## GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Computer Engineering &amp; Informatics</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>CEID_NES888</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>Autumn (Advance Elective)</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Embedded Systems</td>
</tr>
</tbody>
</table>

### INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>Lectures and Tutorials, Laboratory Exercises</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4, 1</td>
<td>5</td>
</tr>
<tr>
<td>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</td>
<td>Total</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>general background, special background, specialised general knowledge, skills development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Special background, Skills development</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PREREQUISITE COURSES:</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td>
<td>Greek</td>
</tr>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>No</td>
</tr>
</tbody>
</table>

### COURSE WEBSITE (URL)

https://eclass.upatras.gr/courses/CEID1085/

## 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?

<table>
<thead>
<tr>
<th>Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data and technology</td>
</tr>
<tr>
<td>Adapting to new situations</td>
</tr>
<tr>
<td>Decision-making</td>
</tr>
<tr>
<td>Working independently</td>
</tr>
<tr>
<td>Team work</td>
</tr>
<tr>
<td>Working in an international environment</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
</tr>
<tr>
<td>Production of new research ideas</td>
</tr>
</tbody>
</table>

### 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
DELIVERY
Face-to-face, Distance learning, etc.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<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><strong>Course total</strong></td>
<td><strong>147 hours</strong></td>
</tr>
</tbody>
</table>

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.

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.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:
  - IEEE Embedded Systems Letters,
  - IEEE Transactions on Computers,
  - IEEE Transactions on Circuits and Systems,
  - IEEE Transactions on VLSI Systems.