Department of Computer Science and Engineering
School of Engineering
University of Ioannina

Graduate Program of Studies
«Data and Computer Systems Engineering»
Courses Outline

ACADEMIC YEAR 2020/2021
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A0. Introduction to Algorithm and Information Technologies

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE &amp; ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>Α0</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>Fall</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Introduction to Algorithm and Information Technologies</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures/Laboratory Exercices</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Special background

PREREQUISITE COURSES:

NO

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)

http://ecourse.uoi.gr/enrol/index.php?id=1736

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

The course covers the necessary background that is required for attending the elective courses of Module A: Algorithm and Information Technologies. The objective of the course is to acquaint students with:

- More elaborate use of fundamental techniques for the design and analysis of algorithms.
- Advanced techniques for the design and analysis of algorithms.
- Mathematical tools such as probabilistic analysis, amortized analysis, and competitive analysis.
• Topics in computational complexity, approximate solutions, and randomization.

Students who complete the course successfully learn to:
• Apply advanced techniques for the design and analysis of algorithms.
• Provide appropriate mathematical models for various problems.
• Compare the efficiency and suitability of different algorithmic techniques for solving specific problems.
• Recognize in which of the basic complexity classes (e.g. P, NP) a specific problem belongs to.

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>Search for, analysis and synthesis of data and information, with the use of the necessary technology</th>
<th>Project planning and management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapting to new situations</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Respect for the natural environment</td>
</tr>
<tr>
<td>Working independently</td>
<td>Showing social, professional and ethical responsibility and sensitivity to gender issues</td>
</tr>
<tr>
<td>Team work</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>Others...</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td>......</td>
</tr>
</tbody>
</table>

• Production of free, creative and inductive thinking
• Search for, analysis and synthesis of data and information, with the use of the necessary technology.
• Algorithmic thinking.
• Team work.
• Autonomous work.

SYLLABUS


TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
<th>Face-to-face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of projector and interactive board during lectures.</td>
<td></td>
</tr>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td>Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Announcement of assessment marks via the e-course platform by UOI.</td>
<td></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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>$13 \times 3 = 39$ hours</td>
</tr>
<tr>
<td>Laboratory practice</td>
<td>$13 \times 1 = 13$ hours</td>
</tr>
<tr>
<td>Student’s study hours</td>
<td>$123$ hours</td>
</tr>
<tr>
<td>Course total</td>
<td>$175$ hours</td>
</tr>
</tbody>
</table>

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.

Language of evaluation: Greek

Methods of Evaluation:
- Final written examination with problem solving questions.
- Homework assignments.

The evaluation procedure is accessible to students via the course website.

ATTACHED BIBLIOGRAPHY
A1. Algorithmic Graph Theory

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE &amp; ENGINEERING</td>
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<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
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<td>COURSE CODE</td>
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<tr>
<td>SEMESTER</td>
<td></td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>ALGORITHMIC GRAPH THEORY</td>
</tr>
</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/Laboratory Exercises</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

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

Specialised general knowledge

PREREQUISITE COURSES:

NO

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)

http://www.cs.uoi.gr/~stavros/mypage-teaching-MSc-AGT.html

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

The main objective of this course is to study the main concepts of graph theory and to recognize graphs as an important modeling technique in several applications. In addition the course introduces the students to algorithmic graph theory which has become one of the major tools for the design and analysis of algorithms. The course focuses on the most interest topics in theoretical computer science.

The course’s aim is to develop interest in graph theory and its many applications. In particular, at the end of this course, a student should be able to

- apply the abstract concepts of graph theory in several practical problems;
- develop a number of standard and powerful algorithms, as well as demonstrate methodologies in graph techniques; and
- use the graphs in the solution of complex problems.
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>Search for, analysis and synthesis of data and information, with the use of the necessary technology</th>
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</tr>
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<tbody>
<tr>
<td>Adapting to new situations</td>
<td>Respect for difference and multiculturalism</td>
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<td>Decision-making</td>
<td>Respect for the natural environment</td>
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<tr>
<td>Working independently</td>
<td>Showing social, professional and ethical responsibility and sensitivity to gender issues</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td>Others...</td>
</tr>
</tbody>
</table>

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

SYLLABUS

- Graph theoretic foundations.
- The design of efficient algorithms (complexity of algorithms, data structures).
- Comparability graphs. Split graphs. Permutation graphs. Interval graphs. Cographs, quasi-threshold (or, trivially perfect), and threshold graphs.
- Perfectly orderable graphs.

TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Information and Communications Technology</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td>Use of projector and interactive board during lectures.</td>
</tr>
<tr>
<td>Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).</td>
<td>• Announcement of assessment marks via the e-course platform by UOI.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Lectures</td>
<td>13x3=39 hours</td>
</tr>
<tr>
<td></td>
<td>Laboratory practice</td>
<td>13x1=13 hours</td>
</tr>
<tr>
<td></td>
<td>Student’s study hours</td>
<td>123 hours</td>
</tr>
<tr>
<td></td>
<td>Course total</td>
<td>175 hours</td>
</tr>
</tbody>
</table>

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Language of evaluation: Greek
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.

Methods of Evaluation:

i) Final written examination
ii) Lab projects examination
iii) Evaluation of weekly assignments

The evaluation procedure is accessible to students via the course website.

ATTACHED BIBLIOGRAPHY

A7. Cryptography and Information Security

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE &amp; ENGINEERING</td>
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<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
<td>Fall</td>
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<tr>
<td>COURSE TITLE</td>
<td>Cryptography and Information Security</td>
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</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

If credits are awarded for the whole of the course, give the weekly teaching hours and the total credits.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures/Laboratory Exercises</td>
<td>4</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Special background

PREREQUISITE COURSES:

NO

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)

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

The course introduces both theoretical and practical aspects of cryptography, authentication and information security. It covers foundations of cryptography and standardized cryptosystems widely used in practice.

After attending the course students should be able to:

- Understand the mathematical techniques associated with cryptography.
- Understand the principles of cryptographic techniques and perform implementations of related algorithms.
- Apply security techniques in solving real-life security problems in practical 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 | 

- Production of free, creative and inductive thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Algorithmic thinking.
- Team work.
- Autonomous work.

SYLLABUS

Basic notions of systems security, cryptographic hash functions, symmetric cryptography (one-time pad, stream ciphers, block ciphers), cryptanalysis, secret-sharing, authentication codes, public-key cryptography (encryption, digital signatures), public-key infrastructure, elliptic curves and bilinear maps, buffer overflow attacks, web browser security, biometrics, electronic cash, viruses, electronic voting.

TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
<th>Face-to-face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td></td>
</tr>
</tbody>
</table>
- Use of projector and interactive board during lectures.
- Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
- Announcement of assessment marks via the e-course platform by UOI. |

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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>$13 \times 3 = 39$ hours</td>
</tr>
<tr>
<td>Laboratory practice</td>
<td>$13 \times 1 = 13$ hours</td>
</tr>
<tr>
<td>Student’s study hours</td>
<td>148 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>200 hours</td>
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</table>
## 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.

**Language of evaluation:** Greek

**Methods of Evaluation:**

- Final written examination with problem solving questions.
- Homework assignments.
- Individual presentation of a research topic related to the subject matter of the course.

The evaluation procedure is accessible to students via the course website.

## ATTACHED BIBLIOGRAPHY

D0. Introduction In Data Analysis And Processing

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPT. OF COMPUTER SCIENCE &amp; ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
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</tr>
<tr>
<td>SEMESTER</td>
<td>SPRING</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>INTRODUCTION IN DATA ANALYSIS AND PROCESSING</td>
</tr>
</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 / Labs / Tutorials</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

General background

PREREQUISITE COURSES

NO

LANGUAGE OF INSTRUCTION and EXAMINATIONS

GREEK or ENGLISH

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)

http://ecourse.uoi.gr/enrol/users.php?id=1720

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

This introductory course exposes the students to the main concepts and methodologies in Data Science. The course comprises a series of lectures that concisely cover the necessary mathematical background as well as essential topics in Data Science, such as data types and representation, clustering techniques, learning and generalization, optimization, data transformations and compression, text processing and information retrieval. Moreover, it offers an overview of popular programming tools used in Data Science.

After the successful completion of this course, students will be exposed to:

- The fundamental mathematical background that is necessary for the in-depth study of specialized topics in Data Science.
● The basic fields of study that they can deepen in data analysis and processing.
● Modern programming tools that are highly useful in Data Science.

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 | ...... |

SYLLABUS

● Elements of Linear Algebra
● Elements of Optimization
● Overview of Probability Theory and Statistics
● Data Types and Representation
● Clustering
● Data Transformations
● Data Compression
● Learning and Generalization
● Text Processing and Information Retrieval
● Programming Tools in Data Science

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 |
| Weekly lectures |
| ● Course webpage where literature and free material is provided. |
| ● Live simulations in the classroom. |
| ● Use of email services and social media for communication with the students. |

| TEACHING METHODS |
| The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice. |
| Activity | Semester workload |
| Lectures | 13*3 = 39 hours |
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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labs</td>
<td>13*1 = 13 hours</td>
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<tr>
<td>Self-study</td>
<td>123 hours</td>
</tr>
<tr>
<td>Total</td>
<td>175 hours</td>
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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, etc.

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

LANGUAGE OF EVALUATION: Greek or English

METHODS OF EVALUATION: Written exam

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:
D1. Machine Learning

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
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<tr>
<td>LEVEL OF STUDIES</td>
<td>POSTGRADUATE</td>
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<tr>
<td>COURSE TITLE</td>
<td>MACHINE LEARNING</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Tutorials</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

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

PREREQUISITE COURSES:

- 

<table>
<thead>
<tr>
<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS</th>
<th>GREEK</th>
</tr>
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<tbody>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>YES</td>
</tr>
</tbody>
</table>

| COURSE WEBSITE (URL) | http://www.cs.uoi.gr/~arly/courses/ml/ml.html |

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

The objective of this course is to provide a detailed description of machine learning problems and solutions. The main problems presented and studied are related to supervised learning (classification, regression), unsupervised learning (clustering, dimensionality reduction, density estimation) and reinforcement learning. State-of-the-art methods are presented and compared for all the above problems.

It is expected that after taking the course the student will have:

- knowledge of machine learning problems
• a clear understanding of the notions of learning and generalization
• the ability to solve classification, regression and clustering problems using state-of-the-art approaches such SVMs, deep neural networks, Gaussian Processes, mixture models.
• the skill to apply all the algorithmic steps required for building machine learning models from a given dataset.

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... |

• Production of free, creative and inductive thinking
• Search for, analysis and synthesis of data and information, with the use of the necessary technology
• Team work
• Algorithmic thinking
• Apply research results in solving practical problems
• Literature studying and management

SYLLABUS


TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Weekly Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td></td>
</tr>
</tbody>
</table>

| USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY | |
| Use of ICT in teaching, laboratory education, communication with students | |
| • Use of projector during lectures. |
| • Method demonstration using demos and videos. |
| • Course website maintenance. Announcements and posting of teaching material (lecture slides |
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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13*3 = 39 hours</td>
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<td>13*1 = 13 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>123 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>175 hours</td>
</tr>
</tbody>
</table>

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, etc.

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION

(i) Final exams
(ii) Project

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:


## D3. Optimization

### COURSE OUTLINE

<table>
<thead>
<tr>
<th>GENERAL</th>
</tr>
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<tbody>
<tr>
<td>SCHOOL</td>
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<tr>
<td>ACADEMIC UNIT</td>
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<tr>
<td>LEVEL OF STUDIES</td>
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<tr>
<td>COURSE CODE</td>
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<tr>
<td>SEMESTER</td>
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<table>
<thead>
<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
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<tbody>
<tr>
<td>Lectures / Labs / Tutorials</td>
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Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

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<th>COURSE TYPE</th>
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<table>
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<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</th>
<th>GREEK or ENGLISH</th>
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</table>

<table>
<thead>
<tr>
<th>IS THE COURSE OFFERED TO ERASMUS STUDENTS</th>
<th>YES</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL)</th>
<th><a href="http://ecourse.uoi.gr/enrol/index.php?id=553">http://ecourse.uoi.gr/enrol/index.php?id=553</a></th>
</tr>
</thead>
</table>

### 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

Optimization is the branch of Mathematics that deals with the detection of optimal solutions. Typically, a solution to a given problem is modeled via a parametric “objective” function (model), the minima of which may correspond to desired solutions. Also, the problem may contain a set of constraints, typically defined through equality and / or
inequality relations.

The Optimization course aims at equipping the students with essential knowledge in local and global Optimization algorithms of various types. Among other, these include:

- Gradient-based algorithms that use first- and second-order derivatives information, such as Gradient Descent, Newton, Quasi-Newton, Conjugate Gradients, in combination with Line Search and Trust Region techniques.
- Derivative-free algorithms such as Nelder-Mead, Hooke-Jeeves, and Pattern Search.
- Stochastic and evolutionary algorithms such as Genetic Algorithms and Particle Swarm Optimization.

Moreover, different techniques for solving problems with constraints are given, along with techniques for the detection of multiple minimizers.

After the successful completion of this course, students are expected to be able to:

- Implement and apply local and global Optimization algorithms.
- Determine the most appropriate algorithm for a given problem.
- Design variants of the algorithms for serial and parallel computing environments, as well as for challenging applications.

**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>Search for, analysis and synthesis of data and information, with the use of the necessary technology</th>
<th>Project planning and management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapting to new situations</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Respect for the natural environment</td>
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<tr>
<td>Working independently</td>
<td>Showing social, professional and ethical responsibility and sensitivity to gender issues</td>
</tr>
<tr>
<td>Team work</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>Others...</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td>.......</td>
</tr>
</tbody>
</table>

- Production of free, creative and inductive thinking.
- Decision-making.
- Search for, analysis and synthesis of data and information.
- Development of algorithmic thinking.
- Ability of analyzing and modelling problems.

**SYLLABUS**

- Introduction to Optimization
- Optimality conditions
- One-dimensional optimization
- Gradient-based methods: Newton, Quasi-Newton, Conjugate Gradients.
- Line Search and Trust Region techniques.
• Stochastic and evolutionary algorithms: Multistart, Simulated Annealing, Genetic Algorithms, Particle Swarm Optimization.
• Solution techniques for constrained problems.
• Techniques for the detection of multiple minimizers. Parallel coordinates.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY
Face-to-face, Distance learning, etc.
Weekly lectures

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students
• Course webpage where literature and free material is provided.
• Live simulations in the classroom.
• Use of email services and social media for communication with the students.

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

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</thead>
<tbody>
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<td>Lectures</td>
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</tr>
<tr>
<td>Labs</td>
<td>13*1 = 13 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>123 hours</td>
</tr>
</tbody>
</table>

Course total 175 hours

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.

LANGUAGE OF EVALUATION: Greek or English
METHODS OF EVALUATION: Projects and written report.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:

  • Optimization Letters, SPRINGER.
  • Optimization Methods and Software, TAYLOR & FRANCIS.
  • Journal of Global Optimization, SPRINGER.
  • Journal of Optimization Theory and Applications, SPRINGER.
  • Mathematical Programming, SPRINGER.
  • SIAM Journal on Optimization, SIAM.
  • IEEE Transactions on Evolutionary Computation, IEEE.
  • Applied Soft Computing, SPRINGER.
  • Soft Computing, ELSEVIER.
  • European Journal on Operational Research, ELSEVIER.
  • Computers & Operations Research, ELSEVIER.
  • Computers & Industrial Engineering, ELSEVIER.
  • Annals of Operations Research, SPRINGER.
D4. Video Processing and Compression

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
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<td>LEVEL OF STUDIES</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<td>COURSE TITLE</td>
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INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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</thead>
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<tr>
<td>Lectures / Labs / Tutorials</td>
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COURSE TYPE

<table>
<thead>
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PREREQUISITE COURSES:

- 

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

<table>
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IS THE COURSE OFFERED TO ERASMUS STUDENTS

<table>
<thead>
<tr>
<th>YES</th>
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</table>

COURSE WEBSITE (URL)


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

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- Guidelines for writing Learning Outcomes

The goal of the course is the learning of the basic theory of video processing and compression.

After successfully passing this course the students will be able to:

- Understand the basic principles of video capture and display.
- Apply tools of multidimensional signal processing to video applications.
- Understand and use video sampling theory.
- Implement various motion estimation algorithms.
- Understand the fundamentals of compression and their application to video coding.
• Be familiar with current video compression standards.

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
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking

SYLLABUS


Video sampling theory: Generalized Nyquist sampling theorem. Sampling rate conversion.

Motion estimation: Motion modeling. Optical flow equation. Block matching.


TEACHING and LEARNING METHODS - EVALUATION

DELIVERY

Face-to-face, Distance learning, etc.

Lectures, lab sessions

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students

• Use of projector during lectures.
• Use of Matlab in the lab.
• Use of the ecourse electronic platform for course announcements, uploading of class notes, homework assignment, and grade announcement.
• Use of email and social media for more effective communication with the students

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>The manner and methods of teaching are described in detail.</td>
<td>Lectures</td>
<td>13*3 = 39 hours</td>
</tr>
<tr>
<td>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.</td>
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<td>13*1 = 13 hours</td>
</tr>
<tr>
<td>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>Self-study</td>
<td>123 hours</td>
</tr>
<tr>
<td></td>
<td>Course total</td>
<td>175 hours</td>
</tr>
</tbody>
</table>

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.

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION

(i) Final examination. The students are tested in theory and exercises of video processing and compression.

(ii) Homework assignments. The students are asked to solve video processing and compression exercises.

(iii) Lab reports. The students turn in their code and answer questions regarding their results.

The evaluation procedure is accessible to students via the course website.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:
  • IEEE Transactions on Image Processing
  • IEEE Transactions on Circuits and Systems for Video Technology
  • IEEE Transactions on Multimedia
D5. Computer Vision

COURSE OUTLINE

GENERAL

<table>
<thead>
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</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>Computer Vision</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 / Labs/ Exercises</th>
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<td></td>
<td>3/1/0</td>
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COURSE TYPE

general background, special background, specialised general knowledge, skills development

Specialised general knowledge

PREREQUISITE COURSES:

NO

LANGUAGE OF INSTRUCTION

and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)


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

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- Guidelines for writing Learning Outcomes

Upon completion of this course, students will:

- Have acquired the intuition behind understanding the 3D world from images
- Be familiar with both the theoretical and practical aspects of computing with images;
- Have described the foundation of image formation, measurement, and analysis;
- Have implemented common methods for robust image matching and alignment;
- Understand the geometric relationships between 2D images and the 3D world.
- Have gained exposure to object and scene recognition and categorization from images;
- Grasp the principles of state-of-the-art regression and classification methods in computer vision;
• Have developed the practical skills necessary to build computer vision applications.

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 multiculturalism, 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 |  

• Search for, analysis and synthesis of data and information, with the use of the necessary technology.
• Decision making
• Production of free, creative and inductive thinking
• Team work
• Autonomous work
• Production of new research ideas

SYLLABUS

• Linear filtering
• Edge detection
• Frequency representation, image pyramids, template matching
• Local features: corners
• Local features: scale and interest point descriptors
• Machine learning for computer vision
• Segmentation by clustering: mean shift
• Segmentation by clustering: normalized cut
• Segmentation by fitting a model: Hough transform and least squares fitting
• Segmentation by fitting a model: robust estimators and RANSAC
• Registration
• PCA and eigenfaces
• Face detection
• Fitting probability models
• Learning and inference in computer vision
• The pinhole camera
• Singular value decomposition
• Models for transformations
• Multiple cameras
• More features (LBP, shape context, dual PCA)
• Models for grids (grphah cut)
• Regression
## TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Lecture slides, multimedia (video demonstrations), e-mail communication, course Web page maintenance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lectures</td>
<td>13x3=39 hours</td>
</tr>
<tr>
<td></td>
<td>Labs</td>
<td>13x1=13 hours</td>
</tr>
<tr>
<td></td>
<td>Student’s autonomous study of the theory, problem solving and response to homework assignments</td>
<td>123 hours</td>
</tr>
</tbody>
</table>

| STUDENT PERFORMANCE EVALUATION | |
|--------------------------------| Language of evaluation: Greek |
| Methods of Evaluation: | |
| iv) Weekly lab and theoretical assignments | |
| v) Mid-term examination | |
| vi) Final examination | |

The evaluation procedure is accessible to students via the course website.

### ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**
  
   

- **Related academic journals:**
  
   IEEE Transactions on Pattern Analysis and Machine Intelligence
International Journal of Computer Vision
IEEE Transactions on Image Processing
Image and Vision Computing
Computer Vision and Image Understanding
Pattern Recognition
Journal of Mathematical Imaging and Vision
Machine Vision and Applications
D6. Online Social Networks and Media

COURSE OUTLINE

GENERAL

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<td>COURSE TITLE</td>
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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

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</thead>
<tbody>
<tr>
<td>Lectures / Exercises/ Project</td>
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</tr>
</tbody>
</table>

COURSE TYPE
- general background, special background, specialised general knowledge, skills development

- Specialised general knowledge

PREREQUISITE COURSES:
- NO

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
- Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:
- YES

COURSE WEBSITE (URL):

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
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- Guidelines for writing Learning Outcomes

It is expected that after taking the course the student will have:

- knowledge of basic metrics and measurements for real networks, such as power-law degree distributions and clustering coefficient
- knowledge of models for real networks
- the knowledge and ability to find communities in graphs, or dense subgraphs.
- understanding of dynamic processes on networks, such as influence spread, or opinion formation, and algorithms for affecting them
- knowledge of metrics and algorithms for identifying central and influential nodes in a graph.
- Knowledge of different models algorithms for predicting links or understanding their strength and sign
- Knowledge on specialized topics related to networks such as privacy, team formation, small world effects, fairness, content-based analysis
- The ability to process and manipulate large graphs using programming tools
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.
- Decision making
- Production of free, creative and inductive thinking
- Team work
- Autonomous work
- Production of new research ideas

SYLLABUS

- Theoretical problems and applications around the analysis and mining of (online) social networks and media such as Facebook and Twitter.
- Indicative subjects: models for networks, techniques for obtaining, storing and processing networked data, models for information diffusion, algorithms for ranking and selecting of influencers, dynamic processes such as influence spread and opinion formation, team formation and community finding, games over networks, privacy, fairness and diversity.

TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
<th>Face-to-face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Lecture slides, multimedia (video demonstrations), e-mail communication, course Web page maintenance.</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>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></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13x3=39 hours</td>
</tr>
<tr>
<td>Student’s study hours</td>
<td>123 hours</td>
</tr>
<tr>
<td>Final Project</td>
<td>13 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>175 hours</td>
</tr>
</tbody>
</table>

STUDENT PERFORMANCE EVALUATION

Language of evaluation: Greek or English

Methods of Evaluation:

vii) Assignments
viii) Presentation
open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

<table>
<thead>
<tr>
<th>ix) Final project</th>
</tr>
</thead>
<tbody>
<tr>
<td>The evaluation procedure is accessible to students via the course website.</td>
</tr>
</tbody>
</table>

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

**ATTACHED BIBLIOGRAPHY**
D7. Management of Non-traditional Data

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>POSTGRADUATE</td>
</tr>
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<td>COURSE CODE</td>
<td>D7</td>
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<tr>
<td>SEMESTER</td>
<td></td>
</tr>
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<td>COURSE TITLE</td>
<td>Management of Non-traditional Data</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Tutorials</td>
<td>4</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Special background

PREREQUISITE COURSES:

- 

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)

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

The course Management of Non-traditional Data typically focuses on database management topics for which the traditional relational database technology is not adequate. It specializes on data management subjects which belong to two big categories, specifically: (a) the area of complex query evaluation (e.g., dynamic ranking queries based on multidimensional aggregate functions, or distance to a reference point) and (b) the area of data management for non-traditional formats and environments (e.g., with a focus on spatial data, time-series, text, and multidimensional data in general). The course specialises each year to a possibly different subarea;
however, it begins by covering the fundamental concepts of each area (as well as how they are related to traditional database management) and later on goes deeper to techniques that cover research efforts and state-of-the-art tools.

After successfully passing this course the students will be able to:

- Understand the state-of-the-art and the historical evolution of research in the area under study
- Understand in depth the critical elements of the DBMS architecture
- Organize the data using appropriate data representations both at the logical and physical levels, such that the data can be easily and efficiently retrieved
- Use specialized query evaluation algorithms, depending on the data domain
- Develop a complete project wherein they apply the design and algorithmic knowledge obtained from the course in order to manage complex data collections

**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 |
| Decision-making | Respect for the natural environment |
| Adapting to new situations | Respect for difference and multiculturalism |
| 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 | ...... |

- Production of free, creative and inductive thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Team work
- Algorithmic thinking
- Abstraction ability for problem modeling
- Apply research results in solving practical problems
- Literature studying and management

**SYLLABUS**

Spatial Indexes and Queries
Dimensionality Reduction for Multimedia Data
Top-k queries and skyline queries
Data Warehouses and OLAP
Processing aggregate queries
Time-series and Prediction
Large project development in phases

TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Weekly Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Face-to-face, Distance learning, etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The manner and methods of teaching are described in detail.</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>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></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>$13 \times 3 = 39 \text{ hours}$</td>
</tr>
<tr>
<td>Tutorials</td>
<td>$13 \times 1 = 13 \text{ hours}$</td>
</tr>
<tr>
<td>Self-study</td>
<td>148 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>200 hours</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
<td></td>
</tr>
<tr>
<td>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</td>
<td></td>
</tr>
<tr>
<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td></td>
</tr>
</tbody>
</table>

| LANGUAGE OF EVALUATION: Greek |
| METHODS OF EVALUATION |
| (i) At each lecture, the students are asked to be prepared on the material of the lecture and to participate in the critical discussions that arise. |
| (ii) At each lecture, the students are asked to answer to questions and exercises related to the learning outcomes of the previous lecture. |
| (iii) A large programming assignment (project). |
| The evaluation procedure is accessible to students via |
ATTACHED BIBLIOGRAPHY

- Suggested bibliography:


- Related academic journals:
  - ACM Transactions on Database Systems
  - IEEE Transactions on Knowledge and Data Engineering
  - The VLDB Journal, Springer
D8. Biomedical data analysis
H0. Introduction to Computer Hardware Systems

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>H0</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>-</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Introduction to Computer Hardware Systems</td>
</tr>
</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

| Lectures / Tutorials     | 3+1 | 7 |

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Specialized general Knowledge

PREREQUISITE COURSES:

- 

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK & ENGLISH

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)

http://ecourse.uoi.gr/course/view.php?id=1727

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

The primary aim of the course is to convey an in-depth understanding of modern computer systems hardware. After successfully passing this course the students will be able to:

● Describe the structure and operational characteristics of the core and memory hierarchy of a microprocessor.
● Demonstrate an understanding of
  ● VLSI Design (full custom, standard cells, gate arrays), CMOS technology, manufacturing technologies and ASICs
  ● Basic theory of MOS transistors, elementary & complex gates
  ● Low-power design techniques at device, module and system levels
● Understand testing requirements in modern VLSI systems, explain testing procedures and describe basic design for testability structures and testing standards.
Demonstrate an understanding of
  o the basic components of a robotic system and their functions
  o the basic concepts of the kinematics of robotic 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
Adapting to new situations
Decision-making
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
Search for, analysis and synthesis of data and information, with the use of the necessary technology
Analysis of requirements for problem solving
Working independently
Use abstraction to understand and analyze complex systems/problems

SYLLABUS

Processor core and cache organization: Instruction set architecture, Instruction-level parallelism, Organization and operation of cache memories, Performance evaluation of a computer
VLSI: VLSI design technologies, ASICs, packaging technologies, DRC, economics, MOS transistors, inverter, basic gates, complex gates, standard cells, gate arrays, basic transistor theory.
Testing and Design for Testability: VLSI testing, scan testing, built-in self test (BIST), testing standards (JTAG, IEEE1500).
Low-power design: Power consumption in CMOS circuits, modelling and evaluation of power, low-power design techniques
Robotics: Basic components of a robotic system and their functions, sensors and actuators, position and orientation of a robot, kinematics of a robot.

TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures and tutorials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>Use of projector and interactive board during lectures.</td>
</tr>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td>Use of special electronic equipment and software for delivering the project.</td>
</tr>
<tr>
<td></td>
<td>Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).</td>
</tr>
<tr>
<td></td>
<td>Announcement of assessment marks via the ecourse platform by UOI.</td>
</tr>
<tr>
<td></td>
<td>Use of email for information exchange and improved communication with students.</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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13x3 = 39 hours</td>
</tr>
<tr>
<td>Tutorials</td>
<td>1.3x1 = 13 hours</td>
</tr>
<tr>
<td>Quizzes</td>
<td>5x1 = 5 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>118 hours</td>
</tr>
<tr>
<td></td>
<td>Course total 175 hours</td>
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</table>

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.

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION
Quiz-style written exam at the end of each sub-module. Overall course mark is the average of the module quiz scores. The Quiz may include problem solving, multiple-choice, and short-answer questions. The quizzes are evaluated based on the correctness and completeness of answers.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - CMOS VLSI DESIGN: A CIRCUITS AND SYSTEMS PERSPECTIVE, N. Weste and D. Harris, Addison-Wesley, 2011.

- Συναφή επιστημονικά περιοδικά:
  - IEEE Transactions on Computers,
  - IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems,
  - IEEE Transactions on VLSI Systems,
  - IEEE Design & Test of Computers
  - IEEE Transactions on Robotics
  - IEEE/ASME Transactions on Mechatronics
H1. Modern Computer Architecture

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>H1</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>-</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>MODERN COMPUTER ARCHITECTURE</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>Lectures / Project</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

COURSE TYPE

Specialized general Knowledge

PREREQUISITE COURSES:

- 

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK & ENGLISH

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)


LEARNING OUTCOMES

The primary aim of the course is to convey an in-depth understanding of modern, high-performance processor micro-architecture and the memory hierarchy. After successfully passing this course the students will be able to:

- Describe the structure and operational characteristics of a pipelined microprocessor.
- Demonstrate an understanding of pipeline hazards and interlocks, out-of-order execution, scoreboards and reservation tables, branch prediction.
- Evaluate the performance of a processor and memory system.
- Describe the memory coherency issues involved when designing a multiprocessor system, and explain the behaviour of a typical cache coherency protocol.
- Adapt existing simulators, run simulations and present a critical evaluation of the
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>
<th>Aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data and information, with the use of the necessary technology</td>
<td>Project planning and management</td>
</tr>
<tr>
<td>Adapting to new situations</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Respect for the natural environment</td>
</tr>
<tr>
<td>Working independently</td>
<td>Showing social, professional and ethical responsibility and sensitivity to gender issues</td>
</tr>
<tr>
<td>Team work</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>Others...</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td></td>
</tr>
</tbody>
</table>

SYLLABUS


Pipelined processor organization: Instruction dependencies, pipeline hazards, data forwarding, pipeline stall, delayed branches. Code scheduling.


Out of order execution. Speculative execution. Branch prediction.


Parallel systems: Shared-memory multicore systems. Memory coherence, memory consistency.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY

Face-to-face, Distance learning, etc.

Lectures, Project

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students

- Use of projector and interactive board during lectures.
- Use of special electronic equipment and software for delivering the project.
- Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
- Announcement of assessment marks via the ecourse platform by UOI.
- Use of email for information exchange and improved communication with students.
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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>$13 \times 3 = 39$ hours</td>
</tr>
<tr>
<td>Tutorials</td>
<td>$116$ hours</td>
</tr>
<tr>
<td>Project</td>
<td>$10 \times 2 = 20$ hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>$116$ hours</td>
</tr>
<tr>
<td><strong>Course total</strong></td>
<td><strong>175 hours</strong></td>
</tr>
</tbody>
</table>

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.

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION

(i) Final examination, which includes problem solving. The exam papers are evaluated based on the correctness and completeness of answers.

(ii) Laboratory & Project Examination

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Συναφή επιστημονικά περιοδικά:
  - Transactions on Architecture and Code Optimization, Transactions on Computer Systems, ACM.
H2. Reliable Integrated Systems

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>POSTGRADUATE - MASTER LEVEL</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>H2</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>Reliable Integrated Systems</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Labs / Tutorials</td>
<td>4</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Specialized General knowledge, Skills development

PREREQUISITE COURSES:

Digital Design I and II, Computer Architecture, VLSI Circuits

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK - ENGLISH

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)

http://www.cs.uoi.gr/~tsiatouhas/Y2-RIS.htm

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

This course aims at introducing to students the fundamentals of integrated circuits and systems testing and design for testability and reliability.

At the end of the course students should be able to perform the following:

- Understand the importance of integrated circuits and systems testing as well as design for testability and reliability, its impact on the total cost and the quality of the designed product.
- State the trends and challenges in the field of VLSI testing and reliable design.
- Understand defect as well as wear out and aging generation mechanisms in
nanometer technologies.
- Analyze testing requirements and examine different test and reliability methodologies.
- Develop design for testability (DfT) techniques.
- Develop design for reliability (DfR) techniques.
- Become a better VLSI designer and test engineer.
- Do research in the field of VLSI test technology.

**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>
<th>General Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data and</td>
<td>Production of new research ideas</td>
</tr>
<tr>
<td>information, with the use of the necessary technology</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Adapting to new situations</td>
<td>Search for, analysis and synthesis of data and information, with the use of the necessary technology</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Adapting to new situations</td>
</tr>
<tr>
<td>Working independently</td>
<td>Analysis of requirements for problem solving</td>
</tr>
<tr>
<td>Team work</td>
<td>Abstraction ability for problem modeling</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Combination of existing methods for the synthesis of high quality solutions</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>Working independently</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td>Team work</td>
</tr>
</tbody>
</table>

**SYLLABUS**

With the continuous scaling of transistor feature size, the chip complexity is dramatically increased since billions of transistors are integrated in a single chip (see the case of Systems-on-Chip – SoCs). Aiming to provide high quality integrated circuits and systems, these must be reliable and fully tested after production. In addition, during their whole operational life time in the field, we must ensure their reliable and uninterruptable operation. Consequently, design for reliability is an integral part of integrated circuits and systems design and manufacturing.

This course covers the fields of integrated circuits and systems testing, design for testability and design for reliability. The topics discussed are: Importance of testing, Defects and fault models, Wear out and aging mechanisms, PVT variations, Test process, Advanced design for testability techniques, Advanced design for reliability techniques, Self-healing systems.

**TEACHING and LEARNING METHODS - EVALUATION**

| DELIVERY                                                                 | Face-to-face, lectures, lab courses, home-works         |
Face-to-face, Distance learning, etc.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students

- Use of e-slides and interactive board during lectures.
- Use of computer-aided design tools at the laboratory (circuit design and simulation).
- Course website maintenance. Announcements and posting of teaching material (lecture slides and notes).
- Use of the ecourse facility.
- Use of email for information exchange and improved communication with students.

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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>$13 \times 3 = 39$ hours</td>
</tr>
<tr>
<td>Project</td>
<td>$11 \times 1 = 11$ hours</td>
</tr>
<tr>
<td>Problems solving</td>
<td>75 hours</td>
</tr>
<tr>
<td>Study &amp; bibliography analysis</td>
<td>75 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>200 hours</td>
</tr>
</tbody>
</table>

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.

LANGUAGE OF EVALUATION: Greek - English

METHODS OF EVALUATION

(i) Final examination, which includes problem solving. The exam papers are evaluated based on the correctness and completeness of answers.

(ii) Project which includes bibliography study, design techniques analysis and their application for the development of high reliability VLSI circuits.

The evaluation procedure is accessible to students via the course website.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

  **Βιβλίο** VLSI TEST PRINCIPLES AND ARCHITECTURES, L-T. Wang, C-W Wu, X. We, Εκδ.: MORGAN-KAUFMANN, 2006.

Book [41963448]: CMOS VLSI DESIGN: A CIRCUITS AND SYSTEMS PERSPECTIVE, N. Weste and D. Harris, Addison-Wesley, 2011.


- Related academic journals:
  - Design and Test Magazine, IEEE.
  - Integration the VLSI Journal, Elsevier
  - IEEE Transactions on Circuits and Systems I & II (TCAS).
H3. 3D Systems on Chip

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>H3</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>-</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>3D SYSTEMS ON CHIP</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>Lectures / Labs / Tutorials</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3+1</td>
<td>7</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).

COURSE TYPE

Specialized general Knowledge

PREREQUISITE COURSES:

- 

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK & ENGLISH

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL):

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

The students acquire the basic knowledge on the design and test of 3-Dimensional Systems-on-Chip. Initially, they understand the 2D limitations that led to the 3D integration and then they study the basic mechanisms for solving such problems. The students emphasize on the design, manufacturing and test methods proposed to attack electrical, temperature and power-dissipation issues in 3D stacks, while at the same time they face problems related to the embedding of multiple cores/memory and they understand the proposed solutions for each case. Finally, they study applications of 3D manufacturing.

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
| Respect for the natural environment
Data and Computer Systems Engineering

Academic Year 2020-21

<table>
<thead>
<tr>
<th>Decision-making</th>
<th>Showing social, professional and ethical responsibility and sensitivity to gender issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working independently</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Team work</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td></td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>Others...</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td></td>
</tr>
</tbody>
</table>

- Production of free, creative and inductive thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Analysis of requirements for problem solving

SYLLABUS


TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>The teaching is performed through powerpoint slides and the communication is conducted by electronic means (ecourse, email etc)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td>Lectures</td>
<td>13x3</td>
</tr>
<tr>
<td></td>
<td>Tutorials</td>
<td>13x1</td>
</tr>
<tr>
<td></td>
<td>Labs</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Self-study</td>
<td>123</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
<th>LANGUAGE OF EVALUATION: Greek / English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
<td>METHOD OF EVALUATION: Written Exam</td>
</tr>
</tbody>
</table>

Specifically-defined evaluation criteria are

Course total 175 hours

[48]
ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

-Συναφή επιστημονικά περιοδικά:
• IEEE Transactions on Computers,
• IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems,
• IEEE Transactions on VLSI Systems,
• IEEE Design & Test of Computers
## Course Outline

### General

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>Y4</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>-</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Embedded Systems for IoT Applications</td>
</tr>
</tbody>
</table>

### Independent Teaching Activities

<table>
<thead>
<tr>
<th>Lectures / Labs / Tutorials</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3+1</td>
<td>7</td>
</tr>
</tbody>
</table>

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.

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

### Course Type

- Specialized general Knowledge

### Prerequisite Courses

- 

### Language of Instruction and Examinations

- GREEK & ENGLISH

### Is the Course Offered to Erasmus Students

- YES

### Course Website (URL)

- 

### 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

The students acquire the basic knowledge on integrated circuit and system design for the Internet of Things (IoT), and in particular for the nodes at its edge.

The students learn what the IoT is from the design point of view and the system point of view, and how the constraints imposed by IoT applications translate into integrated circuit requirements and design guidelines.
After taking this course, beside the state-of-the-art design techniques for IoT applications, the students will learn about the fundamental sub-systems encountered in Systems on Chip for IoT:

- ultra-low power digital architectures and circuits, low- and zero-leakage memories (including emerging technologies)
- circuits for hardware security and authentication
- on-chip power management and energy harvesting
- ultra-low power analog interfaces and analog-digital conversion
- short-range radios
- miniaturized battery technologies
- packaging and assembly of IoT integrated systems (on silicon and non-silicon substrates).

The course also examines how the IoT could evolve based on recent and foreseeable trends in the semiconductor industry, highlighting the key challenges, as well as the opportunities for circuit and system innovation to address them.

### 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>
<th>Course Aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data and information, with the use of the necessary technology</td>
<td>Project planning and management</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>Adapting to new situations</td>
<td>Respect for the natural environment</td>
</tr>
<tr>
<td>Working independently</td>
<td>Showing social, professional and ethical responsibility and sensitivity to gender issues</td>
</tr>
<tr>
<td>Team work</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>Others...</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td></td>
</tr>
</tbody>
</table>

- Production of free, creative and inductive thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Analysis of requirements for problem solving

### SYLLABUS

- The IoT Ecosystem
  - Embedded Computer Devices
  - M2M Communications
  - Smart environments
  - Cyber-physical systems
  - Cloud computing, fog computing, edge computing
▪ Fog and cloud interplay
▪ IoT Application Constraints

▪ Energy efficient IoT devices
  ▪ Ultra-low power digital architectures and circuits
  ▪ Low- and zero-leakage memories (including emerging technologies)
  ▪ Ultra-low power analog interfaces and analog-digital conversion
  ▪ Short-range radios
  ▪ On-chip power management and energy harvesting

▪ Security in IoT Devices
  ▪ Circuits for hardware security and authentication

▪ Miniaturized battery technologies
▪ Packaging and assembly of IoT integrated systems


**TEACHING and LEARNING METHODS - EVALUATION**

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Face-to-face, Distance learning, etc.</td>
</tr>
</tbody>
</table>

**USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**

- Use of projector and interactive board during lectures.
- Use of special electronic equipment and software for delivering the project.
- Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
- Announcement of assessment marks via the ecourse platform by UOI.
- Use of email and social media for information exchange and improved communication with students.
### 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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13x3</td>
</tr>
<tr>
<td>Tutorials</td>
<td>13x1</td>
</tr>
<tr>
<td>Labs</td>
<td>-</td>
</tr>
<tr>
<td>Self-study</td>
<td>123</td>
</tr>
</tbody>
</table>

Course total:

175 hours

### 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.

LANGUAGE OF EVALUATION: Greek / English

METHOD OF EVALUATION: Written Exam

### ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. *Enabling the Internet of Things: From Integrated Circuits to Integrated Systems*, Massimo Alioto (Publisher: Springer)

-Συναφή επιστημονικά περιοδικά:

- IEEE Transactions on Circuits and Systems I and II,
- IEEE Transactions on Computers,
- IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems,
- IEEE Transactions on VLSI Systems
H5. Robotic Systems

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>H5</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>-</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th></th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Labs / Tutorials</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

COURSE TYPE

Specialized general knowledge

PREREQUISITE COURSES:

-  

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)


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

The main course objective is to introduce students with more advanced aspects in selected areas of robotics, such as non-linear control, and motion planning of a robotic platform.

A student that successfully attends this course should be able to:

- Understand, design, and implement advanced control methodologies for robotic manipulators and mobile platforms.
- Demonstrate advanced knowledge in motion planning of a robotic platform or a robotic fleet.
- Study and solve real life complex problems in the control of robotic systems.
- Understand research papers in the field of robotics and try out some innovative ideas.
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 |
| Decision-making | Respect for difference and multiculturalism |
| Working independently | Respect for the natural environment |
| Working in an international environment | Showing social, professional and ethical responsibility and sensitivity to gender issues |
| Working in an interdisciplinary environment | Criticism and self-criticism |
| Production of new research ideas | Production of free, creative and inductive thinking |
| • Search for, analysis and synthesis of data and information, with the use of the necessary technology |
| • Adapting to new situations |
| • Decision-making |
| • Team work |
| • Working in an interdisciplinary environment |
| • Production of new research ideas |
| • Production of free, creative and inductive thinking |
| • Abstraction ability for problem modeling |

SYLLABUS

**Kinematics:** Direct kinematics, inverse kinematics, differential kinematics, Jacobian matrices, singularities, kinematics of mobile robots.

**Sensors and actuators:** Actuators in Robotics, electronic subsystem, sensors, amplifiers, control system, PID control of a joint, control architecture of a mobile robot.

**Robotic motion planning:** Robot planning and control architecture, path planning, the configuration space, obstacles in work-space, roadmap, artificial potential fields, non-holonomic constraints, motion planning of a robotic fleet.

**Advanced control of robotic systems:** Compliance control, impedance control, non-linear control, visual servoing.

TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures, lab courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>• Use of projector and computer during lectures.</td>
</tr>
<tr>
<td></td>
<td>• Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, exercises, example programs).</td>
</tr>
<tr>
<td></td>
<td>• Use of robots in laboratories.</td>
</tr>
<tr>
<td></td>
<td>• Announcement of assessment marks via the ecourse platform by UOI.</td>
</tr>
<tr>
<td></td>
<td>• Use of email for information exchange and improved communication with students.</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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13*3 = 39 hours</td>
</tr>
<tr>
<td>Labs</td>
<td>13*1 = 13 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>123 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>175 hours</td>
</tr>
</tbody>
</table>

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, etc.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION
(i) Final written examination.
(ii) Project.
The evaluation procedure is accessible to students via the course website.

ATTACHED BIBLIOGRAPHY

-Suggested bibliography in Greek:
- Εμίρης, Δ., Κουλουριώτης, Δ.Ε., Ρομποτική, Εκδόσεις ΣΕΛΚΑ - 4Μ ΕΠΕ, 2006.

-Suggested bibliography in English:

-Related academic journals:
- The International Journal of Robotics Research.
- IEEE Transactions on Robotics.
- IEEE/ASME Transactions on Mechatronics
S0. Introduction to Software Systems

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>POLYTECHNIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE &amp; ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>L0</td>
</tr>
<tr>
<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>Introduction to Software Systems</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>Lectures / Labs/ Exercises</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 / 1 / 0</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

COURSE TYPE

- Specialised general knowledge

PREREQUISITE COURSES:

NO

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL):

http://ecourse.uoi.gr/course/view.php?id=1726

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

The course L0 “Introduction to Software Systems” aims to provide post-graduate students with the necessary background on advanced topics in the area of software 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

Respect for difference and multiculturalism
Adapting to new situations
Decision-making
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
- Decision making
- Search for, analysis and synthesis of information, and use of the necessary technology.
- Team work
- Autonomous work
- Ability to apply research results to the solution of practical problems

SYLLABUS

The course covers the following areas of software systems

- Programming languages
- Software technology
- Virtualization
- Security
- Networking
- Fault tolerance and consistency
- Parallelism

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY

Face-to-face, Distance learning, etc.

Weekly lectures

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Lecture slides, course Web page maintenance (slides and course notes), e-mail communication

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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13x3=39 hours</td>
</tr>
<tr>
<td>Laboratory practice</td>
<td>13x1=13 hours</td>
</tr>
<tr>
<td>Student’s study hours</td>
<td>123 hours</td>
</tr>
</tbody>
</table>

[58]
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.

| Course total | 175 hours |

**STUDENT PERFORMANCE EVALUATION**

*Language of evaluation: Greek*

**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.

**Methods of Evaluation:** Course participation, in-class quizzes, programming exercises

The exact evaluation procedure is announced to students on the course website.

**ATTACHED BIBLIOGRAPHY**

Proposed bibliography:


S2. Data Warehouses

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>POSTGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>S2</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Data Warehouses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Tutorials</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Special background

PREREQUISITE COURSES:

D0, L0

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)

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

After successfully passing this course the students will be able to:

- Know the state-of-the-art and the historical evolution of the area under study
- Understand in depth the fundamental concepts of OLAP and data warehouses
- Understand in depth the critical elements of a data warehouse architecture
- Design and organize the structure of a data warehouse using appropriate data representations both at the logical and physical levels, such that the data can be easily and efficiently retrieved
• Understand, design and implement ETL processes
• Understand the fundamental concepts and be able to design and implement querying, data reporting and analytics environments
• Develop a complete project wherein they apply the design and algorithmic knowledge obtained from the course in order to design and implement a data warehouse

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... |

• Production of free, creative and inductive thinking
• Search for, analysis and synthesis of data and information, with the use of the necessary technology
• Team work
• Algorithmic thinking
• Abstraction ability for problem modeling
• Apply research results in solving practical problems
• Literature studying and management

SYLLABUS
Overview of the area of data warehousing and OLAP.
Revision of fundamental database concepts.
Multidimensional models, hierarchies, data warehouse architectures.
Data warehouse design.
Extract-Transform-Load processes.
OLAP & data analytics.
Large project development in phases.

TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Weekly Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>• Use of projector and interactive board during lectures.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education,</td>
<td></td>
</tr>
</tbody>
</table>
communication with students

- Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
- Announcement of assessment marks via the course web site.
- Use of email and social media for information exchange and improved communication with students.

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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13*3 = 39 hours</td>
</tr>
<tr>
<td>Tutorials</td>
<td>13*1 = 13 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>148 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>200 hours</td>
</tr>
</tbody>
</table>

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.

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION

(i) At each lecture, the students are asked to be prepared on the material of the lecture and to participate in the critical discussions that arise.

(ii) At each lecture, the students are asked to answer to questions and exercises related to the learning outcomes of the previous lecture.

(iii) A large programming assignment (project).

The evaluation procedure is accessible to students via the course website.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:


(Εκδότης): ΕΚΔΟΣΕΙΣ Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε.


- **Related academic journals:**
  - ACM Transactions on Database Systems
  - IEEE Transactions on Knowledge and Data Engineering
  - The VLDB Journal, Springer
  - Information Systems, Elsevier
S4. COMPUTER SYSTEMS SECURITY

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE &amp; ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>S4</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>COMPUTER SYSTEMS SECURITY</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

| Lectures / Labs / Exercises | 4 | 7 |

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Specialised general knowledge

PREREQUISITE COURSES:

NO

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)

http://www.cse.uoi.gr/~stergios/teaching/l4

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

- The course covers traditional and latest research publications on computer systems security. Examined issues include cryptographic techniques, storage and network security, web and mobile security, hardware security, anonymity and privacy, blockchains.

- Participating students are expected to actively contribute to the critical discussions during paper reading sessions.

- Additionally, the students under the guidance of the instructor will work on a project of their choice that will explore interesting research directions.
Overall, the course will help students get familiar with the design, implementation and analysis of modern computer systems security.

**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>Task</th>
<th>General Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data and information, with the use of the necessary technology.</td>
<td>Project planning and management</td>
</tr>
<tr>
<td>Adapting to new situations</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Respect for the natural environment</td>
</tr>
<tr>
<td>Working independently</td>
<td>Showing social, professional and ethical responsibility and sensitivity to gender issues</td>
</tr>
<tr>
<td>Team work</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>.....</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td>.....</td>
</tr>
</tbody>
</table>

**SYLLABUS**

- The course covers topics in the design, implementation and analysis of computer systems security, such as cryptography, authentication, confidentiality, authorization, integrity and security protocols.
- The syllabus is adjusted every year according to the latest publications of the related literature published in international conferences and journals.

**TEACHING and LEARNING METHODS - EVALUATION**

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>Lectures</td>
<td>13x3=39 hours</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory practice</td>
<td>13x1=13 hours</td>
</tr>
<tr>
<td>Student’s study hours</td>
<td>148 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>200 hours</td>
</tr>
</tbody>
</table>

STUDENT PERFORMANCE EVALUATION

Language of evaluation: Greek

Methods of Evaluation:

i. Participation in paper reading sessions
ii. Evaluation of weekly assignments
iii. Project or final written examination

The evaluation procedure is accessible to students via the course website.

ATTACHED BIBLIOGRAPHY

- ACM Conference on Computer and Communications Security
- USENIX Security Symposium
- ACM Symposium on Cloud Computing
- ACM Symposium on Operating Systems Principles
- USENIX Annual Technical Conference
- USENIX Symposium on Operating Systems Design and Implementation
- USENIX Symposium on Network Systems Design and Implementation
- ACM Transactions on Privacy and Security
- IEEE Transactions on Dependable and Secure Computing
S5. Mobile and Wireless Networks

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
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</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
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</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>POSTGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>S5</td>
</tr>
<tr>
<td>SEMESTER</td>
<td></td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Mobile and Wireless Networks</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th></th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Tutorials</td>
<td>3/1</td>
<td>7</td>
</tr>
</tbody>
</table>

COURSE TYPE

general background, special background, specialised general knowledge, skills development

PREREQUISITE COURSES:

-  

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)

http://www.cs.uoi.gr/~epap/L05

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

The course offers an insight into wireless and mobile networking. To this end, the course will analyze the most well-known technologies for wireless and mobile networks as well as the users’ needs met by each technology. The course also focuses on new trends in building wireless and mobile networks. After successfully completing the course, a student should be able to:

- understand the basic challenges in wireless and mobile networking
- understand the basic architectures and networking technologies implemented in real-life wireless mobile networks as well as the users’ needs that each of these technologies meets
- comprehend the basic networking mechanisms and how these mechanisms influence the network’s performance
- be able to evaluate the performance of a network in the context of limited resources that are available in a mobile node
• be able to identify open issues and challenges and propose possible solutions

**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 the natural environment |
| Decision-making | Showing social, professional and ethical responsibility and sensitivity to gender issues |
| Working independently | Criticism and self-criticism |
| Team work | Production of free, creative and inductive thinking |
| Working in an international environment | Others... |
| Working in an interdisciplinary environment | ...... |
| Production of new research ideas | ...... |

**SYLLABUS**

The course focuses on the key enabling technologies for wireless and mobile networks and delineates their fundamental operating principles. In the first part, the course examines the dominant technologies in the field of wide area and metropolitan area infrastructured networks such as LTE and WiMAX. Then, the course focuses on ad hoc networks, such as Mobile Ad Hoc Networks (MANETs) and opportunistic networks, as well as on Delay Tolerant Networking (DTN). Finally, the course discusses key technologies proposed in the context of 5G networks. Summarizing, the following technologies will be examined during the course:

- 4G Networks and LTE
- Wireless Metropolitan Access Networks (WiMAX)
- Mobile Ad Hoc Networks (MANETs) and Opportunistic Networks, Mobile Social Networks
- Delay Tolerant Networks (DTNs)
- Machine-to-Machine Communication (M2M), Internet of Things (IoT) in 5G Networks,
- Software Defined Networking (SDN), Network Slicing

**TEACHING and LEARNING METHODS - EVALUATION**

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Weekly Lectures</th>
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<tbody>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>Use of projector during lectures.</th>
</tr>
</thead>
</table>

[68]
Use of ICT in teaching, laboratory education, communication with students

- Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
- Use of email to improve communication with students.

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.

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</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>$13 \times 3 = 39$ hours</td>
</tr>
<tr>
<td>Tutorials</td>
<td>$13 \times 1 = 13$ hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>123 hours</td>
</tr>
</tbody>
</table>

Course total: 175 hours

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, etc.

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION
(iii) Final exams
(iv) Project

ATTACHED BIBLIOGRAPHY
- Suggested bibliography:
  - Scholarly articles published in the relevant scientific journals

- Relevant scientific journals
  - IEEE/ACM Transactions on Networking
  - IEEE Transactions on Mobile computing
  - IEEE Transactions on Wireless Communications
  - IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS (J-SAC)
  - Elsevier Ad Hoc Networks
S7. Computer Graphics and Game Development

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
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</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>POSTGRADUATE</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>COMPUTER GRAPHICS AND GAME DEVELOPMENT</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>S7</td>
</tr>
<tr>
<td>SEMESTER</td>
<td></td>
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</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures/Laboratory exercises</td>
<td>3/1</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Special background

general background, special background, specialised general knowledge, skills development

PREREQUISITE COURSES:

-

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK/ENGLISH

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)


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

With the successful completion of the course, students will:

acquire all background and foundations for computer graphics and game development,

be able to design and develop 3D graphics software,

be able to design and develop computer games.

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
- Respect for difference and multiculturalism
- Respect for the natural environment
<table>
<thead>
<tr>
<th>Decision-making</th>
<th>Showing social, professional and ethical responsibility and sensitivity to gender issues</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Team work</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>-------</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td>Others...</td>
</tr>
</tbody>
</table>

- Production of free, creative and inductive thinking
- Decision-making
- Criticism and self-criticism
- Project planning and management
- Working in an interdisciplinary environment
- Production of new research ideas
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Team work

SYLLABUS

Computer graphics principles, libraries and development tools for computer graphics, 3D and 2D representations for objects, the rendering pipeline, textures, shadows and illumination, photorealistic and non-photorealistic rendering, techniques for fast computer graphics algorithms, computing intersections in real time graphics, collision detection, animation, computer graphics and game engine, shaders and GPUs, game design, game development, low poly for games, pseudo-photorealism, crowd simulation.

Term project for designing and developing a game.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY

- Face-to-face, Distance learning, etc.
- Weekly Lectures

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

- Project website with online literature, tutorials, manuals and other reading material.
- Use of asynchronous e-learning platform for discussion for a, online turn-in, wiki reporting, etc.
- Use of e-mailing lists and social media for communicating with students.

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
</table>
| 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 | 13*3 = 39 hours |
| | Tutorials | 13*1 = 13 hours |
| | Self-study | 123 hours |
| | Course total | 175 hours |

STUDENT PERFORMANCE EVALUATION

| LANGUAGE OF EVALUATION: Greek/English |
| METHODS OF EVALUATION |
| (v) 2-3 homeworks |
| (vi) Term Project |

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - J. Schell, The Art of Game Design - A Book of Lenses. Elsevier/Morgan Kaufmann,
2008.


- Scientific Journals and Magazines:
  - ACM Transactions on Computer Graphics
  - IEEE Transactions on Visualization and Computer Graphics
  - Visual Computer
  - Computer Graphics Forum
  - The Computer Games Journal
  - 3D Research
S8. High Performance Systems and Software

COURSE OUTLINE

GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
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</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>S8</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>&gt;= 1</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>High Performance Systems and Software</td>
</tr>
</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>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Labs</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

COURSE TYPE

Special background

general background, special background, specialised general knowledge, skills development

PREREQUISITE COURSES:

- |

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)

- |

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

High performance systems are nowadays synonymous to parallel computers, i.e. computing systems with multiple processors or cores which can work concurrently towards the solution of a problem. This course teaches the organization, the operation and the programming of parallel computers. The basic architectural choices are presented, along with the corresponding problems one has to solve during their design and implementation. In addition, parallel programming is introduced, which is necessary for the full exploitation of these systems. Parallel programming is taught through the use of contemporary programming models. Finally, the course includes a survey of recent research problems and publications related to high performance systems.
After successfully concluding this course the students will be able to:

- Study, understand and analyze the organization of high performance system.
- Understand the problems of memory hierarchy, cache coherency and memory consistency, and select the most suitable solutions.
- Understand and analyze the topology, the switching scheme and the routing protocols in processor interconnection networks.
- Synthesize parallel software.
- Program in the shared address space model using threads and OpenMP
- Program in the message passing model using MPI.
- Use the international bibliography for related research problems and results.

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
- Adapting to new situations
- Decision-making
- 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
- Project planning and management
- Respect for difference and multiculturalism
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Respect for the natural environment
- Respect for the natural environment

SYLLABUS

- History and importance of high performance systems
- Basic principles of parallelism at the hardware and software levels, and fundamental performance laws
- Shared memory organization and multicore architectures.
- The problems of cache coherency and memory consistency
- Distributed memory organization and computational clusters.
- Interconnection networks, topologies, routing, high-performance switching
- Distributed shared memory and non-uniform memory access (NUMA)
- SIMD and GPU organizations
- Principles and languages for parallel programming
- Programming in the shared address space model (threads, OpenMP)
- Programming in the message passing model (MPI)

TEACHING and LEARNING METHODS - EVALUATION
DELIVERY
Face-to-face class lectures

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
- Use of projector electronic slides.
- Use of computers for the Lab exercises.
- Course website maintenance with announcements and posting of teaching material (lecture slides and notes).
- Use of email for communicating with students.

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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>$13 \times 3 = 39$ hours</td>
</tr>
<tr>
<td>Labs</td>
<td>$13 \times 1 = 13$ hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>123 hours</td>
</tr>
<tr>
<td><strong>Course total</strong></td>
<td><strong>175 hours</strong></td>
</tr>
</tbody>
</table>

STUDENT PERFORMANCE EVALUATION
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, etc.

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION

(i) Homework problems and exercises
(ii) Programming assignments
(iii) Reading assignments and topic
(iv) Term project

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - P.S. Pacheco, *Εισαγωγή στον παράλληλο προγραμματισμό*, Κλειδάριθμος 2015
- Research publications from conferences and periodicals

- Related academic journals:
  - Transactions on Parallel and Distributed Systems, IEEE.
  - Concurrency and Computation: Practice and Experience, Wiley.
  - Parallel Computing, Elsevier
  - Journal of Supercomputing, Springer
  - ACM Transactions on Parallel Computing