Department of Computer Science and Engineering

University of Ioannina

Graduate Programme

Outlines of Courses

ACADEMIC YEAR 2016-17

Graduate Programme Courses Outlines

Y3. Topics on Networks: Video Transmission over Wireless Networks

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE			
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING			
LEVEL OF STUDIES	POSTGRADUATE			
COURSE CODE	**Y03**	**SEMESTER**		
COURSE TITLE	Topics on Networks: Video Transmission over Wireless Networks			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures / Tutorials			**3/1**	**8**
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/~epap/vow/			

(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 in-depth of view state-of-the-art topics in computer networking. During this academic year (2016-2017), the course will focus on techniques for transmitting video over wireless networks. Therefore, the first part of the course focuses on video compression and coding techniques, while the second part examines the provisions of well-known wireless technologies for video transmission.

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

- be familiar with the basic principles of image and video compression as well as with the current standards H.264 and H.265
- understand the importance of error resilience and error concealment technique in video transmission
- know the basic perceptual video quality estimation techniques
- understand the operation of well-known wireless networking technologies such as IEEE 802.11, IEEE 802.16, LTE, etc
- evaluate the performance of a wireless network with respect to its ability to deliver video streams
- identify the mechanisms of a network that are designed for improving video transmission
- select a set of networking mechanisms that are suitable for delivering a video stream with a given set of requirements

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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

(3) SYLLABUS

The aim of the course is to analyze the operation and discuss the applications of several state-of-the-art networking technologies. During this academic year (2016-2017) the courses focuses on **video transmission over wireless networks**. The courses aims at providing an in-depth understanding of the challenges faced. Furthermore, it provides a detailed presentation of the solutions implemented so far.

The course consists of two parts. In the first one, the focus is on video and image compression techniques, including state-of-the-art standards such as H.264 and H.265. This part will also investigate advanced techniques such as scalable and multiple description

coding, as well as error concealment and error resilience methods for video transmission over lossy channels. Finally, this part contains an introduction to techniques for calculating the perceptual video quality.

The second part of the course focuses on wireless networking and the requirements for high quality transmission of video streams. More specifically, we will examine a series of wireless technologies (with an emphasis on 4G wireless networks) and focus on the mechanisms that directly affect the quality of video transmission. Finally, we will present a collection of mechanisms (e.g. network coding) that aim at improving the quality of video transmission.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Weekly Lectures</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Use of projector during lectures.
• Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
• Use of email to improve communication with students.</td></tr>
<tr><td>TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>13*3 = 39 hours</td></tr>
<tr><td>Tutorials</td><td>13*1 = 13 hours</td></tr>
<tr><td>Self-study</td><td>148 hours</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>200 hours</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION
(i) Final exams
(ii) Project</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Video Processing and Communications, Y. Wang, J. Ostermann, Y.-Q. Zhang, Prentice-Hall, 2002.
- 4G Wireless Video Communications, H. Wang, L. P. Kondi, A. Luthra, S. Ci, Wiley, 2009.

-Relevant scientific journals

- IEEE Transactions on Wireless Communications
- IEEE Transactions on Communications
- IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS (J-SAC)
- IEEE Transactions on Circuits and Systems for Video Technology
- IEEE Transactions on Multimedia

Y6. Operating Systems

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	Y06	**SEMESTER**	
COURSE TITLE	Operating Systems		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures / Labs/ Exercices	4	8
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge
PREREQUISITE COURSES:	NO
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.cs.uoi.gr/~stergios/teaching/y6/

(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 covers a combination of classical and latest research publications on modern operating systems. Examined issues include cloud scheduling, data storage, networking, heterogeneous systems, mobile systems, security.
- Participating students are expected to actively contribute to the critical discussions during paper reading sessions.
- Additionally, the students under the guidance of the instructor will work on a project of their choice that will explore interesting research directions.
- Overall, the course will help students get familiar with the design, implementation and experimental evaluation of modern systems.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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

(3) SYLLABUS

- The course covers topics in the design and implementation of operating systems, such as communication, synchronization, scheduling, fault-tolerance, data consistency, file systems, security.
- The syllabus is adjusted every year according to the latest publications of the related literature published in international conferences and journals.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Lecture slides, • E-mail communication, • Course Web page maintenance.
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*	

Activity	***Semester workload***
Lectures	13x3=39 hours
Laboratory practice	13x1=13 hours
Student's study hours	148 hours
Course total	***200 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: i. Participation in paper reading sessions ii. Evaluation of weekly assignments iii. Project or final written examination The evaluation procedure is accessible to students via the course website.

(5) ATTACHED BIBLIOGRAPHY

- ACM Symposium on Operating Systems Principles
- ACM SIGCOMM Conference
- USENIX Annual Technical Conference
- USENIX Conference on File and Storage Technologies
- USENIX Symposium on Operating Systems Design and Implementation
- USENIX Symposium on Network Systems Design and Implementation
- IEEE Computer
- Communications of the ACM

Θ3. Complexity Theory

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	**Θ03**	**SEMESTER**	**FALL**
COURSE TITLE	Complexity Theory		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures/Laboratory/Exercises	3/1/0	8

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background
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/~cnomikos/courses/complexity/complexity-main.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 course objective is to introduce students in the research area of computational complexity theory, to present them the basic complexity classes and the inclusion relations between them, the notions of reduction and completeness and the basic theorems in this area and to bring them in touch with the most important open problems.

After successfully completing this course the students

- will know what a computational problem is.
- will know what a complexity measure is.
- will know the basic deterministic and non-deterministic time and space complexity classes and the relations between them.
- will have clear understanding of what it means that a problem is complete for a class.
- will have the ability to prove that a problem is hard to solve, using a polynomial time reduction.
- will have clear understanding of what it the meaning of randomized computation and how it can be modeled using non-deterministic Turing machines.
- will know the basic randomised complexity classes.
- will have clear understanding of what it means to solve an optimization problem by an approximation algorithm.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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

(3) SYLLABUS

- Computational problems and formal languages.
- Turing machines.
- Complexity measures: running time and working space.
- Non-deterministic Turing machines.
- Complexity classes.
- Relations between complexity classes.
- Hierarchy Theorems. The Gap Theorem.
- Polynomial time reductions and completeness.
- The class NP.
- Cook’ s Theorem.
- NP-complete problems in logic.
- NP-complete problems in graphs.

- NP-complete problems in sets.
- NP-complete problems in numbers and pseudo-polynomial algorithms.
- The class PSPACE.
- PSPACE-complete problems
- Savitch's Theorem.
- The Immerman-Szelepscenyi Theorem.
- Probabilistic complexity classes: RP, ZPP, PP, BPP.
- The polynomial hierarchy.
- Approximate solution of hard computational problems: positive and negative results.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Lecture slides, e-mail communication, course Web page maintenance**.**
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek Methods of Evaluation: i) Assignments during semester (25%) ii) Public presentation (25%) iii) Final written examination (problem solving) (50%)

Activity	***Semester workload***
Lectures	13x3=39 hours
Laboratory practice	13x1=13 hours
Student's study hours	148 hours
Course total	***200 hours***

(5) ATTACHED BIBLIOGRAPHY

-Recommended Bibliography :

"Computational Complexity", Christos Papadimitriou.

"Computational Complexity: A Modern Approach", Sanjeev Arora and Boaz Barak.

"Computability, Complexity and Languages", Martin Davis, Ron Sigal and Elaine Weyuker.

"Computers and Intractability", M. R. Garey and D. S. Johnson.

-Related Journals:

Computational Complexity (Springer)

Journal of Complexity (Elsevier)

Transactions on Computation Theory (ACM)

Journal of the ACM

SIAM Journal on Computing

Theoretical Computer Science (Elsevier)

Theory of Computing Systems (Springer)

Journal of Computer and System Sciences (Elsevier)

Information and Computation (Elsevier)

L5. Topics on Information Systems: Infrastructure Technologies for Large-Scale Service Oriented Systems

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE		
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	**L05**	**SEMESTER**	
COURSE TITLE	Topics on Information Systems: Infrastructure Technologies for Large-Scale Service Oriented Systems		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures / Labs / Tutorials	**4**	**8**
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.cse.uoi.gr/~magoutis/L05

(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 explosive growth of the Internet in recent years has created the need to design, implement, and manage infrastructures that support large-scale service-oriented systems. The course offers an introduction to the scalable infrastructure technologies designed to support large-scale e-services. In the course we will examine existing design techniques and research problems in the design and implementation of these systems. The course covers a range of topics including Cloud computing, scalable data stores (with particular emphasis on data replication techniques and NoSQL systems), large-scale Web services, and infrastructure management systems. The course is based on class discussions and analyses of important papers on the field.

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

- Understand the fundamental principles of designing, implementing, and managing large-scale service-oriented systems.
- Understand the main research challenges in achieving reliability and scalable performance in large-scale data stores, and indicative solutions to these challenges from the recent research literature.
- Understand the basic methods for evaluating reliability, availability, and performance of large-scale service-oriented systems.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Production of free, creative and inductive thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Analysis of requirements for problem solving
- Ability to abstract and model problems
- Working independently
- Team work

(3) SYLLABUS

Introduction to Large-Scale Service-Oriented Infrastructures: Introduction to the aspects of scalability (expandability, performance, availability, manageability) and infrastructure technologies in Data Centers, review of basic principles, examples.

Large-scale Data Stores: The Paxos distributed consensus algorithm, replication and reconfiguration, consistency models, comparative study of replication systems with regard to performance, high availability, reliability, methods of metadata management in large-scale data stores.

Cloud Infrastructure Technologies: Introduction to virtualization technologies and to the cloud computing model, load balancing techniques, soft state management and distributed caching systems.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	• Use of projector and interactive board during lectures.

Use of ICT in teaching, laboratory education, communication with students	• 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*	
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, including open-ended questions and problem solving. (ii) Written report and oral presentation in class.

Activity	***Semester workload***
Lectures	13*3 = 39 hours
Project	52 hours
Self-study	109 hours
Course total	**200 hours**

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Βιβλίο: Barroso, Clidaras, Holze: The Datacenter as a Computer: An Introduction to the Design of Warehouse-Scale Machines, Morgan & Claypool Publishers, 2nd edition

Βιβλίο: Distributed Systems, Sape Mullender, editor, ACM Press / Addison-Wesley, 1993, 2nd Edition

- *Related academic journals:*

- IEEE Transactions on Parallel and Distributed Systems.
- ACM Journal of Parallel and Distributed Computing.
- SpringerOpen Journal of Internet Services and Applications
- IEEE Transactions on Cloud Computing.

L5. Data Mining

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE		
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	Λ05	**SEMESTER**	
COURSE TITLE	Topics on Information Systems: Software & Data Evolution		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures / Tutorials	**3/1**	**8**
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/~zarras/software-data-evol.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*

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

- Understand the state-of-the-art and the historical evolution of research in the area under study.
- Understand in depth the critical steps in the process of re-engineering.
- Reverse engineer an existing system and produce (a) an abstract model of the system and (b) the appropriate documentation that goes along with the abstract model.
- Identify symptoms of bad design and rigidity and prioritize them in terms of re-engineering.
- Understand the role of re-engineering patterns in the process of software

maintenance, their interrelationships and tradeoffs.

- Design specific solutions for the identified problems and assess both the "forces" that constrain the solution space as well as the trade-offs that each candidate solution incurs.
- Acquire hands-on experience by developing a complete project wherein they apply the design and algorithmic knowledge obtained from the course in order to re-engineer an existing complex software 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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

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

(3) SYLLABUS

The course Topics on Information Systems typically offers an in-depth coverage of a topic within the broader field of information systems engineering. In this context, the course either cover in depth a part the full lifecycle of their design, construction and maintenance, or targets its focus on the broader coverage of a specific category of information systems (e.g., web based IS's, web services, data-intensive IS's, etc).

The course specializes each year to a possibly different subarea, however, it begins by covering the fundamental concepts of each area (as well as how they are related to traditional information systems engineering) and later on goes deeper to techniques that cover research efforts and state-of-the-art tools.

In the academic year 2016-2017 the course will focus on the management of software and data evolution, with a particular in-depth analysis of software re-engineering.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Weekly Lectures
USE OF INFORMATION AND	• Use of projector during lectures.

<table>
<tr><td>COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
• Use of email to improve communication with students.</td></tr>
<tr><td>TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>13*3 = 39 hours</td></tr><tr><td>Tutorials</td><td>13*1 = 13 hours</td></tr><tr><td>Self-study</td><td>148 hours</td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>200 hours</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>LANGUAGE OF EVALUATION: Greek

METHODS OF EVALUATION

(i) A large programming assignment in groups (project).

(ii) At each lecture, the students are asked to be prepared on the material of the lecture and to participate in the critical discussions that arise concerning their project. Moreover, the students are regularly required to report on intermediate milestones of their project.

(iii) Each student is assigned either (a) a data analysis tasks or (b) a literature survey, on topics relevant to the material of the course. The assignment involves the authoring of a report, to be publicly presented in class at the end of the semester

The evaluation procedure is accessible to students via the course website.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Object-Oriented Reengineering Patterns, S. Demeyer, S. Ducasse, O. Nierstrasz, ISBN 978-3-

9523341-2-6.

Working Effectively with Legacy Code, M. Feathers, Prentice Hall, ISBN-13: 978-0131177055.

Refactoring. Improving the Design of Existing Code, Fowler, Addison-Wesley, ISBN 0-201-48567-2.

Refactoring To Patterns, J. Kerievsky. Addison-Wesley, ISBN 0-321-21335-1.

Design Patterns: Elements of Reusable Object-Oriented Software, E. Gamma,R. Helm, Richard, R. Johnson, Ralph, J. Vlissides, Addison-Wesley, ISBN 0-201-63361-2.

E2. Numerical Methods for Differential Equations

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	**E02**	**SEMESTER**	**FALL**
COURSE TITLE	Numerical Methods for Differential Equations		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures/Laboratory/Exercises	3	8

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge
PREREQUISITE COURSES:	NO
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.cs.uoi.gr/~akrivis/

(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*

Numerical methods for initial value problems for ordinary differential equations are studied in this course; an introduction to numerical methods for the two-point boundary value problem is also given. Learning Objectives: Understanding the basic facts for initial value problems and the two-point boundary value problem. Understanding the fundamental qualitative characteristics of numerical methods for initial value problems, like consistency, order of accuracy, stability and convergence.

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

- Understand the basic facts for initial value problems as well as for the two-point boundary value problem.
- Know the basic numerical methods for initial value problems, and are familiar with their advantages and drawbacks.

- Understand the role of consistency, order of accuracy and stability of numerical methods for initial value problems.
- Know the basic numerical methods for initial value problems.
- Know the basic properties of finite difference and finite element methods for the two-point boundary value problem.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Production of free, creative and inductive thinking.
- Consolidation, deepening and application of mathematical knowledge.
- Familiarity with numerical methods for initial as well as for boundary value problems.

(3) SYLLABUS

- Short introduction to the theory of initial value problems.
- Analysis of the Euler methods: order of accuracy; stability properties, A-stability and B-stability; error estimates under various Lipschitz conditions (global, local and one-sided); a posteriori error estimates.
- Runge-Kutta and collocation methods: stability properties, order of accuracy, embedded pairs of methods and adaptive time step selection.
- Multistep methods: elements of the theory of difference equations, the root condition and stability, order of accuracy, one-leg methods and G-stability.
- Introduction to the theory of the two-point boundary value problem: energy method and elliptic regularity.
- Finite difference methods for the two-point boundary value problem.
- Finite element method: construction of finite element spaces for various boundary conditions, Galerkin and Ritz methods, the Nitsche trick. Error estimates in the case of indefinite operators.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	e-mail communication

<table>
<tr>
<td>TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td>
<td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>13x3=39 hours</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Student’s study hours</td><td>161 hours</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>200 hours</td></tr>
</table>
</td>
</tr>
<tr>
<td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>Language of evaluation: Greek

Methods of Evaluation:

Mid-term and final written examinations</td>
</tr>
</table>

(5) SUGGESTED BIBLIOGRAPHY

G. D. Akrivis and V. A. Dougalis: Numerical Methods for Ordinary Differential Equations, Crete University Press, Heraklion, second ed., 2013, first pr., 2015 (in Greek)

E6. Global Optimization Methods

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES			
ACADEMIC UNIT	DEPT. OF COMPUTER SCIENCE & ENGINEERING			
LEVEL OF STUDIES	GRADUATE			
COURSE CODE	**E06**	**SEMESTER**	**-**	
COURSE TITLE	**GLOBAL OPTIMIZATION METHODS**			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures / Labs / Tutorials			3 / 1 / 0	8
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:	NO			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	http://www.cse.uoi.gr/~kostasp/courses/Global_Optimization_Methods.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*

Global Optimization is a branch of Applied Mathematics that deals with the detection of global minimizers of a function, according to a number of predetermined criteria. Often, such problems are accompanied by a set of constraints, which are typically modeled with inequality and equality relations. There is a multitude of factors that may affect the degree of difficulty of solving a Global Optimization problem. Such factors are the form and mathematical properties of the objective function, the type and form of the constraints, the presence of noise in function values etc.

The aim of this course is to familiarize the students with a set of methods for solving Global Optimization problems, their properties, as well as their advantages and weaknesses. Also,

techniques for the implementation of the algorithms in serial and parallel computation environments are presented.

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

- Determine the most appropriate algorithm for a given problem.
- Distinguish and exploit special characteristics of the 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?

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

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

(3) SYLLABUS

Introduction: Introduction to Optimization. Review of Local Search algorithms.

Random Search Algorithms: Stochastic Search. Methods of Multiple Restarts. Clustering Methods. Theoretical issues and termination conditions. Parallel implementations.

Metaheuristics: Trajectory-based methods. Simulated Annealing and Tabu Search. Evolutionary Algorithms and Swarm Intelligence. Techniques for the alleviation of local minima and for the detection of multiple global minimizers. Parallel implementations and applications.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Weekly lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Course webpage where literature and free material is provided. • Live simulations in the classroom. • Use of email services and social media for communication with the students.

TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	***Activity***	***Semester workload***
	Lectures	13*3 = 39 hours
	Labs	13*1 = 13 hours
	Self-study	148 hours
	Course total	***200 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: Public presentation and submission of written report.	

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Handbook of Global Optimization Vol. 2, P.M. Pardalos, H.E. Romeijn (eds), 2012.
New Ideas in Optimization, D. Corne, M. Dorigo, F. Glover, McGraw-Hill, 1999.
Evolutionary Computation for Modeling and Optimization, D. Ashlock, Springer, 2010.
Particle Swarm Optimization and Intelligence: Advances and Applications, K.E. Parsopoulos, M.N. Vrahatis, Information Science Publishing (IGI Global), 2010.
Stochastic Global Optimization, A. Zhigljavsky, A. Zilinskas, Springer, 2010.
Introduction to Evolutionary Computing, *A.E. Eiben, J.E. Smith, Springer, 2010.*

- *Related academic journals:*

- Journal of Global Optimization, SPRINGER.
- Optimization Letters, SPRINGER.
- Journal of Optimization Theory and Applications, SPRINGER.
- SIAM Journal on Optimization, SIAM.
- IEEE Transactions on Evolutionary Computation, IEEE.
- Evolutionary Computation, MIT PRESS.
- Swarm Intelligence, SPRINGER.
- Soft Computing, SPRINGER.
- Applied Soft Computing, ELSEVIER.

T6. Machine Learning

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE		
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	**T06**	**SEMESTER**	
COURSE TITLE	Machine Learning		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures / Tutorials		**3/1**	**8**
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/~arly/courses/ml/ml.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 objective of this course is to provide a detailed description of machine learning problems and solutions. The main problems presented and studied are related to supervised learning (classification, regression), unsupervised learning (clustering, dimensionality reduction, density estimation) and reinforcement learning. State-of-the-art methods are presented and compared for all the above problems.

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

- knowledge of machine learning problems
- a clear understanding of the notions of learning and generalization
- the ability to solve classification, regression and clustering problems using state-of-

the-art approaches such SVMs, deep neural networks, Gaussian Processes, mixture models.

- the skill to apply all the algorithmic steps required for building machine learning models from a given dataset.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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

(3) SYLLABUS

Introduction to Machine Learning, probability distributions, linear models. Neural Networks, the multilayer perceptron, overfitting and regularization, deep neural networks. Kernel methods, Support Vector Machine, Relevance Vector Machine, Gaussian Processes. Clustering Methods, k-means, kernel k-means, spectral clustering. Dimension reduction. PCA, probabilistic PCA, autoencoders. Graphical models, inference methods, EM algorithm, mixture models, sampling methods, Hidden Markov Models, reinforcement learning.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Weekly Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of projector during lectures. • Method demonstration using demos and videos. • Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs). • Use of email to improve communication with students.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice,*	

Activity	***Semester workload***
Lectures	13*3 = 39 hours

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*	Tutorials	13*1 = 13 hours
	Self-study	148 hours
	Course total	***200 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 (iii) Final exams (iv) Project	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

C. Bishop, “Pattern Recognition and Machine Learning”, Springer 2007.

P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.

T10. Robotics

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	**T10**	**SEMESTER**	**2**
COURSE TITLE	Robotics		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures / Labs / Tutorials	**4**	**8**
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)	http://ecourse.uoi.gr/course/view.php?id=1037

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

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

- Understand, design, and implement advanced control methodologies for robotic manipulators and mobile platforms.
- Demonstrate advanced knowledge in motion planning of a robotic platform.
- Study and solve real life complex problems in motion planning, and control of robotic systems.

- Understand research papers in the field of robotics, and try out some new ideas.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology *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…*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Team work
- Working in an interdisciplinary environment
- Production of new research ideas
- Production of free, creative and inductive thinking
- Abstraction ability for problem modeling

(3) SYLLABUS

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

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

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

Advanced control of robotic systems: Control based on dynamics, compliance control, impedance control, non-linear control, vision-based control.

(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 during lectures. • Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, exercises, example programs). • Use of robots in laboratories. • Announcement of assessment marks via the ecourse platform by UOI. • Use of email for information exchange and improved communication with students.

TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
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 written examination. (ii) Homework. The evaluation procedure is accessible to students via the course website.

Activity	*Semester workload*
Lectures	13*3 = 39 hours
Labs	13*1 = 13 hours
Self-study	148 hours
Course total	**200 hours**

(5) ATTACHED BIBLIOGRAPHY

-Προτεινόμενη Βιβλιογραφία :

Βιβλίο [32997955]: Siciliano, B., Sciavicco, L., Villani, L., Oriolo, G., Ρομποτική: Μοντελοποίηση, Σχεδιασμός και Έλεγχος, Εκδόσεις Φούντας, 2013.
Βιβλίο [18548724]: Craig, J.J., Εισαγωγή στη Ρομποτική, Εκδόσεις Τζιόλα, 2009.
Βιβλίο: Corke, P., Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer Tracts in Advanced Robotics, Springer, 2011.
Βιβλίο: Angeles, J., Fundamentals of Robotic Mechanical Systems: Theory, Methods, and Algorithms, Springer, 2014.
Βιβλίο: Asada H., Slotine J.J., Robot Analysis and Control, Wiley, 1986.

-Συναφή επιστημονικά περιοδικά:

- The International Journal of Robotics Research.
- IEEE Transactions on Robotics.
- *IEEE/ASME Transactions on Mechatronics*

T11. Computer Vision

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	**T11**	**SEMESTER**	
COURSE TITLE	Computer Vision		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
	Lectures / Labs/ Exercises	3/1/0	8
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge		
PREREQUISITE COURSES:	NO		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.cs.uoi.gr/~cnikou/Computer%20Vision.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*

Upon completion of this course, students will:

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

- Have developed the practical skills necessary to build computer vision ;applications.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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

(3) SYLLABUS

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

- Classification

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Lecture slides, multimedia (video demonstrations), e-mail communication, course Web page maintenance.
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*	
gaSTUDENT 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: iv) Weekly lab and theoretical assignments v) Mid-term examination vi) Final examination The evaluation procedure is accessible to students via the course website.

Activity	***Semester workload***
Lectures	13x3=39 hours
Labs	13x1=13 hours
Student's autonomous study of the theory, problem solving and response to homework assignments	148 hours
Course total	***200 hours***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. D. Forsyth and J. Ponce. Computer Vision: A Modern Approach. Second edition. Prentice Hall, 2011.

2. S. Prince. Computer Vision: Models, Learning and Inference. Cambridge University Press,

2012.

- *Related academic journals:*

IEEE Transactions on Pattern Analysis and Machine Intelligence

International Journal of Computer Vision

IEEE Transactions on Image Processing

Image and Vision Computing

Computer Vision and Image Understanding

Pattern Recognition

Journal of Mathematical Imaging and Vision

Machine Vision and Applications

T13. CMOS Circuit Design Techniques

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE			
ACADEMIC UNIT	DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING			
LEVEL OF STUDIES	POSTGRADUATE - MASTER LEVEL			
COURSE CODE	**T13**	**SEMESTER**		
COURSE TITLE	CMOS Circuit Design Techniques			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures / Labs / Tutorials			**4**	**8**
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, Skills development			
PREREQUISITE COURSES:	VLSI Circuits			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK - ENGLISH			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	http://www.cs.uoi.gr/~tsiatouhas/M-CCD.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*

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

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

- Understand nanometer manufacturing technologies of CMOS integrated circuits and the problems related to their scaling.
- Understand CMOS circuit operation.
- Analyze complex CMOS circuits.
- Synthesize CMOS circuits.
- Solve performance related problems (high-speed or low-power operation, cost, reliability issues) in CMOS circuits.

- Design and simulate CMOS circuits and verify their performance characteristics.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Production of free, creative and inductive thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Analysis of requirements for problem solving
- Abstraction ability for problem modeling
- Combination of existing methods for the synthesis of high quality solutions
- Working independently
- Team work

(3) SYLLABUS

CMOS digital integrated circuit design techniques for high speed, low power consumption and low voltage operation. Clocking styles and timing techniques (slack borrowing and time stealing). Design for testability (DFT) and diagnosis techniques for VLSI circuits (scan testing, built-in self test, IDDQ testing, on-line testing, memory testing) and testing standards IEEE 1149.1 and IEEE 1500.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face, lectures, lab courses, home-works
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of e-slides and interactive board during lectures. • Use of computer-aided design tools at the laboratory (circuit design and simulation). • Course website maintenance. Announcements and posting of teaching material (lecture slides and notes). • Use of email for information exchange and improved communication with students.

<table>
<tr>
<td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td>
<td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>13*3 = 39 hours</td></tr>
<tr><td>Laboratory practice</td><td>11*1 = 11 hours</td></tr>
<tr><td>Problems solving</td><td>75 hours</td></tr>
<tr><td>Study & bibliography analysis</td><td>75 hours</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>200 hours</td></tr>
</table>
</td>
</tr>
<tr>
<td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>LANGUAGE OF EVALUATION: Greek - English

METHODS OF EVALUATION
(i) Final examination, which includes problem solving. The exam papers are evaluated based on the correctness and completeness of answers.
(ii) Project which includes bibliography study, design techniques analysis and their application for the development of high quality CMOS circuits.

The evaluation procedure is accessible to students via the course website.</td>
</tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Book [41963448]: CMOS VLSI DESIGN: A CIRCUITS AND SYSTEMS PERSPECTIVE, N. Weste and D. Harris, Addison-Wesley, 2011.
Book [13944]: DIGITAL INTEGRATED CIRCUITS, Jan M. Rabaey, A. Chandrakasan, B. Nikolic, Prentice Hall, 2003.
Book [18548832]: CMOS DIGITAL INTEGRATED CIRCUITS: ANALYSIS AND DESIGN, Sung-Mo Kang and Yusuf Leblebici, McGraw-Hill, 2003.
Βιβλίο VLSI TEST PRINCIPLES AND ARCHITECTURES, L-T. Wang, C-W Wu, X. We, Εκδ.: MORGAN-KAUFMANN, 2006.
Βιβλίο VLSI TEST PRINCIPLES AND ARCHITECTURES, L-T. Wang, C-W Wu, X. We, Εκδ.: MORGAN-KAUFMANN, 2006.
Βιβλίο SYSTEM ON CHIP TEST ARCHITECTURES, L-T. Wang, C. Stroud, N. Touba, Εκδ.: MORGAN-KAUFMANN, 2008.
Βιβλίο THE BOUNDARY-SCAN HANDBOOK, K. Parker, Εκδ.: KLUWER ACADEMIC PUBLISHERS, 2002.
Βιβλίο POWER MANAGEMENT OF DIGITAL CIRCUITS IN DEEP SUB-MICRON TECHNOLOGIES,

S. Henzler, Εκδ.: SPRINGER, 2007.
Βιβλίο DESIGN OF HIGH-PERFORMANCE MICROPROCESSOR CIRCUITS, A. Chandrakasan, W. Bowhill, F. Fox, Εκδ.: IEEE PRESS, 2001.

- Related academic journals:

- IEEE Transactions on VLSI Circuits and Systems (TVLSI).
- Integration the VLSI Journal, Elsevier
- IEEE Transactions on Circuits and Systems I & II (TCAS).
- IEEE Journal of Solid-State Circuits (JSSC).