Department of Computer Science and Engineering
University of Ioannina

Undergraduate Programme:
Outlines of Elective Courses

ACADEMIC YEAR 2015-16
## Undergraduate Programme: Elective Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MYE001</td>
<td>Human Computer Interaction</td>
<td>3</td>
</tr>
<tr>
<td>MYE002</td>
<td>Pattern Recognition</td>
<td>7</td>
</tr>
<tr>
<td>MYE003</td>
<td>Information Retrieval</td>
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</tr>
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<td>14</td>
</tr>
<tr>
<td>MYE005</td>
<td>Computer Architecture II</td>
<td>17</td>
</tr>
<tr>
<td>MYE006</td>
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<td>20</td>
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<td>MYE008</td>
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<td>MYE009</td>
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<tr>
<td>MYE011</td>
<td>Evolutionary Computation</td>
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</tr>
<tr>
<td>MYE012</td>
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<td>MYE014</td>
<td>Graph Theory</td>
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<td>MYE017</td>
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<td>MYE023</td>
<td>Parallel Systems and Programming</td>
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<td>MYE030</td>
<td>Advanced Topics of Database Technology and Applications</td>
<td>48</td>
</tr>
<tr>
<td>MYE031</td>
<td>Robotics</td>
<td>52</td>
</tr>
<tr>
<td>MYE035</td>
<td>Computational Intelligence</td>
<td>55</td>
</tr>
<tr>
<td>MYE036</td>
<td>Computability and Complexity</td>
<td>58</td>
</tr>
<tr>
<td>MYE039</td>
<td>Digital Design II</td>
<td>61</td>
</tr>
<tr>
<td>MYE041</td>
<td>Complex Data Management</td>
<td>64</td>
</tr>
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</table>
COURSE OUTLINE

(1) 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>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΜΥΕ001</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>≥5</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Human Computer Interaction</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 / Labs / Tutorials | 3/2/0 | 5 |

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)
- http://ecourse.uoi.gr/course/view.php?id=64

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A
- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

Learning principles, guidelines, rules and practices for developing interactive software. Awareness of IDEs, technologies, tools and libraries for GUI development. Training software engineers to develop user centered systems.

After successfully passing this course the students will be able to:
- Knowhow and skills for designing and developing interactive software.
- Understand the basic principles of Human Computer Interaction.
- Comprehend the principles, rules and practices for software usability.
- Learn how to measure software usability.
- Become acquainted with principles and methods for designing interactive software systems of high usability.
- Learn how to evaluate interactive software systems.
• Learn about the software implementation architectures for User Interface development.
• Acquire knowledge regarding the various tools, IDE, libraries that are available for developing UI.
• Understand the principles of interactivity in virtual reality.

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

Others...

• Production of free, creative and inductive thinking
• Team work
• Search for, analysis and synthesis of data and information, with the use of the necessary technology
• Analysis of requirements for problem solving
• Working independently
• Ability to design, develop and evaluate user centered software systems.

(3) SYLLABUS

• Introduction. Issues and examples.
• Defining and measuring usability.
• Learnability.
• Theories, principles and guidelines.
• Interaction styles.
• Specifying the interaction protocol.
• Design considerations.
• Development and assessment.
• Error recovery.
• Adaptive systems. Prototyping.
• Alternative interaction methods and virtual reality.
• GUI development tools. Libraries and tools for building GUIs: IDE, visual editors, GUI libraries, web GUI development frameworks, prototyping tools, 3D GUIs. Term project.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures, lab courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of projector and interactive board during lectures.</td>
</tr>
</tbody>
</table>

Face-to-face, Distance learning, etc.
communication with students

- 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 forums for information exchange and improved communication with students.
- Use of asynchronous platform for distance learning (moodle)

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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<th>Activity</th>
<th>Semester workload</th>
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<td>Lectures</td>
<td>13*3 = 39 hours</td>
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<td>Labs</td>
<td>13*2 = 26 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>60 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>125 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 examination, which includes questions for applying principles, theory and foundations to solve graphics problems. The exam papers are evaluated based on the correctness and completeness of answers.

(ii) One term take-home programming assignment: To design, develop and evaluate the interactive part (front end) of an interactive software system.

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  

  **Book [12172]**: Ν. Αβούρης. Εισαγωγή στην επικοινωνία ανθρώπου–υπολογιστή. Εκδόσεις Δίαυλος. 1η έκδοση.


**Book:** Y. Rogers, H. Sharp, J. Preece. Σχεδίαση Διαδραστικότητας: Επεκτεινοντας την Αλληλεπίδραση Ανθρώπου - Υπολογιστή.

- **Related academic journals:**
  - Communications of the ACM, ACM
  - IEEE Computer, IEEE
  - ACM Transactions of Human Computer Interaction, ACM
COURSE OUTLINE

(1) GENERAL

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<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<tr>
<td>COURSE CODE</td>
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</tr>
<tr>
<td>SEMESTER</td>
<td>&gt;=5</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Pattern Recognition</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>5</td>
<td>5</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

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)

http://www.cs.uoi.gr/~kblekas/courses/PR/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

This course aims to expose the students to pattern recognition problems and applications and also to methodologies and tools for analyzing patterns and solve them. Basic notions of statistical pattern analysis, Bayesian analysis and inference methods, decision theory, neural networks and discriminant analysis are introduced. At the end of this course, students will be able to analyze complex data, to model simple and complex pattern recognition problems, to establish a parametric learning mechanism and to construct a decision support system. Also, they will display knowledge and understanding of the mathematical theory underlying the main classes of constrained (mainly) optimisation problems and the practical contexts in which such problems may arise.

Students develop methods and techniques for pattern recognition in the laboratory using (mainly) the Matlab programming environment. The objective is to design and understand basic and advanced methods for data processing and analysis such as:

- Clustering: discovering and constructing groups of data
• Classification: building decision support systems,
• Regression: constructing function approximation approaches, and
• Dimension reduction: transformation methods for data and selecting most important features.

Another direction is to discover the possibilities of all these methods as tools for data handling and knowledge extraction. For this purpose students either develop their own routines, or apply ready routines from Matlab.

**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>Decision-making</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>Working independently</td>
<td>Respect for the natural environment</td>
</tr>
<tr>
<td>Team work</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>

After successfully completing this course, the student is able to:

• Recognize pattern recognition problems and select algorithms and methodologies to solve them,
• Learn some of the traditional as well as the more recent tools for classification, clustering and regression problems,
• Construct a learning system to solve a given simple pattern recognition problem, using algorithms, tools and existing software,
• Read and comprehend recent articles in computer science and engineering-oriented pattern recognition journals, such as Pattern Recognition, IEEE Transactions on Pattern Analysis & Machine Intelligence and Transactions on Neural Networks and Learning Systems,
• Get hands-on experience in using some of these techniques, through the homework assignments.

(3) **SYLLABUS**

**Introductory concepts.** Bayes Decision theory, Bayes error, the normal density, discriminant functions for the normal density.

**Non-parametric density estimation:** Parzen-windows and k-nearest neighbors.

**Parametric density estimation:** Unbiased estimator, likelihood function, maximum likelihood estimation, application on the general multivariate case, maximum a-posteriori estimation. Mixture models.


**Regression:** linear regression and kernel-based regression models.

**Unsupervised learning:** clustering and applications, k-means algorithm and its extensions,
Hierarchical (or tree-based) clustering, Spectral clustering.

Dimension Reduction: Curse of dimensionality, Feature Extraction:
Principal Component Analysis (PCA), Independent Component Analysis (ICA) and Linear Discriminant Analysis (LDA). Feature selection methods.

(4) TEACHING and LEARNING METHODS - EVALUATION

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<tbody>
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<td>Use of projector during lectures.</td>
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<tr>
<td></td>
<td>Use of computer for demos</td>
</tr>
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<td>Course website maintenance: announcements, assignments and posting of teaching material (lecture slides, notes, work papers, demos, etc.).</td>
</tr>
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<td></td>
<td>Use of email for information exchange and improved communication with students.</td>
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</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>Lectures</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>Lectures</th>
</tr>
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<tbody>
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<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>
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<td>Self-study</td>
<td>60 hours</td>
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</tbody>
</table>

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 | 125 hours |

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</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, etc.</td>
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<tr>
<th>LANGUAGE OF EVALUATION: Greek</th>
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<tbody>
<tr>
<td>METHODS OF EVALUATION</td>
</tr>
<tr>
<td>(i) Final examination</td>
</tr>
<tr>
<td>(ii) Take-home assignments. The assignments are marked based on their correctness and completeness. The evaluation procedure is accessible to students via the course website.</td>
</tr>
<tr>
<td>(iii) Programming assignments on studying pattern recognition methods in real-life applications and applications related to scientific data analysis. The evaluation procedure is accessible to students via the course website.</td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Scientific International Journals:
  - Pattern Recognition, ELSEVIER.
  - Machine Learning, Springer
- Journal of Machine Learning Research
- IEEE Transactions on Neural Networks and Learning Systems
- IEEE Transactions on Pattern Analysis & Machine Intelligence (PAMI)
COURSE OUTLINE

(1) GENERAL

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<tr>
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<td>UNDERGRADUATE</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
<td>&gt;=5</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Information Retrieval</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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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)

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A
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- Guidelines for writing Learning Outcomes

This course aims at introducing the basic principles, structures, algorithm and applications of information retrieval from document collections and the web.

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

- Apply appropriate pre-processing steps (including stop word removal, stemming, lemmatization, etc.) to construct indexes for information retrieval
- Build and use appropriate data structures (dictionaries, inverted indexes, etc) for efficient information retrieval from document collections
- Apply compression techniques
- Evaluate the results of information retrieval tasks using appropriate metrics such as relevance and precision.
- Combine various criteria for raking search results
- Use link analysis to improve the quality of results
- Understand how search engines work
Design and implement information retrieval systems using appropriate tools

**General Competences**

Taking into consideration the general competences that the degree-holders 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
- Others...

**SYLLABUS**

**Introduction to Information Retrieval**: basic concepts and applications, types of information retrieval systems, the Boolean model.

**Pre-processing and natural language processing**: document delineation, stemming, lemmatization, tokenization, stop-word removal

**Search queries**: phrase queries, proximity queries, tolerant retrieval, phonetic corrections, edit distance, k-gram indexes

**Information retrieval models**: the vector model, term frequency (tf), inverted document frequency (idf), the probabilistic model

**Data structures**: dictionary, inverted index, posting lists, Zipf’s law, Heap’s law, zone indexes

**Compression**: lossy and lossless compression, variable byte codes

**Evaluation**: relevance, precision, recall, precision/recall curve, mean average precision, discounted cumulative gain, kappa statistics

**Implementation issues**: term-at-a-time, document-at-a-time retrieval, parallel retrieval, result summarization, the Lucene system.

**Search Engines**: link analysis, PageRank, HITS, advertisements

**TEACHING and LEARNING METHODS - EVALUATION**

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Weekly lectures, lab sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of information and communications technology</td>
<td>Use of online material and interactive board in lectures.</td>
</tr>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td>Building information retrieval systems using</td>
</tr>
</tbody>
</table>
appropriate tools (e.g., Lucene)
- Course web site, announcement and posting of teaching material (lecture slides, notes, SQL programs)
- Announcement of grades via the UOI ecourse platform
- 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

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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 exam which includes short-answer questions, and problem solving
(ii) Design and implementation of an information retrieval system using appropriate tools. Students are evaluated for the correctness and functionality of their system.
(iii) Written assignments. Students are evaluated based on the correctness and completeness of their answers.

The detailed evaluation procedure is accessible to students at the course website.

(5) **ATTACHED BIBLIOGRAPHY**

- Suggested bibliography:
  Βιβλίο [12532681]: Εισαγωγή στην Ανάκτηση, Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, Κλειδάριθμος 2012
  Βιβλίο [41954965]: Ανάκτηση Πληροφορίας, 2η Έκδοση, Baeza-Yates Ricardo, Ribeiro-Neto Berthier, Εκδόσεις Τζιόλα, 2014

- Related academic journals:
  - IEEE Transactions on Knowledge and Data Engineering (TKDE)
  - Information Retrieval, Springer
(1) GENERAL

SCHOOL: SCHOOL OF SCIENCES
ACADEMIC UNIT: DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
LEVEL OF STUDIES: UNDERGRADUATE
COURSE CODE: MYE004
SEMESTER: >=5
COURSE TITLE: Software Development II

INDEPENDENT TEACHING ACTIVITIES
Lectures, laboratory exercises

WEEKLY TEACHING HOURS CREDITS
5 5

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: GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS: YES
COURSE WEBSITE (URL): http://www.cs.uoi.gr/~zarras/soft_devII.htm

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A
• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
• Guidelines for writing Learning Outcomes

The main objective of this course is the study and application of best practices, patterns and refactoring techniques that allow to avoid issues of poor software design/implementation.

The main outcomes of the course is that the students will be capable to:
• Identify issues of poor software design/implementation.
• Improve the quality of software that suffers from issues of poor software design/implementation by applying refactoring techniques.

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

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
Working in an interdisciplinary environment
Production of new research ideas

- Search for, analysis, and synthesize of data and information, with the use of the necessary technology.
- Decision making.
- Team work.
- Project planning and management.
- Ability to abstract and model problems.

(3) SYLLABUS

This course focuses on issues related to the development of clean software. More specifically, the course consists of the following parts.

**Fundamental principles, conventions, standards, and best practices for the development of clean code:** Basic concepts, naming (conventions, standards and best practices for naming selection), comments (types of good/bad comments, conventions, standards and best practices for writing comments), formatting (properties of horizontal formatting, properties of vertical, code density, code transparency, formatting conventions, standards and best practices), source code organization (properties of clean functions, properties of clean classes, conventions, standards and best practices for the implementation of clean code), principles of object-oriented design (dependency inversion, open close principle, single responsibility principle, interface segregation, etc.), error handling issues.

**Software refactoring:** Basic concepts, design and code smells, refactoring techniques for the composition of methods, refactoring techniques for the simplification of conditional logic, refactoring techniques to improve responsibility assignment, refactoring techniques for generalization/specialization, advanced refactoring techniques, refactoring to patterns.

The course also comprises a project that aims at the development of a large software system in groups of 2-3 students. The project consists of two phases. The goal of the 1st phase is the development of an initial version of the software system, while the goal of the 2nd phase is to refactor the outcome of the 1st phase. The objective of the project is to train the students in the use of integrated development environments and refactoring.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Weekly lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of transparencies and interactive white board.</td>
</tr>
<tr>
<td></td>
<td>Maintenance of a web page dedicated to the course that provides announcements, reading material, grades, etc.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>Activity</td>
</tr>
<tr>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td></td>
<td>Laboratory practice</td>
</tr>
<tr>
<td></td>
<td>Study hours</td>
</tr>
</tbody>
</table>
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>STUDENT PERFORMANCE EVALUATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
<td></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>LANGUAGE: Greek</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD:</td>
<td></td>
</tr>
</tbody>
</table>

1. Final written exam with questions, problems and practical exercises.
2. Oral examination and evaluation of the different phases of the project (requirements analysis, design, implementation & testing).

Information about the specific evaluation process is provided in the course’s web page.

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**
  - **Book [13600]:** OO Design: UML, principles, patterns and rules, A. Xatzigeorgiou.

- **Related academic journals:**
  - IEEE Transaction on Software Engineering
  - ACM Transaction on Software Engineering and Methodology
  - Information and Software Technology
  - Information Systems
  - Journal of Systems and Software
  - IEEE Software
(1) 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>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>MYE005</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>&gt;=5</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Computer Architecture II</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 / Tutorials</td>
<td>3</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

Special background

PREREQUISITE COURSES:

- 

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)

http://www.cs.uoi.gr/~ple074

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The primary aim of the course is to convey an understanding high-performance architecture of processor 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 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
- 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
- ..... Others...
- Production of free, creative and inductive thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary techniques
- Algorithmic thinking
- Use abstraction to understand and analyze complex systems/problems
- Working independently
- Adapting to new situations
- Communicate information, ideas, problems and solutions to experts in the field

(3) 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.

(4) 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></td>
</tr>
</tbody>
</table>

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

- Course website maintenance. Announcements and posting of teaching material (lecture slides and notes).
- Use of projector and interactive board during lectures.
- Announcement of assessment marks via the ecourse platform by UOI.

<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,</td>
<td>Lectures</td>
<td>13*3 = 39 hours</td>
</tr>
<tr>
<td></td>
<td>Labs</td>
<td>2*12 = 24 hours</td>
</tr>
<tr>
<td></td>
<td>Self-study</td>
<td>62 hours</td>
</tr>
<tr>
<td>Tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</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>
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<tr>
<td><strong>Course total</strong></td>
<td>150 hours</td>
<td></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**

(i) Final examination, which includes argument development questions and problem solving.

(ii) Programming exercises on the development and use of simple simulators. The exercises are evaluated based on correctness and completeness.

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

---

**ATTACHED BIBLIOGRAPHY**

- **Suggested bibliography:**
  
  **Book [18548925]:** Hennessy John L., Patterson David A., Αρχιτεκτονική Υπολογιστών.

  **Book [22713808]:** Νικολάς: Αρχιτεκτονική Υπολογιστών.

- **Related academic journals:**
  
  - Transactions on Architecture and Code Optimization, Transactions on Computer Systems, ACM.
COURSE OUTLINE

(1) 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>UNDERGRADUATE</td>
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<tr>
<td>COURSE CODE</td>
<td>MYE006</td>
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<tr>
<td>SEMESTER</td>
<td>&gt;=5</td>
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<tr>
<td>COURSE TITLE</td>
<td>Wireless Networks</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>5</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)

http://www.cse.uoi.gr/~epap/asurmata

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The course provides an introduction to wireless networks and their applications. It first discusses the fundamental properties of wireless transmission in order to illustrate the need for specialized networking protocols and technologies. A wide range of wireless networks, extending from wireless local area networks to cellular systems, are presented and analyzed in order to: a) provide theoretical as well as practical information on of state-of-the-art wireless technologies, b) analyze the differences compared to traditional wired networking, and c) explain the challenges in building a wireless network.

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

- understand the communication paradigms that necessitate the use of wireless networks.
- understand the challenges and the limitations in designing wireless networks imposed by wireless transmission and user mobility.
- explain how wireless networking protocols are different from wired ones.
• be able to identify the most significant types of wireless networks and the corresponding networking principles.
• understand and be able to describe how most well-known wireless networking protocols work.
• choose the optimal parameter setting for a wireless network in order to achieve the desired performance.
• choose and combine known wireless networking concepts for creating a network that meets specific performance requirements.
• understand new trends and the challenges in wireless networking.

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
- 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
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures, lab courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</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></td>
</tr>
<tr>
<td></td>
<td>Use of computers and networking facilities in</td>
</tr>
</tbody>
</table>
laboratories.
• Course website maintenance. Announcements and posting of teaching material (lecture slides, programs).
• Announcement of assessment marks via the course webpage.
• Use of email and social media for information exchange and improved communication with 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. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td>
<td>Lectures</td>
<td>13*3 = 39 hours</td>
</tr>
<tr>
<td></td>
<td>Labs</td>
<td>13*2 = 26 hours</td>
</tr>
<tr>
<td></td>
<td>Self-study</td>
<td>60 hours</td>
</tr>
<tr>
<td></td>
<td>Course total</td>
<td>125 hours</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
<th>LANGUAGE OF EVALUATION: Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
<td>METHODS OF EVALUATION</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, etc. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>(i) Final examination, which includes questions and problem solving. (ii) Optional project.</td>
</tr>
<tr>
<td></td>
<td>The evaluation procedure is accessible to students via the course website.</td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  Book [18548700]: Ασύρματες επικοινωνίες και δίκτυα, Stallings William
  Book [13615]: ΑΣΥΡΜΑΤΑ ΔΙΚΤΥΑ, P. NICOPOLITIDIS, M. S. OBAIDAT, G. I. PAPADIMITRIOU, A. S. POMPORTISIS

- Related academic journals:
  • IEEE Transactions on Wireless Communications, IEEE.
  • IEEE Wireless Communications, IEEE.
  • IEEE Transactions on Mobile Computing, IEEE.
  • Wireless Networks: The Journal of Mobile Communication, Computation and Information, Springer
  • Ad Hoc Networks, ELSEVIER.
  • IEEE Transactions on Networking (TON), IEEE.
  • IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS (J-SAC), IEEE.
  • Computer Networks: The International Journal of Computer and Telecommunications Networking, ELSEVIER.
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCES</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>UNDERGRADUATE</td>
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<tr>
<td>COURSE CODE</td>
<td>MYE008</td>
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<td>SEMESTER</td>
<td>&gt;=5</td>
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<tr>
<td>PLE030</td>
<td></td>
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</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 / 0 / 2</td>
<td></td>
<td>5</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

- Specialized general knowledge

### PREREQUISITE COURSES:

- 

### LANGUAGE OF INSTRUCTION and EXAMINATIONS:

- GREEK

### IS THE COURSE OFFERED TO ERASMUS STUDENTS:

- YES

### COURSE WEBSITE (URL)


### (2) LEARNING OUTCOMES

**Learning outcomes**

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

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, the minima of which may correspond to desired solutions.

In this course, we study Optimization algorithms that exploit the mathematical characteristics of the objective function (continuity, differentiability) for the detection of a local minimum. Such algorithms are the Steepest Descent, Newton and modified Newton, Quasi-Newton, Conjugate Gradient, etc., which employ first- and second-order derivatives. Also, Line Search and Trust Region, techniques are presented. Moreover, Direct Search methods that do not use derivatives, such as Pattern Search, Nonlinear irregular Simplex and Multi-Directional Search, are considered.

After successful completion of this course, students are expected to be able to:
• Implement and apply 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>Showing social, professional and ethical responsibility and sensitivity to gender issues</td>
</tr>
<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>
</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 modeling problems.

(3) SYLLABUS

**Introduction to Optimization**

Optimality conditions
One-dimensional optimization
Direct Methods: Simplex, Hook & Jeeves, Multidirectional search
Gradient based methods: Newton and modifications, Quasi-Newton, Conjugate Gradients.
The line-search and the trust-region approaches.

(4) TEACHING and LEARNING METHODS - EVALUATION

**DELIVERY**

Face-to-face, Distance learning, etc.

**USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**

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

**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*2 = 26 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>60 hours</td>
</tr>
<tr>
<td><strong>Course total</strong></td>
<td><strong>125 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:** Final written exams or submission of written work.

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

---

### (5) ATTACHED BIBLIOGRAPHY

**Suggested bibliography:**


**Related academic journals:**

- Optimization Letters, SPRINGER.
- Journal of Optimization Theory and Applications, SPRINGER.
- SIAM Journal on Optimization, SIAM.
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td></td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>MYE009</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>≥ 5</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Linear Programming</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

- Lectures / Labs / Tutorials
  - WEEKLY TEACHING HOURS: 4
  - CREDITS: 6

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

COURSE TYPE

- specialized general knowledge and skills development

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/~kontog/courses/LinProg/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

This course is an introduction to linear programming (a.k.a. linear optimization), dealing with the efficient computation of optimal solutions to problems which are described as a set of linear constraints, along with a linear objective function that is to be optimized. Linear programming is one of the most significant mechanisms for modeling a vast collection of problems, with modest effort. The popularity of linear programming lies primarily with the formulation phase of analysis, rather than the solution phase, which nevertheless is also important. The framework has applications in almost all Sciences (e.g., operations research, business administration, economics, applied mathematics, etc.). In this course we deal also with some classical applications of linear programming, such as network-flow optimization problems and zero-sum strategic 2-player games, both as a solving tool and as a proof technique of properties of optimal solutions.

The learning objectives of this course are:

(i) Comprehension of basic concepts related to linear programming.
(ii) Familiarity with modeling combinatorial problems as integer /
mixed / continuous linear programs. (iii) Study and application of the most elementary solving methods for linear programs. (iv) Comprehension of the capabilities of LP, when used as a machinery for constructing efficient (exact or approximate) solutions to combinatorial problems. (v) Ability to exploit duality of linear programs and extract properties of optimal solutions from complementary slackness conditions.

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

1. To model combinatorial optimization problems as integer/mixed/continuous linear programs.
2. To solve simple instances of LPs with Simplex.
3. To exploit existing LP solvers as subroutines for solving more complex problems.
4. To use the complementary slackness conditions as optimality certificates.
5. To exploit duality of linear programs in order to prove properties of optimal solution pairs.
6. To solve integer linear programs using the B&B method.

**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?

- 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
- 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
- Others...
- Others...

(3) SYLLABUS

**Modeling of combinatorial problems as linear programs:** Μοντελοποίηση προβλημάτων ως γραμμικά προγράμματα: Types of linear programs, and their equivalence. Modeling examples of combinatorial problems as linear programs.

**Geometry of solution space of an LP:** Affine spaces, subspaces, hyperplanes, polyhedra and polytopes, linear independence, basis of solution space, vertices and basic feasible solutions. Carathéodory’s theorem.


**Duality theory:** Dual of a linear program, complementary slackness, Farkas lemma. Sensitivity analysis of LPs.

**Integer linear programming:** Minimum batch size problem, linear programs with either-or constraints, facility-location problem. Branch and bound (B&B) algorithm. Cutting planes (CP) algorithm.
**Interior point algorithms for LP:** Interior point method of Karmakar. Primal-dual interior point method.

**Applications of Linear Programming:** Zero-sum bimatrix games. Network-flow optimization problems (max-flow, min-cost flow, shortest-paths computation, etc.).

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>Weekly lectures and tutorials, in class.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td>Transparencies, projector and interactive boards in lectures.</td>
</tr>
<tr>
<td></td>
<td>Use of MATLAB software for the programming assignments of the course.</td>
</tr>
<tr>
<td></td>
<td>Maintenance of course site with Calendar, Announcement, and provision of supplementary course material.</td>
</tr>
<tr>
<td></td>
<td>Announcement of grades via the e-course platform of UOI.</td>
</tr>
<tr>
<td></td>
<td>Use of email and social-media channels for direct communication with the students.</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. 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>Activity</td>
</tr>
<tr>
<td></td>
<td>Weekly Lectures</td>
</tr>
<tr>
<td></td>
<td>Weekly Tutorials</td>
</tr>
<tr>
<td></td>
<td>Lab assignments</td>
</tr>
<tr>
<td></td>
<td>Home Study</td>
</tr>
<tr>
<td></td>
<td>Course total</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>ASSESSMENT LANGUAGE: Greek</td>
</tr>
<tr>
<td></td>
<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>
</tr>
<tr>
<td></td>
<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The evaluation procedure is accessible to students via the course website.</td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**


**Related academic journals:**
- Mathematical Programming Journal, Series A and Series B
- SIAM Journal on Optimization (SIOPT)
(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCES</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>UNDERGRADUATE</td>
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<tr>
<td>COURSE CODE</td>
<td>MYE011 PLE072</td>
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<td>SEMESTER</td>
<td>&gt;= 5</td>
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<td>COURSE TITLE</td>
<td>EVOLUTIONARY COMPUTATION</td>
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</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 / 0 / 2</td>
<td>5</td>
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Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

<table>
<thead>
<tr>
<th>Specialized general knowledge</th>
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PREREQUISITE COURSES:

<table>
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<th>NO</th>
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</thead>
</table>

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

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

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

COURSE WEBSITE (URL)

| http://www.cse.uoi.gr/~kostasp/courses/Evolutionary_Computation.html |

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The course presents modern Computational Optimization methods from the fields of Evolutionary Computation and Swarm Intelligence. Typically, these methods are based on models of optimization procedures in natural systems, using mathematical tools such as Probability Theory and Dynamical Systems. Nevertheless, there are no prerequisite mathematical conditions for their application.

This property renders these algorithms suitable for solving problems where analytical models and desirable mathematical characteristics (continuity, differentiability) are absent or problems where the model is contaminated by noise and / or incomplete information. Also, their inherent parallelization properties make these algorithms suitable for computationally demanding problems.

During the course, the basic principles of algorithms such as Genetic Algorithms,
Evolutionary Algorithms, Particle Swarm Optimization, Differential Evolution, and Ant Colony Optimization are presented. Also, applications are discussed with an emphasis on Global Optimization problems from various scientific and technological fields, such as Operations Research, Astrophysics, Engineering etc.

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

- Design and implement evolutionary algorithms.
- Determine the most appropriate algorithm for a given problem.
- Exploit specific characteristics of the problem (mixed variables, multiple local / global minimizers).
- Design variants of the algorithms for serial and parallel computing environments.

**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.
- Decision-making.
- Search for, analysis and synthesis of data and information.
- Development of algorithmic thinking.
- Ability of analyzing and modeling problems.

**SYLLABUS**

**Introduction:** Introduction to Optimization. Basic definitions. Types of problems and algorithms.


**Techniques for Efficient Problem Solving:** Penalty functions for solving constrained optimization problems. Filled functions for alleviating local minimizers. Deflection and Stretching techniques. Examples and applications.

**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 | |
| |
| • Course webpage where literature and free material is provided. |
| • Live simulations in the classroom. |
• Use of the asynchronous tele-education services of University of Ioannina.
• 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

<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*2 = 26 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>60 hours</td>
</tr>
</tbody>
</table>

Course total 125 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

METHODS OF EVALUATION: Final written examination based on full essay questions.

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  **Βιβλίο [12278503]:** Μεθευρετικοί και Εξελικτικοί Αλγόριθμοι Σε Προβλήματα Διοικητικής Επιστήμης, Ι. Μαρινάκης, Μ. Μαρινάκη, Ν.Φ. Ματσατσίνης, Κ. Ζοπουνίδης, Εκδόσεις Κλειδάριθμος, 2011.

- Related academic journals:
  - IEEE Transactions on Evolutionary Computation, IEEE.
  - Evolutionary Computation, MIT PRESS.
  - Swarm Intelligence, SPRINGER.
  - Applied Soft Computing, ELSEVIER.
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCE</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<td>COURSE CODE</td>
<td>MYE012</td>
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<tr>
<td>SEMESTER</td>
<td>&gt;=5</td>
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<tr>
<td>COURSE TITLE</td>
<td>Data Mining</td>
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INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>Activity</th>
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</thead>
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<tr>
<td>Lectures / Labs / Tutorials</td>
<td>5</td>
<td>5</td>
</tr>
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</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

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

- YES

COURSE WEBSITE (URL):

http://www.cs.uoi.gr/~tsap/teaching/cse012

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

Data mining refers to the extraction of knowledge from large quantities of data. This course aims at introducing the students to basic and advanced concepts, algorithms and tools of Data Mining, and give them hands on experience with the analysis of real data using state-of-the-art tools.

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

- Understand the main concepts and problems involved in Data Mining.
- Understand algorithmic data mining techniques and utilize them to design algorithms for solving practical problems.
- Understand the theoretical underpinnings and the mathematics behind the Data Mining techniques, and utilize them to analyze the theoretical properties of data mining algorithms.
- Utilize state-of-the-art data mining tools for implementing data mining
algorithms.
- Deal with the requirements and challenges of analyzing large amounts of real data.
- Solve new data mining problems using the algorithms, theory and existing tools.
- Design and develop a data mining pipeline for large data analysis.
- Think about new problems and solutions in data mining.

### 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
- Adapting to new situations
- Analysis of requirements for problem solving
- Algorithmic thinking
- Abstraction ability for problem modeling
- Working independently
- Team work

### (3) SYLLABUS

**Introduction to Data Mining:** What is Data Mining? Why is it important? The Data Mining Pipeline

**Frequent Itemsets and Association Rules:** Algorithms, Theory, Evaluation.

**Similarity and Distance:** Definitions of Similarity and Distance. Recommendation Systems. Min-Hashing Sketches and Locality Sensitive Hashing.

**Dimensionality Reduction:** Singular Value Decomposition. Principal Component Analysis.


**Minimum Description Length Principle:** Introduction to Information Theory. Use of MDL for co-clustering.

**Classification:** Decision Trees, Logistic Regression, SVM Classifiers. Naive Bayes Classifier. Evaluation.

**Link Analysis Ranking:** PageRank and HITS. Random Walks. Absorbing Random Walks.

**Coverage:** The Minimum Set Cover and Maximum Coverage Problems and their applications. Approximation Algorithms.

**Data Mining With Python:** Iron Python, Pandas, the Sci-Kit library.

**Specialized topics:** The Map-Reduce Programming Paradigm.
(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures, lab courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Lectures, use of projector and board during lectures. Use of computer for demonstration of python scripts. Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, data and code). Use of email direct communication with students. Use of open source code and data for assignments.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13*5= 39 hours</td>
<td></td>
</tr>
<tr>
<td>Tutorials</td>
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<td></td>
</tr>
<tr>
<td>Self-study</td>
<td>60 hours</td>
<td></td>
</tr>
<tr>
<td>Course total</td>
<td>125 hours</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
<th>LANGUAGE OF EVALUATION: Greek (slides in English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHODS OF EVALUATION</td>
<td>METHODS OF EVALUATION</td>
</tr>
<tr>
<td>Take-home assignments that include theoretical questions, algorithm design, implementation of algorithms, and application of existing tools in data analysis. The assignments are marked based on their correctness and completeness. The evaluation procedure is accessible to students via the course website.</td>
<td></td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  Book [22768468]: Mining Massive Datasets, Anand Rajaraman, Jeffrey David Ullman
  Book [395]: DATA MINING, Margaret H. Dunham
  Book [18549105]: Introduction to Data Mining, Tan Pang - Ning, Steinbach Michael, Kumar Vipin
  Book [31391]: Εξόρυξη γνώσης από βάσεις δεδομένων και τον παγκόσμιο ιστό, Βαζιργιάννης Μιχάλης, Χαλκίδη Μαρία

- Related academic journals:
  - ACM Transactions on Knowledge Discovery from Data (TKDD).
  - ACM Transactions on Knowledge and Data Engineering (TKDE)
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCES</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE &amp; ENGINEERING</td>
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<td>LEVEL OF STUDIES</td>
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INDEPENDENT TEACHING ACTIVITIES

<table>
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<th>CREDITS</th>
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<tbody>
<tr>
<td>Lectures/Laboratory Exercises</td>
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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, Specialised general knowledge</th>
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</table>

PREREQUISITE COURSES: NO

LANGUAGE OF INSTRUCTION and EXAMINATIONS: Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS: YES


(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

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 interesting 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?

- 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
- 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

(3) SYLLABUS

The course covers the basic definitions and concepts related to classical graph theoretic problems. The course also covers a number of applications in which graph modeling are known to be useful. Topics:

1. Introduction and basic definitions
2. Graph representations and graph isomorphism
3. Trees - special properties and applications
4. Connectivity, Euler tours and Hamiltonian cycles
5. Coverings and matching
6. Cliques and independent sets
7. Vertex colorings and edge colorings
8. Directed graphs and applications
9. Planar graphs and networks
10. General applications

(4) TEACHING and LEARNING METHODS - EVALUATION

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

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

| 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>13*3 = 39 hours</td>
</tr>
<tr>
<td>Laboratory practice</td>
<td>13*1 = 13 hours</td>
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<tr>
<td>Student's study hours</td>
<td>73 hours</td>
</tr>
</tbody>
</table>

Course total 125 hours
activity are given as well as the hours of non-directed study according to the principles of the ECTS

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description of the evaluation procedure</strong></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Language of evaluation: Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods of Evaluation:</td>
</tr>
<tr>
<td>i) Final written examination</td>
</tr>
<tr>
<td>ii) Written work</td>
</tr>
</tbody>
</table>

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

---

**ATTACHED BIBLIOGRAPHY**

- **Suggested bibliography:**

  **Βιβλίο [3472]:** Μαθήματα Θεωρίας Γράφων, Γ. Μανωλόπουλος, ΕΚΔΟΣΕΙΣ ΝΕΩΝ ΤΕΧΝΟΛΟΓΙΩΝ ΜΟΝ. ΕΠΕ, 1η/1996

  **Book (in Greek) [31356]:** Εισαγωγή στους γράφους, Κυρούσης Λευτέρης Μ., Μπούρας Χρήστος Ι., Σπυράκης Παύλος Γ., Σταματίου Γ., Γ. ΔΑΡΔΑΝΟΣ - Κ. ΔΑΡΔΑΝΟΣ Ο.Ε., 1η έκδ./1999.
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCE</th>
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</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
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</tr>
<tr>
<td>SEMESTER</td>
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</tr>
<tr>
<td>COURSE TITLE</td>
<td>Distributed Systems</td>
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</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</td>
<td></td>
<td>5</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:

MYY601/IIAY510 OPERATING SYSTEMS

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)

http://www.cse.uoi.gr/~magoutis/MYE017

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A
- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

Distributed Systems consist of independent networked computers that communicate by exchanging messages, and that appear to their users as a single, coherent system. The study of distributed systems in this course focuses on communication (remote procedure calls, multicasting), coordination (clock synchronization, logical clocks, totally ordered multicasting, vector clocks, causally ordered multicasting, leader election, mutual exclusion, global state, distributed commitment), reliable communication within a group of processes (atomic multicasting, virtual synchrony), data replication, consistency protocols, and fault tolerance (checkpoints, logging, recovery).

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

- Understand the basic principles and fundamental models of distributed systems, and the main methods used in solving basic coordination problems
- Understand the impact of failures on the correctness and reliability of distributed systems, and the main methods with which those properties can be achieved
• Understand the basic principles of data replication and the main consistency models that characterize it.
• Implement different types of group communication, such as totally ordered and causally ordered multicasting, and basic consensus protocols such as distributed commitment.

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

(3) SYLLABUS

**Introduction to Distributed Systems:** Organization, main properties, transparency, scalability, fundamental models of distributed systems.

**Communication:** Point-to-point communication, remote procedure calls, multicasting.

**Coordination:** Clock synchronization, causality, logical and vector clocks, totally ordered multicasting, causally ordered multicasting, leader election, mutual exclusion, global state.

**Reliable group communication:** Reliable multicasting, atomic multicasting, virtual synchrony, distributed commitment.

**Consistency protocols and replication:** Strict consistency, linearizability, sequential consistency, local and remote write protocols, leases, active replication, quorum replication protocols.

**Fault tolerance:** Remote procedure calls in the presence of failures, creation of checkpoints, maintaining a log, recovery.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

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

- Use of projector and interactive board during lectures.
- Use of networked computers in laboratories for development and testing of distributed systems software.
Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).

- Announcement of course grades via the UOI electronic course administration system.
- 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>Labs</td>
<td>$13 \times 3 = 39$ hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>72 hours</td>
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</table>

**Course total**: 150 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**

(i) Final examination, including open-ended questions and problem solving.

(ii) Laboratory exercises in program development and testing, and oral examination on them by course staff.

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

### (5) ATTACHED BIBLIOGRAPHY

**- Suggested bibliography:**

**Book [13777]**: Κατευθείως Συστήματα: Αρχές και Υποδείγματα, Andrew S. Tanenbaum, Maarten van Steen, Εκδόσεις Κλειδάριθμος, 2005, 1η Έκδοση


**- Related academic journals:**

- IEEE Transactions on Parallel and Distributed Systems.
# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
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</tr>
<tr>
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<td>ENGINEERING</td>
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</tr>
<tr>
<td>SEMESTER</td>
<td>≥ 5</td>
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<tr>
<td>COURSE TITLE</td>
<td>VLSI Circuits</td>
</tr>
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<td>INDEPENDENT TEACHING ACTIVITIES</td>
<td>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</td>
</tr>
<tr>
<td>WEEKLY TEACHING HOURS</td>
<td>Lectures / Labs / Tutorials</td>
</tr>
<tr>
<td>CREDITS</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).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>General background, general background, special background, specialised general knowledge, skills development</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREREQUISITE COURSES:</td>
<td>-</td>
</tr>
<tr>
<td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td>
<td>GREEK</td>
</tr>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>YES</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td><a href="http://www.cs.uoi.gr/~tsiatouhas/MYE018-VLSI.htm">http://www.cs.uoi.gr/~tsiatouhas/MYE018-VLSI.htm</a></td>
</tr>
</tbody>
</table>

## (2) LEARNING OUTCOMES

### Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

This course aims at introducing to students the fundamentals of VLSI circuit analysis, synthesis, design and simulation.

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

- Understand manufacturing technologies of nanometer integrated circuits.
- Understand logic circuit operation at the transistor level.
- Analyze simple or complex digital circuits.
- Synthesize digital circuits at the transistor level.
- Solve performance related problems in VLSI circuits.
- Design and simulate VLSI circuits, perform measurements on their characteristics and verify their performance.

### 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?

- 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
- Analysis of requirements for problem solving
- Abstraction ability for problem modeling
- Combination of existing methods for the synthesis of high performance circuits
- Working independently
- Team work

### (3) SYLLABUS


### (4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, lectures, lab courses, home-works</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of e-slides and interactive board during lectures.</td>
</tr>
<tr>
<td></td>
<td>Use of computer-aided design tools at the laboratory (circuit design and simulation).</td>
</tr>
<tr>
<td></td>
<td>Use of components and instruments (signal generators, power supplies, multi-meters, oscilloscopes) at the laboratory for circuit implementation and measurement.</td>
</tr>
<tr>
<td></td>
<td>Course website maintenance. Announcements and posting of teaching material (lecture slides and notes).</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.

<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>$11 \times 2 = 22$ 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>Problems solving</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study &amp; bibliography analysis</td>
<td>56 hours</td>
</tr>
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<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Course total</strong></td>
<td><strong>125 hours</strong></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**

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

(ii) Laboratory exercises on circuit design and simulation. The students are evaluated during their work at the laboratory and also with the final examination of a design project at the laboratory.

(iii) Home-works on problem solving. The home-works are marked based on their correctness and completeness.

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

**(5) ATTACHED BIBLIOGRAPHY**

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

- Related academic journals:
  - Transactions on VLSI Circuits and Systems (TVLSI), IEEE.
  - Integration the VLSI Journal, Elsevier
  - Transactions on Circuits and Systems I & II (TCAS), IEEE.
  - Journal of Solid-State Circuits (JSSC), IEEE.
MYE023. Parallel Systems and Programming

COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCE</th>
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</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>UNDERGRADUATE</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<td>COURSE TITLE</td>
<td>Parallel Systems and Programming</td>
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<table>
<thead>
<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Labs</td>
<td>5</td>
<td>5</td>
</tr>
</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>
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</table>

| PREREQUISITE COURSES: | - |

| LANGUAGE OF INSTRUCTION and EXAMINATIONS: | GREEK |

| IS THE COURSE OFFERED TO ERASMUS STUDENTS | YES |

| COURSE WEBSITE (URL) | http://www.cse.uoi.gr/index.php?menu=m219&id=MYE023%20/%20%CE%A0%CE%A0%CE%9B%CE%95079 |

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

Almost all modern computing systems are parallel, with multiple processors or cores, which can work concurrently towards the solution of a problem. This course is an introduction to the organization and operation of parallel computers and to their architectural categories. An engineer should know the problem which appear and the solutions he/she can give, as well as judge the appropriateness of the techniques involved. In addition, the course teaches parallel programming which is a highly sought qualification. The general parallel programming knowledge is complemented with actual programming assignments which utilize the most important parallel programming models.

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

- Study and understand the organization of a parallel computer.
- Analyze the pros and cons of architectural choices.
- Synthesize the organization of a parallel system.
- Understand the problems of the memory hierarchy, cache coherency and memory consistency.
- 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.
- Analyze the performance of a parallel system.

**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
- 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
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Others...

**SYLLABUS**

- Basic principles of parallelism
- Shared memory organization
- The problems of cache coherency and memory consistency
- Distributed memory organization
- Interconnection networks, topologies, routing, high-performance switching
- Distributed shared memory and non-uniform memory access
- Multicore architectures
- SIMD and GPU organizations
- Principles of parallel programming
- Programming in the shared address space model (threads, OpenMP)
- Programming in the message passing model (MPI)
- Performance analysis (speedup, efficiency, cost, scalability)

**T&L Methods - Evaluation**

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face class lectures</th>
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<tbody>
<tr>
<td>USE OF INFORMATION AND</td>
<td></td>
</tr>
<tr>
<td>COMMUNICATIONS TECHNOLOGY</td>
<td></td>
</tr>
<tr>
<td>Use of ICT in teaching</td>
<td></td>
</tr>
<tr>
<td>Laboratory education,</td>
<td></td>
</tr>
<tr>
<td>communication with students</td>
<td></td>
</tr>
<tr>
<td>Use of projector electronic slides.</td>
<td></td>
</tr>
<tr>
<td>Use of computers for the Lab exercises.</td>
<td></td>
</tr>
<tr>
<td>Course website maintenance</td>
<td></td>
</tr>
</tbody>
</table>
announcements and posting of teaching material (lecture slides and notes).
- Announcement of assessment marks via the ecourse platform by UOI.
- 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>$13 \times 2 = 26$ hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>$60$ hours</td>
</tr>
</tbody>
</table>

Course total 125 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
(i) Two or three lab exercises which require the design and development of parallel programs.
(ii) Written final examination.

### ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**
  - Γ. Πάντζιου, Β. Μάμαλης, Αλ. Τομαράς, Εισαγωγή στον Παράλληλο Υπολογισμό, Εκδόσεις Νέων Τεχνολογιών, 2013
  - Σ. Παπαδάκης, Κ. Διαμαντάρας, Προγραμματισμός και Αρχιτεκτονική Συστημάτων Παράλληλης Επεξεργασίας, Εκδόσεις Κλειδάριθμος, 2012
  - D. B. Kirk, W-m. W. Hwu, Προγραμματισμός μαζικά παράλληλων επεξεργαστών, Εκδόσεις Κλειδάριθμος, 2010

- **Related academic journals:**
  - Transactions on Parallel and Distributed Systems, IEEE.
  - Concurrency and Computation: Practice and Experience, Wiley.
  - Parallel Computing, Elsevier
MYE30. Advanced Topics of Database Technology and Applications

COURSE OUTLINE

(1) GENERAL

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

<table>
<thead>
<tr>
<th>Lectures / Labs / Tutorials</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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</thead>
<tbody>
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<td></td>
<td>5</td>
<td>5</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

PREREQUISITE COURSES:

- 

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

COURSE WEBSITE (URL)

http://www.cs.uoi.gr/~pvassil/courses/db_III

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The goal of the course is twofold: one the one hand, the first goal is to present advanced topics of database management and on the other hand, a second goal concerns the hands-on experience of students with the design and implementation of a data-centric information system. Concerning the first goal, the students are presented with the software architecture of a Database Management System (DBMS) along with the techniques, theoretical foundations and algorithms used by DBMSs for their three fundamental tasks: query processing, concurrency control and recovery from failures. Concerning the programming part, the students are exposed via a project to the design and implementation of an information system with a relational DBMS as its back-end and a graphical user interface on the front-end.

The expected outcomes of the course include the following skills for a successful student:

- The ability to tune the queries submitted to a DBMS with the goal of efficiency
- The ability to tune the concurrency control and the recovery from failures with the
goals of data integrity and efficiency
- The ability to tune the design of a database with the goals of data integrity and efficiency in performance
- The ability to design and implement a complete information system with a relational DBMS back-end and an interactive GUI as a front-end

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

(3) SYLLABUS

Architecture of a Database Management System. Processes, memory structures and data storage. Internal architecture of a DBMS.

Query processing. The general context of query processing. Algebraic operators and algorithms for their implementation (selection, join, aggregation).


Security and access control for databases.

Data warehouses. General architecture of data warehouses. OLAP. ETL. Star & Snowflake schemata. Query processing in data warehouses

Implementation of a sizeable project, concerning an information system, built on top of database.
(4) TEACHING and LEARNING METHODS - EVALUATION

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

Lectures, lab courses

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 computer for demonstration of programming.
- Use of computers in laboratories for development and testing of programs.
- Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
- Announcement of assessment marks via the course website
- 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>Labs</td>
<td>13*2 = 26 hours</td>
</tr>
<tr>
<td>Self-study &amp; project</td>
<td>60 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>125 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, which includes questions of program development and testing. The exam papers are evaluated based on the correctness and completeness of answers.
(ii) Project developed by the students on their own that has a significant level of complexity and volume in terms of programming
(iii) Take-home exercises. To be marked based on their correctness and completeness.

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Related academic journals:
- Information Systems, Elsevier
- IEEE Transactions on Knowledge and Data Engineering
- The VLDB Journal, Springer
- ACM Transactions on Database Systems
# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCES</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>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
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</tr>
<tr>
<td>SEMESTER</td>
<td>&gt;=5</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Robotics</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>Activity</th>
<th>Weekly Teaching Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures / Labs / Tutorials</td>
<td>5</td>
<td>5</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

- Special background

**PREREQUISITE COURSES:**  
-

**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=1036

## (2) LEARNING OUTCOMES

**Learning outcomes**  
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The main course objectives are to:

- Offer an introduction to theoretical and practical aspects on the design and modeling of robotic systems, as well as on the analysis and control of classical robotic mechanisms.
- Bring students closer and make them familiar with mathematical tools for studying industrial robots and offer a comprehensive analysis to the usability and functionalities of robots in our daily life.

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

- Understand basic topics in the theory and practical implementation of robotics.
- Understand the basic functionalities of a typical robotic platform as well as the mathematical models for modeling the motion and behavior of robots.
• Study and solve simple problems in robotic manipulation, sensory design, dynamic behavior and fault analysis.

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
- 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
- Others...

(3) SYLLABUS

Introduction: History, robot structure and categories, position and orientation.

Kinematics: Direct kinematics, inverse kinematics, differential kinematics, Jacobian matrices, singularities, work space, statics, kinematics of mobile robots.

Dynamics: Acceleration of a rigid body, manipulator dynamics, dynamics of a mobile robot, Lagrangian formulation, simulation.

Trajectory and motion design: Trajectory generation, trajectories in joint-space, trajectories in Cartesian-space, motion design of mobile robots.

Control of robotic systems: Actuators and sensors, position control, vision based control, programming languages for robotic systems, simulation software.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures, lab courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of projector during lectures.</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, 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>
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>8*2 = 16 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>70 hours</td>
</tr>
<tr>
<td><strong>Course total</strong></td>
<td><strong>125 hours</strong></td>
</tr>
</tbody>
</table>

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

LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION
(i) Final written examination.
(ii) Homework.

- Προτεινόμενη Βιβλιογραφία:

- Συναρτήσεις επιστημονικών περιοδικών:
  - The International Journal of Robotics Research.
  - IEEE Transactions on Robotics.
  - IEEE/ASME Transactions on Mechatronics
COURSE OUTLINE

(1) GENERAL

SCHOOL  | SCHOOL OF SCIENCES
---|---
ACADEMIC UNIT  | DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
LEVEL OF STUDIES  | UNDERGRADUATE
COURSE CODE  | MYE035
SEMESTER  | >5
COURSE TITLE  | Computational Intelligence

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>Lectures /Laboratory Exercises</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (2).

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/~arly/courses/nn/nn.html

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

This course aims at first to provide a general description of computational intelligence problems and methods. Then the emphasis is given to artificial neural network methods and applications. The main course objective is to provide understanding of the learning from data paradigm as a general methodology for solving real-world problems. The most successful neural network models and learning algorithms are presented for supervised learning (classification, regression) and unsupervised learning (clustering, topographical mapping) problems. Moreover, a clear understanding of the notion of generalization and the typical methods used for model order selection constitute another important objective of this course.

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

- deep knowledge of the learning from the data problem solving paradigm
- a clear understanding of the various categories of learning problems
- a clear understanding of the notions of generalization and overtraining
- the ability to solve classification, regression and clustering problems using neural
network methods

**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

(3) **SYLLABUS**

Introduction to computational intelligence, biological neural networks, introduction to artificial neural networks, learning from examples, the perceptron, the multilayer perceptron, RBF networks, learning and generalization, competitive learning, the LVQ algorithm, self-organizing maps, associative memories (the Hopfield network), neurofuzzy systems.

(4) **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 COMMUNICATION TECHNOLOGY</td>
<td>Lecture slides, multimedia (video demonstrations), e-mail communication, course Web page maintenance.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<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>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>Lectures</td>
<td>13x3=39 hours</td>
</tr>
<tr>
<td>Laboratory practice</td>
<td>13x2=26 hours</td>
</tr>
<tr>
<td>Student’s study hours</td>
<td>60 hours</td>
</tr>
<tr>
<td>Course total</td>
<td><strong>125 hours</strong></td>
</tr>
</tbody>
</table>

**STUDENT PERFORMANCE EVALUATION**

Language of evaluation: Greek

Methods of Evaluation:

- iii) Final written examination
- iv) Lab projects examination

The evaluation procedure is accessible to students via the course website.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

(5) ATTACHED BIBLIOGRAPHY


COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
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</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
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</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<td>COURSE TITLE</td>
<td>Computability and Complexity</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/Laboratory/Tutorials</td>
<td>3/0/2</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)


(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The course objective is to formally define the notion of computational problem, introduce basic models of computation such as Turing Machines, show that there exist problems that are unsolvable, define time and space requirements of a Turing Machine, introduce nondeterminism, classify solvable problems in complexity classes and investigate the relations between these classes.

A student that successfully attends the course will know:

- what a computational problem is
- some basic models of computation
- how we can give a formal definition for the informal notion of a computable function
- that there exist computational problems that are unsolvable
- that there exist solvable problems that are intractable
- how to prove that a problem is unsolvable using diagonalization or reduction.
• how to prove that a problem is intractable using polynomial time reduction.
• some basic complexity classes and the relations between 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?

| 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 | ...... |

• Adapting to new situations
• Working independently
• Production of free, creative and inductive thinking
• Decision-making

(3) SYLLABUS
Computational problems and formal languages.
Primitive recursive functions.
Recursive functions.
Turing machines and equivalent models of computation.
Church's Thesis.
Kleene normal form.
Unsolvability.
Recursive and recursively enumerable sets.
The arithmetic hierarchy.
Non-deterministic Turing machines.
Complexity classes.
The classes P, NP and PSPACE.
Reductions and Completeness.
NP-complete problems.
Grammars and the Chomsky Hierarchy.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures, Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td></td>
</tr>
<tr>
<td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td>
<td></td>
</tr>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td></td>
</tr>
<tr>
<td>• Use of projector and interactive board during lectures.</td>
<td></td>
</tr>
<tr>
<td>• Maintenance of a course website, in which announcements, exercises, lecture notes, solution to exercises and other useful material is posted.</td>
<td></td>
</tr>
<tr>
<td>• Use of email for communication with students.</td>
<td></td>
</tr>
<tr>
<td>• Announcement of assessment marks via the ecourse 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*3 = 39 hours</td>
</tr>
<tr>
<td>Tutorial</td>
<td>13*2 = 26 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>60 hours</td>
</tr>
</tbody>
</table>

Course total 125 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
METHOD OF EVALUATION:
(i) Final written examination
(ii) Take-home assignments
The evaluation procedure is accessible to students via the course website.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - "Introduction to the Theory of Computation", M. Sipser.
  - "Basic Computability Theory", Ch. Hartonas.

- Related academic journals:
  - Computational Complexity (Springer)
  - SIAM Journal on Computing
  - Journal of the ACM
  - Journal of Computer and System Sciences (Elsevier)
  - Theoretical Computer Science (Elsevier)
  - Information and Computation (Elsevier)
  - Journal of Complexity (Elsevier)
  - Bulletin of the EATCS
# COURSE OUTLINE

## (1) 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>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΜΥE039</td>
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<tr>
<td>SEMESTER</td>
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<td>COURSE TITLE</td>
<td>Digital Design II</td>
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</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>
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<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).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>General background</th>
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<tbody>
<tr>
<td>PREREQUISITE COURSES</td>
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</table>

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

## (2) LEARNING OUTCOMES

### Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

This course aims to expose the students to the design process of Digital Circuits and Systems. Basic design processes using high-level behavioral descriptions with VHDL are introduced. The whole design process from design entry to synthesis into gate level description, partitioning, floorplanning, placement & routing is presented. The basic principles of programmable devices are also presented. At the end of this course, students will be able to describe systems using behavioral and structural modeling in high-level hardware description language, understand the basic steps of the system development and finally develop circuits using FPGAs.

After taking this course students will be able to:

- Design a circuit on a CAD tool using library gates and complex structures (decoders, multiplexers, adders etc).
- Design arithmetic circuits.
- Describe a circuit using VHDL.
• Simulate a circuit using CAD tools.
• Understand the back-end of the design process.
• Understand the basic principles of Programmable Devices.
• Program FPGAs

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
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

• 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
• Team work

(3) SYLLABUS

Theory
Design entry with CAD tools.
Elementary Digital-Arithmetic Circuits.
RTL Design.
Design of Digital Circuits with VHDL (Basic & Composite Data Types, Behavioral & Structural Modeling, Subroutines, Packages, Libraries, Simulation, Synthesizable units with VHDL).
Memories, Back-End (Partitioning, Floorplanning, Placement, Global & Detailed Routing).
Programmable Devices (PLAs, PLDs, CPLDs), Field Programmable Gate Arrays).
Input/Output.

Laboratory
Design of combinational and sequential units using primitive gates.
Design of combinational and sequential units using VHDL.
Hierarchical Design and Embedded Cores.
Advanced circuit design using embedded memory.
System programming using FPGAs

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Lectures, lab courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</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 at the laboratory.</td>
</tr>
<tr>
<td></td>
<td>• Course website maintenance. Announcements and</td>
</tr>
</tbody>
</table>
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 workshops, 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*2 = 26 hours</td>
</tr>
<tr>
<td>Self-study</td>
<td>60 hours</td>
</tr>
</tbody>
</table>

**Course total**: 125 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**

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

(ii) Laboratory Examination

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

### ATTACHED BIBLIOGRAPHY

- **Suggested bibliography**:
  - Book [64314]: Ψηφιακή Σχεδίαση με VHDL, P. J. Ashenden (Εκδόσεις Νέων Τεχνολογιών)
  - Book [18548869]: ΨΗΦΙΑΚΑ ΣΥΣΤΗΜΑΤΑ, Μοντελοποίηση & Προσομοίωση με τη γλώσσα VHDL, Σ. Σουραβλάς, Μ. Ρουμελιώτης (Publisher: Tziolas).

- Συναφή επιστημονικά περιοδικά:
  - Transactions on Circuits and Systems I & II (TCAS), IEEE.
  - Transactions on VLSI Circuits and Systems (TVLSI), IEEE.
MYE041. Complex Data Management

COURSE OUTLINE

(1) 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>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΜΥΥ041</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>&gt;=5</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Complex Data Management</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

Lectures / Tutorials 4 5

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>PREREQUISITE COURSES:</td>
<td>-</td>
</tr>
<tr>
<td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td>
<td>GREEK</td>
</tr>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS:</td>
<td>YES</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td><a href="http://ecourse.uoi.gr/course/view.php?id=1040">http://ecourse.uoi.gr/course/view.php?id=1040</a></td>
</tr>
</tbody>
</table>

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

This course aims at introducing to students management techniques for complex data used in extended database systems. The focus is on indexing such data in order to efficiently search and analyse them. The data types examined include spatial data, data on spatial networks, multidimensional data, set-valued data, data on graphs, multimedia data and time-series.

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

- Understand the types and sources of complex data
- Understand how the relationships, the distance, and the similarity between data is defined in different spaces (e.g., Euclidean, metric spaces, graphs)
- Express queries on complex data
- Apply search and analysis techniques on complex data
- Design extensions of relational database systems that manage complex data
• Design indexing methods and search algorithms for complex data

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
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
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
Others...

• 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
• Analysis of requirements for problem solving
• Algorithmic thinking
• Abstraction ability for problem modeling
• Working independently
• Production of new research ideas

(3) SYLLABUS

Advanced topics on managing relational data: relational data, query languages, indexing, query evaluation, query optimization.

Spatial data: storing spatial data in databases, spatial relationships, spatial queries, the R-tree, spatial query evaluation, nearest neighbor queries, spatial joins.

Spatial networks: data on spatial networks, distance in spatial networks, storage of network and data, indexing, shortest path search, spatial queries on networks, precomputation techniques.

Multidimensional data: multimedia data, feature vectors, collections of multidimensional data, indexing, dimensionality reduction, similarity queries, time-series, containment queries on time-series, indexing time-series, dynamic time warping.

Top-k and skyline queries: multidimensional data, top-k query variants, top-k query evaluation, indexing for top-k queries, top-k joins, dominance between multidimensional points, skyline queries, skyline computation on raw data, skyline computation on indexed data.

Set-valued data and text: document databases, containment and similarity queries on text, indexing set-valued data, signature files, inverted files, query evaluation, string matching, suffix trees and arrays, approximate string matching, edit distance computation.

Geo-textual and geo-social data: queries on geo-textual data, query evaluation, indexing, distance between social network nodes, PageRank, Personalized PageRank, query evaluation on geo-social data.
(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Weekly Lectures.</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<th>Activity</th>
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<tr>
<td>Lectures</td>
<td>13*4 = 52 hours</td>
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<tr>
<td>Self-study</td>
<td>73 hours</td>
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<tr>
<td>Course total</td>
<td>150 hours</td>
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<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>(i) Final examination, which includes questions on problem solving for complex data management. The exam papers are evaluated based on the correctness and completeness of answers.</td>
</tr>
<tr>
<td>(ii) Take-home programming assignments. The assignments are marked based on their correctness and completeness.</td>
</tr>
<tr>
<td>(iii) Midterm examination, which includes questions on problem solving for complex data management. The exam papers are evaluated based on the correctness and completeness of answers.</td>
</tr>
</tbody>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:
- ACM Transactions on Database Systems (TODS)
- the VLDB Journal, Springer
- IEEE Transactions on Knowledge and Data Engineering (TKDE)