taylor, 2013, ISBN 978-1-4398-2669-0 (e-book).
5. Greenpeace / Will Rose, "Green gadgets: designing the future. The path to greener electronics", September 2014.
6. Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE).
7. Green Electronics Council webpage http://greenelectronicscouncil.org/
8. EPEAT webpage http://www.epeat.net/about-epeat/

-Relevant Journals:

1. Elsevier, Sustainable Computing
2. Electronic Green Journal
3. Challengers – Special Issue on "Electronic Waste — Impact, Policy and Green Design" (2016)
4. Chemical Society Reviews – "Green Electronics" review article (2013)
5. Materials Research Society (MRS) Proceeding
6. IEEE Transactions on VLSI
7. IEEE Transactions on Circuits and Systems, I & II