COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Department of Computer Engineering & Informatics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	CEID_NE5888	**SEMESTER**	Autumn (Advance Elective)
COURSE TITLE	Embedded 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**
Lectures and Tutorials, Laboratory Exercises	4, 1	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	Total	5

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background Skills development
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CEID1085/

(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*

A. Lectures and Tutorials

Upon successful completion of the course, a student will be able to:

(1) analyse the model of an embedded system,
(2) understand and be able to program the operation of embedded systems devices, for current and future technologies,
(3) obtain the appropriate background knowledge and skills to design and implement an embedded system,
(4) analyze, design and implement embedded systems of alternative technologies,
(5) to implement communication interfaces with other peripherals,
(6) to evaluate the operation of embedded systems and peripherals, with the use of software tools and hardware platforms.

B. Laboratory Exercises

Upon successful completion of the course, a student will be able to:

(1) to program an embedded system,
(2) implement services with peripherals and secondary units,
(3) evaluate the right operation and co-operation of the units,
(4) to take measurements, via real time scenarios of operation.

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…*
	…….

Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Production of free, creative and inductive thinking

(3) SYLLABUS

- Basic terms, background,
- Examples of current and future applications,
- Design challenges,
- Design methodologies,
- Requirements, specifications,
- Computational models,
- Modeling, Early design phase,
- Finite state machines,
- Data flow,
- Programming Languages,
- Hardware description languages,
- Comparative study of modeling,
- Embedded system hardware,
- Sensors, transducers, encoders,
  - Processing units, Inputs/Outputs,
  - ASICs, FPGAs,
  - Memories,
  - Communication systems,
  - Safe hardware,
- System Software,
  - Operating systems,
  - Firmware,
  - Real-time software,
  - Hardware/software codesign,
- Verification, performance, consumption, energy,
- Simulation, depiction of application,
- Multiprocessors,
- Optimization,
- High level of optimization,
- Compilers for embedded systems,
- Power/energy management,
- Test,
  - Test procedures,
  - Design for test,
  - Test vectors,
- Evaluation,
- Modern and future cutting-edge technologies and applications,
- Advanced topics and areas.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Wide use of ICT and more specifically:
· The course is backed up by a homepage, providing all course materials. This web page is duly updated.
· Course announcements are provided electronically and are available via: online news platform, and e-mail.
· The communication with the students is performed electronically: via e-mail. An online course forum, is also supported, for questions/answers, comments etc.</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><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>52 hours</td></tr><tr><td>Laboratory exercises</td><td>13 hours</td></tr><tr><td>Homework of laboratory exercises</td><td>26 hours</td></tr><tr><td>Study</td><td>52 hours</td></tr><tr><td>Theory exams</td><td>3 hours</td></tr><tr><td>Laboratory exams</td><td>1 hours</td></tr><tr><td>Course total</td><td>147 hours</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>The students' assessment is supported in Greek, through a final written examination, twice in each academic year. The examination is based in two independent modules: theory and laboratory exercises.
The examination of the theory is organized by development questions, short answer questions, exercises and problems solving. Within ten days of the examination, scores and indicative answers to the exam questions are announced, and posted electronically. It is defined a day and an hour at which students can see their exams' papers about any questions and doubts they may have, as well as to express their disagreement in rating, if they so wish. Then the rating is validated and finalized.
The evaluation of the laboratory exercises is done during students' practice, in the laboratory room, but also in the laboratory reports they deliver after their completion.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

· D. Soudris, M. Dasygenis, *Embedded Systems Design*, Da Vinci Publisher**,** ISBN: 9789609732208, 2017.

· Peter Marwedel, *Embedded System Design, Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things*, 3rd Edition, ISBN: 9783319560458, 2018.

· P. Kitsos, N. Skavos, *Design of Digital Systems for FPGAs*, New Technologies Publisher**,** ISBN: 9789606759888, 2014. *[Translation in Greek of the Source:* Wayne Wolf*, FPGA-Based System Design***,** ISBN: 0-137-03348-6, *Prentice Hall Modern Semiconductor Design Series].*

· K. Kalovrektis, *Basic Embedded Systems Structures*, ISBN: 978-960-7996-48-0, 2012.

- Related academic journals:

· IEEE Embedded Systems Letters,

· IEEE Transactions on Computers,

· IEEE Transactions on Circuits and Systems,

· IEEE Transactions on VLSI Systems.