COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Engineering</th>
</tr>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Computer Engineering and Informatics</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>CEID_NE4117</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Distributed Systems I</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>WINTER</td>
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</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Lectures, Tutorials, Laboratory</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 (L), 1 (T), 2 (Lab)</td>
<td></td>
</tr>
</tbody>
</table>

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
- skills development

PREREQUISITE COURSES:


LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek (English if there are Erasmus students)

IS THE COURSE OFFERED TO ERASMUS STUDENTS

Yes

COURSE WEBSITE (URL)

https://www.ceid.upatras.gr/webpages/courses/katanemhmena/

(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 the course, students ought to have acquired the following knowledge:

- They will be able to determine what a distributed system is and what are the basic theoretical models of distributed systems. Also, to distinguish their characteristics, and to understand their potential as well as their limitations.
- They will understand the basic algorithmic problems that arise in distributed systems and their fundamental algorithmic solutions.
- They will know what qualitative and quantitative metrics are used to evaluate the performance and correctness of distributed algorithms.

Upon successful completion of the course, students ought to be able to:

- Distinguish between different models of distributed systems and decide which model is appropriate for different settings/conditions.
- Modify and combine the fundamental distributed algorithms taught in the course to solve more complex algorithmic problems.
- Prove correctness of a distributed algorithm and analyze its complexity.
Upon successful completion of the course, students ought to have acquired the following skills:

- They will be able to design new synchronous and asynchronous distributed algorithms, prove their correctness and analyze their qualitative and quantitative characteristics (how close to the optimal solution is the solution they provide, what is their time complexity and what is their communication complexity).
- They will be able to combine, modify and extend the basic theoretical models of distributed systems and thus to describe and study in a more realistic context specific cases of distributed systems.

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 | Others... |
| Production of new research ideas | Others... |

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Production of free, creative and inductive thinking

(3) SYLLABUS

Part I: Synchronous Distributed Systems
2. Design principles of distributed algorithms, message complexity and time complexity.
3. Leader election in synchronous ring, the LCR algorithm and the HS algorithm.
4. Leader election in general networks, the FloodMax and OptFloodMax algorithms.
5. Breadth First Search (BFS) problem, the SynchBFS algorithm, variants and applications.
6. Consensus problems (without failures), the SimpleConsensus algorithm.
7. Consensus with link failures, the coordinated attack problem (deterministic and probabilistic algorithms).
8. Consensus with process failures, FloodSet algorithm, the Commit problem, the TwoPhaseCommit and ThreePhaseCommit algorithms.

Part II: Asynchronous Distributed Systems
10. Leader election algorithms in asynchronous ring.
11. Fundamental asynchronous distributed algorithms on trees: broadcast, flooding, echo, analysis and applications of the flooding/echo algorithm.
13. Asynchronous construction of a minimum spanning tree, the Gallager-Humblet-Spira algorithm.
15. Order of events, “happened-before” relation, logical time, Lamport’s logical clock.
16. Shared memory distributed systems and mutual exclusion.
### (4) TEACHING and LEARNING METHODS - EVALUATION

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

- ICT methods are used in both teaching and communication with the students. Lecture slides and supplementary material are uploaded in the course’s website.

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

- ICT methods are used in both teaching and communication with the students. Lecture slides and supplementary material are uploaded in the course’s website.

#### TEACHING METHODS

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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<tbody>
<tr>
<td>Lectures</td>
<td>$2 \times 13 = 26$</td>
</tr>
<tr>
<td>Tutorials</td>
<td>$1 \times 13 = 13$</td>
</tr>
<tr>
<td>Laboratory Exercises</td>
<td>$2 \times 13 = 26$</td>
</tr>
<tr>
<td>Individual study, preparation and problem solving.</td>
<td>$3 \times 13 = 39$</td>
</tr>
<tr>
<td>Weekend study</td>
<td>$2 \times 13 = 26$</td>
</tr>
<tr>
<td>Study during the 3 &quot;empty weeks&quot; (2 weeks of vacation and 1 week of exam preparation).</td>
<td>$5 \times 3 = 15$</td>
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</table>

Course total (25-30 hours per ECTS unit) **145**

#### STUDENT PERFORMANCE EVALUATION

**Description of the evaluation procedure**

- The language of instruction and examination is Greek. Special provisions (lecture notes and examination in English) can be made for foreign students.

Methods of evaluation:

1. Final examination (written), consisting of questions for short-answer questions and problem-solving (of graded difficulty). The final examination contributes 80% of the final grade.
2. Homework assignments, consisting of theoretical exercises and problem-solving. Homework assignments contribute 20% of the final grade.

#### ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - Lecture notes and slides available at the course website.

- Related academic journals:
  - Distributed Computing
    - Springer Berlin Heidelberg, ISSN: 0178-2770 (Print); 1432-0452 (Online), https://link.springer.com/journal/446