MSC-IICS-101. Internet of Things

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**MSC-IICS-101**	**SEMESTER**	**1**
COURSE TITLE	INTERNET OF THINGS		

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	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Specialised
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://smart-ict.ece.uop.gr/%cf%80%cf%81%cf%8c%ce%b3%cf%81%ce%b1%ce%bc%ce%bc%ce%b1-%cf%83%cf%80%ce%bf%cf%85%ce%b4%cf%8e%ce%bd/%ce%b5%ce%be%ce%ac%ce%bc%ce%b7%ce%bd%ce%bf-%ce%b1/201-2/

(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 goal of the course is to introduce students to the basic concepts of systems that are characterized as "Internet of Things" (IoT), basic technologies and their practical design issues. In this context, many different aspects of the systems related to communication, processing, programming, energy, etc. will be presented and analyzed. challenges. At the same time, there will be training in the

use of dominant relevant technologies and in the programming of development boards through which students will have the opportunity to focus on practical issues of designing IoT systems.

Keywords: Built-in systems, Wireless communication protocols, Low resources, Dynamic topologies, Wireless sensor networks, Cloud infrastructure

The knowledge and the skills acquired will form the basis for the courses of next semesters like the course CYBERPHYSICAL SYSTEMS, for which the current course is prerequisite.

Learning outcomes

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

At knowledge level:

1. To describe the basic structural components of an IoT system
2. To understand the architecture and the way an IoT system works
3. To know the interfacing capabilities between the constituent components of an IoT system
4. To be able to analyze the performance of an IoT system

At skills' level:

1. Familiarize with the development boards used for IoT system design
2. Be trained in programming end-to-end IoT systems using state-of-the art development boards
3. Be trained in using specialized software for designing/development of IoT systems

At capabilities' level:

1. Select the proper components for designing an IoT solution considering the functional and non-functional requirements
2. To solve practical problems that appear during IoT system design
3. To evaluate the properties, the capabilities and the features of an IoT system
4. To perform holistic analysis and evaluation of end-to-end application specific IoT platforms

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, analysis and synthesis of data and information using appropriate tools and technology
- Working individually
- Working in group
- Working in international environment
- Promoting free, creative and inductive thinking
- Promoting new research ideas

(3) SYLLABUS

The importance that the IoT paradigm introduced. Familiarize to the IoT technonological ecosystem. Which are the difficulties/challenges/constraints of IoT systems? Comprehension of all the major aspects of designing/developing/operating/maintaining and IoT system. In depth analysis of cloud services and interconnection with IoT ecosystems. Architecture of IoT applications. IoT communication protocols. IoT processing units. Review the IoT architectures taxonomy. IoT driven Operating Systems (OS). Study the role of sensors/actuators in IoT. How the IoT architecture affects its performance. How the IoT architecture affects its energy consumption. IoT communication buses. Programming of IoT devices.

The course lectures cover the following thematic areas:

● Basic concepts – Fields of application Basic definitions, characteristics and applications of IoT. Why do we use IoT? Challenges in Designing IoT Systems and Applications.

● Models, Architectures and Technologies for IoT Connectivity models of IoT devices. Dominant IoT Platform Reference Models. Differentiations of the IoT model from traditional models. Advantages and challenges.

● Embedded system Introduction to architectures and designs of embedded systems with low processing, storage and energy resources.

● Sensor and controller technologies Study of sensor categories (analog, digital, pwm), programming in I/O interfaces (SPI, I2C) ADC/DAC, clocks, etc. and in practical applications.

● Gateway Architecture, Backend communication technologies (1) End-to-end presentation of the IoT architecture emphasizing the design of suitable gateways to implement the edge. Emphasis on relevant communication approaches such as MQTT, RestAPI, CoaP etc.

● Gateway Architecture, Backend communication technologies (2) End-to-end presentation of IoT architecture emphasizing the design of appropriate cloud infrastructures to implement cloud computing. Emphasis on relevant communication approaches such as MQTT, RestAPI, CoaP etc.

● Communication Protocols for IoT, Disadvantages Advantages (1) Design, develop and detail dominant communication protocols that focus on maximum resource savings, dynamic topologies, scalability, adaptability and general elements required in IoT. Emphasis on MAC layers.

● Communication Protocols for IoT , Disadvantages Advantages (2) Design, development and detail presentation of dominant communication protocols which focus on maximum resource savings, dynamic topologies, scalability, adaptability and general elements required in IoT. Emphasis on Routing, Transport levels.

● IoT Operating Systems Detailed presentation and analysis of specialized operating systems for IoT devices that focus on resource saving, task scheduling, preemptive

operation, real-time operation, scheduling, etc. Concrete examples based on mainstream solutions such as Cooja, TinyOS, FreeRTOS

● Socia Network Analysis in IoT Study of the combination of Internet technology and machine industry. Taking machine-to-machine (M2M) to the next level, IoT is a sensor system of billions of smart gadgets that connect people, contexts and different applications to collect and offer information. Currently, M2M offers the network that empowers the IoT.

● Industrial IoT Introduction to Industry 4.0, study of related requirements, platforms and technologies

(4) TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform.
Asynchronous distance learning support via e-Class platform.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Slides (ppt) of the presentation of the theoretical part of the course, which will be available from the beginning of semester through e-Class.
• Guidelines for the exercises (one per exercise), which will be available from the beginning of the semester through e-Class.
• Suggested solutions for each exercise will be provided following the completion of each exercise.
• Support of teaching procedure through the e-Class platform (notification of the teaching procedure, distribution of slides, supplementary material, announcements, relative links and literature, provision of test and the final examination)
• Specialized software relevant to the course.</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>48</td></tr>
<tr><td>Practical examples and exercises – focusing on problem solving</td><td>15</td></tr>
<tr><td>Study of lectures and bibliography</td><td>60</td></tr>
<tr><td>Project implementation</td><td>27</td></tr>
<tr><td>Course Total</td><td>150 hours (6 ECTS)</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</td><td><u>A. Evaluation of theoretical part:</u>

Final written exam that includes:

1. Solving exercises
2. Multiple choice questions
3. Comparative evaluation of theory elements

<u>B. Evaluation of exercises/projects</u>

Written exams take place throughout the semester and include:
1. Solving exercises</td></tr>
</table>

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	2. Multiple choice questions Comments: • The final grade is the weighted result of the grades of theory and assignments. The weights will be defined and the beginning of each semester and they will be announced via e-Class. • The final exams are in Greek language • The examination process and the evaluation criteria are publicly available to the students through e-Class.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Δουληγέρης, Χ., Μητρόπουλος, Σ., 2015. Πληροφοριακά συστήματα στο διαδίκτυο. [ηλεκτρ. βιβλ.] Αθήνα: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών
- Learning Internet of Things Paperback – January 27, 2015, by Peter Wahe http://choonsiong.com/public/books/Learning%20Internet%20of%20Things.pdf
- The Internet of Things (IoT): An Overview, White Papers, Internet Society, https://www.internetsociety.org/sites/default/files/ISOC-IoT-Overview-20151014_0.pdf
- Δασυγένης, Μ., Σούντρης, Δ., 2015. Ενσωματωμένα συστήματα. [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών

- Related academic journals:

MSC-IICS-102. Distributed Systems

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Graduate		
COURSE CODE	**MSC-IICS-102**	**SEMESTER**	**1st**
COURSE TITLE	**Distributed 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		2	
Seminars / Practice exercises		-	
Laboratory		1	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		3	5
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)	https://www.ece.uop.gr/		

(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 introduces the students to the advanced topics of Distributed Computing and Distributed Systems. The course is designed to introduce students in advance level both at theoretical and applied knowledge of distributed systems. **Learning Outcomes**

Upon successful completion of the course, student will be able to:

At the knowledge level:

- Understand at advanced level, the most important topics of Distributed Computation like syncronization, mutual exclusion, fault torenance, control and communication.
- Understand at advanced level, load and resource balancing algorithms and the most important distributed scheduling techniques.
- Know in depth, the most important problems and techniques of Distributed Transactions and Distributed Data Bases.
- Understand the most important categories of Peer-to-Peer networks and their characteristics as well as the most important strategies of the distributed data organization and access in P2P networks.

At the skill level:

- Select and apply the most important and efficient techniques for solving known problems of distributed computation.
- Select and apply the most important resource balancing and distributed scheduling strategies in real systems.
- Select, improve and apply the most important and efficient techniques for distributed transactions.
- Select, improve and apply the most important and efficient techniques for Peer-to-Peer networks

At the level of abilities:

- Understand the specific features of distributed computing and become able to design and implement solutions for various problems of distributed middleware.
- Become able to understand the specific features of the modern distributed systems for big data processing and study them in depth.
- Understand the specific requirements of distributed data bases and become able to manage, study in depth and use them efficiently.
- Understand the advantages and disadvantages of today Peer-to-Peer networks and become able to manage and use them efficiently.

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 theoretical concepts, terms and technology
- Adapting to new situations
- Decision-making
- Working independently

- Team work
- Critical thinking development
- Inductive thinking development
- Ability to make an idea work thru implementation
- Develop skills for applied research

(3) SYLLABUS

Theoretical courses cover and consist of:

- Advanced Introduction to Distributed Algorithms and Systems. State of the art of Distributing Computing (e.g. IoT and Big Data)
- Advanced topics concerning the synchronization in shared memory models. Threads and Processes
- Advanced topics of fundamental Distributed Computing: Distributed Computation Models, Distributed Clocks, Distributed Synchronization, Distributed Mutual Exclusion, Fault Tolerance
- Load and resource balancing algorithms and techniques. Scheduling algorithms for independent loads.
- Resource mapping and scheduling problems for Cloud, Edge and IoT. Case studies Kubernetes, edge platforms AKRAINO and EDGE X Foundry.
- Distributed Transactions and Distributed Data Bases
- Distributed Peer-to-Peer networks

The laboratory courses consist of advanced applied training exercises and projects using the MPI programming environment and Python Programming Language. Exercises and projects are focused on the following fields:

- Synchronizing threads and processes with Python
- Use and familiarization with advanced MPI features
- Solving fundamental and advanced problems of Distributed Computing with MPI and Python

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	- Power Point presentations. - Laboratory exercises textbooks. Available in typed and digital form. - Freeware development software tools. - Further digital learning & educational/training material such as : exercise presentations older exam solutions & problems solved for theory and lab, announcements, homework collecting service, student registration & mail service, alerts, statistics, other educational services, etc The whole teaching staff is available at uop e-class (https://eclass.uop.gr/courses/ECE126/)

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	2 x 13=26
Laboratory practice	1 x 13=13
Homework	80
Final exam (theory)	3
Final exam (lab)	3
Course Total	***125 ώρες (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: Greek

Evaluation:

(a) Final written examination in theory. It includes all educational material described in (3)

(b) Written and/or practical examination in every laboratory exercise/project described also in (3). All students deliver a written report that includes their answers . A final exam written and/or practical, may also be available for consideration.

Final grade=0,6x(a) + 0,4x(b)

The whole evaluation procedure and criteria are known to all students from the beginning of the Academic Year.

(5) ATTACHED BIBLIOGRAPHY

- Introduction to Distributed Algorithms, G. TEL, Cambridge University Press.
- Distributed Algorithms, N. Lynch, Morgan Kaufman.
- Distributed Systems – Concept and Design, G. Koulouris, J. Dollimore and T. Kindberg.
- Handbook of Peer-to-Peer Networking, Xuemin Shen, · Heather Yu, · John Buford, Mursalin Akon Editors, 2014
- Distributed Algorithms – an intuitive approach, Wan, Fukkink, MIT Press, 2018.
- Distributed and Cloud Computing, Morgan Kaufmann, Kai Hwang, Jack Dongarra, and Geoffrey Fox, 2011.

- Distributed Computing in Big Data Analytics, Sourav Mazumder, Robin Singh Bhadoria, Ganesh Chandra Deka (eds), Springer, 2018.
- Distributed Systems, M. van Steen and A.S. Tanenbaum 3rd ed., Distributed-systems.net, 2017.
- Peer-to-Peer Computing: Applications, Architecture, Protocols, and Challenges, Yu-Kwong Ricky Kwok
- Python Parallel Programming Cookbook, Giancarlo Zaccone, 2015 Packt Publishing.
- Α., Ι., Μάργαρης, MPI Θεωρία και Εφαρμογές, Εκδόσεις Τζιολα, 2014.

MSC-IICS-103. Next Generation Networks

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ECE_IISC_103**	SEMESTER	1
COURSE TITLE	**NEXT GENERATION 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	2	
Seminars / Practice exercises	1	
Laboratory		
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	3	5

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Specialized
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://bit.ly/3uTXCmG & https://eclass.uop.gr

(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 focuses on the study of advanced networking technologies that are shaping the future of modern communications. It includes training in 5G & 6G technologies, in multiple access technologies, in transmission technologies that consider quality of service rules, in service-specific functions independent of transport technologies, in software-defined networks, in the implementation of next-generation networks generation in a wide range of applications as well as in economic and technical

issues of convergence of fixed and mobile communication technologies. Students will examine security, performance, and management issues in the new networks, with an emphasis on serving real-time demands. They will also work on practical exercises and work on developing and experimenting with modern networking technologies. Overall, the course provides a deep understanding of developments in the field of next-generation networks and provides students with the ability to adapt to continuous innovations.

Keywords: 5G and 6G technologies, Fiber optic networks, Advanced wired and wireless networks, Fiber-to-the-Home, Software-defined networks, Convergence of fixed and mobile communications, Network performance, Network security, Next-generation network exercises.

Learning outcomes

In terms of Knowledge:

1. Understanding advanced network architectures.
2. Understanding of 5G/6G technologies and their impact on modern communications.
3. Understanding network security and understanding the challenges involved.
4. Understanding of advanced networking technologies related to the Internet of Things.
5. Understanding the use of networks in smart cities.
6. Understanding the challenges and solutions in modern applications.

At Skill level:

1. Management and security in next-generation network environments.
2. Explore 5G and 6G technologies and apply them to real networking scenarios.
3. Develop Internet of Things (IoT) design skills in practical applications.
4. Developing skills of applying real-time requirements in modern networks.
5. Developing skills in problem solving and communication in groups.
6. Developing adaptability skills to continuous innovations in networking.
7. Developing skills to design innovative solutions in practical applications.

In terms of Skills:

1. Expertise in 5G and 6G technologies to develop faster and more reliable networks.
2. Developing capabilities in next-generation network management and security.
3. Development of capabilities for the application of new networking technologies in various application areas.
4. Applying the knowledge of Internet of Things (IoT) connectivity.
5. Application of knowledge in projects and experiments to gain experience.
6. Gain hands-on experience in subjects related to next-generation networks.

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, analyze and synthesize data and information using the necessary technologies.
- Adapt to new situations
- Working independently
- Team work
- Working in an international environment
- Production of new research ideas.
- Project planning and management
- Criticism and self-criticism
- Promote of free, creative and inductive thinking

(3) SYLLABUS

Brief description

The purpose of the course is to provide students with the necessary knowledge for next generation networks. Next Generation Network (NGN) refers to a single broadband network that unifies all types of access, supports all types of telecommunication services and manages heterogeneous types of traffic such as voice, data and multimedia in a unified manner. NGNs are based on packet transmission and use transmission technologies that consider Quality of Service (QoS) rules. In NGN, service related functions are independent of transport-related technologies.

Theoretical Part

- Introduction to Next Generation Networks (NGN): Principles and definition of an NGN, General characteristics and architectures, TISPAN Architecture, Femto-Cells, Standardization in 3GPP, IMS Architecture, Service Delivery Platform, Transmission Layer, Network Attachment Control Functions (NACF), Mobility and Nomadism. Software Defined Radio (SDR), GNU Radio.
- Multiple access technologies in next-generation networks: Orthogonal Frequency Division Multiple Access (OFDMA) and Single-carrier FDMA, Code Division Multiple Access (CDMA) and W-CDMA, Dense Wavelength Division Multiplexing (DWDM).
- New generation wireless access networks: 4G cellular networks, WiFi, WiMAX and LTE technologies, fifth generation 5G networks, MIMO and massive MIMO technologies. NS2/3 network emulator.
- Fundamentals of optical communications and networks. Modern applications and services for visual communications. Optical fiber operating principles and modern standards (ITU-G.652). Broadband Access Networks: FTTH, FTTx, Different technologies, PON, GPON, EPON, BPON future architectures WDM PON etc. SONET-SDH, SONET/SDH new generation (NG-SONET) and packet-via-SONET networks. Principles of operation of multiwave optical systems and modern standards (ITU-T G.694). Optical transport networks (OTN, ITU G.709). Demonstration of basic optical communications system. Measurements and Performance Criteria of Physical Layer of Optical Networks. Optical modules (transceivers and amplifiers).
- Software Defined Networks (SDNs): SDN Architecture, OpenFlow Technology, Floodlight OpenFlow Controller, Mininet Network Emulator.
- Convergence of fixed and mobile communications: Presentation of the virtual 5GC architecture as a unified convergence architecture, Network convergence, Service QoS convergence, Factors and Phases leading to convergence. Presentation of subscriber identification signaling flow in convergence networks. International experience in the transition to next generation networks and accesses: Example 5G Fixed Wireless Broadband FWB Networks.

Laboratory Part

The laboratory part of the course includes practical exercises aimed at applying and consolidating the knowledge of the theory and in particular they concern:

- In the implementation of custom communication protocols and in the simulation of telecommunication systems using the GNU Radio software.
- In the design and implementation of new generation wireless access networks using the NS2/3 emulator.
- In optical network physical layer performance measurements and criteria, use of optical network modules, such as transceivers and amplifiers.
- In emulating the Software Defined Networks function using the Mininet emulator.

Attending the laboratory exercises is mandatory.

(4) TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Slides (ppt) for teaching the theoretical part, which have been posted since the beginning of the semester in e-Class. • Laboratory guides for the laboratory part (one for each laboratory exercise), which have been posted since the beginning of the semester in e-Class. • Solutions to the laboratory exercises. • Learning process support through the e-Class platform (to communicate course regulations, to distribute slides, supplementary material, notices, links and bibliography, to conduct the evaluation, etc.). • Specialized mathematics software for the laboratory part freely available to every student. • Elaboration of assignments by the students and posting in e-Class.
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-*	

Activity	*Semester workload (hours)*
Lectures	26 (=13×2)
Seminars	13 (=13×1)
Laboratory Exercises (in Lab)	12 (=6x2)
Projects (homework)	18 hours
Lecture & bibliography study (at home)	23 hours
Preparing for Final Exam	30 hours

directed study according to the principles of the ECTS	Final Exam	3 hours
	Course total	**125 hours (5 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.*	B. Evaluation of Theoretical Part: • Final written exam that includes solving exercises, multiple choice questions and comparative evaluation of theory elements, graded difficulty. B. Evaluation of Laboratory Section: • Oral and written examination of the assignments during the laboratory exercises. Remarks: • The final grade results from the weighting of theory and laboratory grades with weighting factors of 60% and 40%, respectively. • The evaluation is done in the Greek language • The evaluation process and evaluation criteria are published on the course website in e-Class.	

(5) ATTACHED BIBLIOGRAPHY

Suggested Bibliography:

Related scientific journals:

In Greek language

- "New Generation Access Networks", C. Vassilopoulos and others, Kleidarithmos Publications, 2010
- "Broadband Networks: Technologies and Applications with an emphasis on the Internet", I. Venieris, Tziola Publications, 2023.

In English language

- "Broadband Network Architectures: Designing and Deploying Triple-Play Services: Designing and Deploying Triple-Play Services", Hellberg, Greene & Boyes, Prentice Hall.
- "Next Generation Networks: Network Management and Control" J.Rubio-Loyola, A.Azcorra, R.Agüero, Wiley, 2016.
- "Next-Generation Networks: Paradigm Shift in Information, Communications and Entertainment", S.Chakraborty, P.Venkataram, R.Prasad, Springer, 2017

MSC-IICS-104. Machine Learning Technologies

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MSC-IISC-104**	**SEMESTER**	**1**
COURSE TITLE	**Machine Learning Technologies**		

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	3	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		

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	
COURSE WEBSITE (URL)	https://eclass.uop.gr/courses/2039/

(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 aim of the course is to introduce and deepen students' understanding of machine learning, with special emphasis on the use of the Python programming language. In addition, the course aims to provide students with the knowledge and skills to develop machine learning applications in fields such as natural language processing and audio signal processing.

Upon successful completion of the course, the student will be able to:

At Knowledge level:

- Understand the basic concepts and principles of machine learning, and its applications in various fields.
- Recognises and understands the different approaches to machine learning, such as supervised, unsupervised and reinforcement learning.
- Analyses the methods and techniques of machine learning, such as classification, regression and clustering.
- Has a deep understanding of machine learning algorithms such as decision trees, support vector machines and artificial neural networks.
- He/she is familiar with the evaluation and optimization techniques of machine learning models.
- Is familiar with the key Python tools and libraries used in machine learning, such as Scikit-Learn and TensorFlow.
- Understands the applications of machine learning to real-world problems and scenarios, such as in natural language processing and audio signal processing.

At the Skills level:

- Develops and improves machine learning models for practical applications.
- Handles different types of data and trains models using various learning methods.
- Designs feature extraction and data analysis procedures.
- Applies advanced techniques to improve machine learning models.
- Develops machine learning systems using Python tools.
- Integrates machine learning into multimedia applications such as language and audio signal processing.

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, analysis and synthesis of data and information, using the necessary technologies
- Adaptation to new situations
- Decision-making
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- - Promotion of free, creative and deductive thinking

(3) SYLLABUS

Machine learning is now a fundamental part of many commercial and research applications. By making use of the Python language, and libraries such as Scikit-learn and TensorFlow, it is possible to rapidly develop complex applications, in fields such as the development of audio human-machine communication interfaces (e.g. speech recognition, speech synthesis), audio event recognition, robotic vision and hearing, etc.

With the above in mind, this course aims to introduce students to the field of machine learning. Within this framework, the principles governing the different stages of the implementation of a system for knowledge extraction from data, using both basic and cutting-edge methods, will be studied. The

course lectures will cover the complete process of developing decision functions, including those for data collection, feature extraction and evaluation of results.
In addition to covering the relevant theoretical background, the course will make use of Python language libraries, used in research and commercial applications, for the development of automatic pattern recognition systems in fields such as natural language processing, audio signal processing, etc.

Below is the material that will be covered in the applied machine learning course:

1. Introduction to machine learning and pattern recognition
2. Supervised/unsupervised learning, reinforcement learning.
3. Classification, regression, clustering
4. Decision trees
5. Learning by memorization
6. Support vector machines
7. Artificial neural networks and deep learning networks
8. Evaluation of machine learning models
9. Processing of multimedia data to create training-evaluation sets
10. Open source tools in Python for creating complete machine learning systems (Scikit-Learn, Tensorflow)
11. Applications of machine learning methods in research fields such as natural language processing and acoustic signal processing (e.g. speech, music, etc.)

(4) TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	- Electronic presentations for teaching the theoretical part and relevant instructions for the applied lectures. - - Use of Python language and Jupyter Notebooks to conduct exercises and implementations.
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	50
Practical exercises focusing on the application of the methods of the subject	18
Homework	32
Independent study of lectures and literature	50

	Course Total	***125 hours (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.*	Students will be assessed on the basis of written examinations at the end of the semester, laboratory exercises and assignments that will be given to students during the semester. Remarks: - The final grade is derived by weighting each instructor's grades by a common weighting factor. - The assessment will be in the Greek language.	

(5) ATTACHED BIBLIOGRAPHY

- *Bishop, C. M. (1995). Neural Networks for Pattern Recognition, Oxford University Press. ISBN 0-19-853864-2*
- *Ian H. Witten; Eibe Frank; Mark A. Hall (2011). "Data Mining: Practical machine learning tools and techniques, 3rd Edition". Morgan Kaufmann, San Francisco. Retrieved 2011-01-19.*
- *MacKay, D. J. C. (2003). Information Theory, Inference, and Learning Algorithms, Cambridge University Press. ISBN 0-521-64298-1*
- *Mitchell, T. (1997). Machine Learning, McGraw Hill. ISBN 0-07-042807-7*
- *Bishop, C., Pattern Recognition and Machine Learning, Springer-Verlag New York, Inc. Secaucus, NJ, USA, 2006*
- *Guido S., Müller A., Introduction to Machine Learning with Python, O'Reilly Media, 2016*

MSC-IICS-105. Technology and Entrepreneurship

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Graduate		
COURSE CODE	**MSC-IISC-105**	**SEMESTER**	**1**
COURSE TITLE	**Technology and Entrepreneurship**		

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	2	
Seminars / Practice exercises	1	
Laboratory	0	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).	3	6

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://www.ece.uop.gr/

(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 aim of the course is to familiarize students with the basic concepts of entrepreneurship in the modern environment of the World Wide Web with emphasis on the design and implementation of efficient e-business applications. As part of the course, students will be given the opportunity to understand the concept of the business model and its components and to become familiar with examples of applications based on one or more models. They will also be able to see how they operate on a business and technological level (advertising networks, beacons, web cookies, retargeting, etc.). Special topics such as security and privacy technologies and services as well as modern electronic

transaction processing services (credit cards, bitcoin, e-wallet, etc.) will be presented in detail.

Teaching includes subjects such as:

- Introductory concepts and definitions, elements of expansion of e-business applications at national, European and global level
- Business models, e-procurement and supply chain management
- Digital marketing and e-commerce on social media and mobile devices.
- Electronic management of customer relations.
- Software development lifecycle and e-business application development project management
- Management of e-business technological infrastructure
- E-business applications and personalization techniques
- Electronic transaction processing and security issues
- Legal and privacy issues

The main objectives of the course are:

- familiarizing students with basic concepts and terms related to e-business
- the presentation of concepts and the importance of business models and their components.
- Practicing the design and implementation of efficient e-business applications.
- The examination of the operational and technological role of advertising networks,
- Understanding security and privacy technologies and services.

Upon successful completion of the course the student will be able to:

<u>At Knowledge level:</u>

- Fully know all the basic concepts necessary to understand modern entrepreneurship
- Design and Implementation of Electronic Applications:
- He is sensitive to issues of security in e-business and privacy protection.
- He has knowledge of the role of technology in the field of entrepreneurship and how various technologies work in this field.

<u>In terms of Skills:</u>

- Design and Implement Electronic Applications
- It incorporates best practices that meet business needs.
- implements CRM strategies to effectively manage customer relationships and increase customer loyalty.
- She has skills in digital marketing and e-commerce, including social media and mobile advertising strategies.
- Develops skills in software development lifecycle management and e-business application development project management.
- Analytical Thinking and Problem Solving and Skills in problem analysis and decision-making

based on analytical criteria.

In terms of Competences:

- Ability to design and implement electronic applications, using modern technologies and platforms.
- Ability to effectively communicate technical concepts to non-technical partners and vice versa.
- Ability to implement and manage CRM systems to better manage customer relationships.

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, analyze and synthesize data and information, using the necessary technologies
- Decision-making
- Autonomous work
- Teamwork

(3) SYLLABUS

1. Introduction - Basic concepts
2. Flashback to Technologies
3. Trends in entrepreneurship based on technologies and models
4. Basic Functions of an Online Business Endeavor
5. App design guidelines
6. Case Study 1: Presentation of case study 1
7. Modern e-Business Metrics
8. Case Study 2: Presentation of case study 2
9. Basic Personalisation Theory
10. Design of Personalized Applications: Algorithms and Practices
11. Case Study 3: Presentation of case study 3
12. Recommendation systems
13. Personalisation case study. Recommendation Case Study (Spotify, Netflix)

(4) TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform.

	Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Slides (ppt) for teaching the theoretical part, which are posted after each lecture in the e-Class. • Laboratory guides for the laboratory part (one for each laboratory exercise), which are posted for the preparation of the exercise in the e-Class. • Support of the learning process through the e-Class platform (for notification of the course regulations, for distribution of slides, supplementary material, announcements, links and bibliography, for the conduct of any intermediate and final exams, etc.). • Specialized software for designing integrated e-business applications (woo commerce) available to every student.
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	28,5
Laboratory practice	10,5
Lab exercises preparation	10,5
Project preparation	52,5
Study of Lectures Slides and Bibliography	48
Course Total	***150 ώρες (6ECTS)***

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*	A. <u>Evaluation of the Theoretical and Practical Part:</u> • Creation of a complete business project and its delivery (80%) 1. Solving a problem • Open Presentation of the Business Idea, presentation of the implementation and Support in the process of questions (20%) <u>Notes</u>: • The final grade results from the weighting of the

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	above with weighting factors of 80% 20%, respectively. • The evaluation is done in Greek. • The evaluation process and evaluation criteria are published on the course website in e-Class.

(5) ATTACHED BIBLIOGRAPHY

- Thiel, P., & Masters, B. (2014). Zero to One: Notes on Startups, or How to Build the Future. Crown Business.
- Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.
- Enge, E., Spencer, S., Stricchiola, J., & Fishkin, R. (2015). The Art of SEO: Mastering Search Engine Optimization. O'Reilly Media.
- Christensen, C. M. (2016). The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business Review Press.
- Provost, F., & Fawcett, T. (2013). Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking. O'Reilly Media.

MSC-IICS-201. Advanced Security Systems

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**MSC-IISC-201**	**SEMESTER**	**2**
COURSE TITLE	Advanced Security 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	2	
	Seminars / Practice exercises	1	
	Laboratory	0	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		3	6
COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	General background		
PREREQUISITE COURSES:	No. Students are advised to have already attended the courses of the 1st semester		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes.		
COURSE WEBSITE (URL)	https://smart-ict.ece.uop.gr/εξάμηνο-α/101-2		

(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*
In this course, some basic and mainly advanced concepts for cryptography are given and how these are used in the security of computer systems. More specifically, the concepts of symmetric and asymmetric cryptography algorithms are briefly given, then the properties of cryptography algorithms and the basic structures used in the design of secure cryptography algorithms are

analyzed. Then extensive reference to modern symmetric, asymmetric algorithms and some modern hash functions is mad. In addition, very important information is given on modern cryptographic protocols and methods used in modern computer security systems.

The main objectives of the course are:

- familiarizing students with basic concepts of information security and security in cybersystems
- the presentation of the privacy concepts
- the analysis of threats that the privacy can be affected
- learning basic aspects of system security
- learning the basics of software security
- learning basic concepts of infrastructure security (industrial control systems, internet, hardware)

Learning outcomes

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

At the knowledge level:

- Knows all the basic concepts necessary to understand cryptography
- Knows the basic concepts of computer system security
- Knows all types of cryptographic functions and their properties
- Chooses the appropriate methodologies against vulnerabilities of an information system
- Assesses the needs required for the security of systems, software and infrastructure

At the skill level:

- Uses cryptographic protocols and their applications
- Manages modern methods and techniques for the security of systems, software and infrastructure
- Analyzes a security problem and finds countermeasures

At the level of abilities:

- Selection of appropriate components for designing a secure 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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team Work
- Project planning and management

(3) SYLLABUS

Lectures:

1st : Introduction - Basic concepts of applied cryptography
2nd: Modern Cryptography Algorithms - Lightweight Cryptography Algorithms - Key Management
3rd: Digital certificates, signatures and public key infrastructure
4th: Cloud computing security and system deployment strategies
5th: Security of network applications
6th: Detection and Analysis of Cyber Attacks
7th: Incident Management and Criminal Investigation
8th: Secure System Design in FPGA
9th: Detection of Hardware Trojan Horses
10th: Network Security (Theory)
11th: Network Security (Lab)
12th: Email security
13th: Security in Cyber-Physical Systems

(4) TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Slides (ppt) for teaching the theoretical part, which have been posted since the beginning of the semester in the e-Class. • Laboratory guides for the laboratory part (one for each laboratory exercise), which have been posted on the e-Class since the beginning of the semester. • Support of learning process through the e-Class platform (for notification of the course operating regulations, for distribution of slides, supplementary material, announcements, links and bibliography, for the conduct of the intermediate and final examination of the laboratory part, etc.). • Specialized software e.g (INTEL QUARTUS, XILINX VIVADO) for the laboratory part freely available to each student.
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-*	

Activity	***Semester workload***
Lectures	28.5 hours
Laboratory Exercises (in Lab)	10.5 hours
Preparing Laboratory Exercises	10.5 hours
Preparing home exercise	52.5 hours

directed study according to the principles of the ECTS	Lecture & bibliography study (at home)	48 hours
	Course Total	***150 hours (6 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.*	Assessment of Theoretical Part: • Intermediate homework (30%), which includes solving exercises. • Written final exam (70%), that includes solving exercises, multiple choice questions and comparative evaluation of theory elements, graded difficulty. <u>Remarks</u>: • The evaluation is done in the Greek language • The evaluation process and evaluation criteria are published on the course's website in the e-Class.	

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

In Greek

1) William Stallings, "Cryptography for Network Security: Principles and Applications", ION, 2011.

2) William Stallings and Lawrie Brown, "Computer Security: Principles and Practices", Keystone, 2016.

3) S. Gritzalis, "Modern Cryptography: Theory and Applications", Papasotiriou, 2010.

4) V. Katos, G. Stefanidis, "Cryptography and Cryptanalysis Techniques", Zygos, 2003.

MSC-IICS-202. Cloud Computing Technologies

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**ICT_202**	**SEMESTER**	**2**
COURSE TITLE	Cloud Computing Technologies		
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		3	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		3	5
COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Special background, skills development		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek or English if required		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://smart-ict.ece.uop.gr/		

(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 aim of the course is to familiarize students with the basic concepts in cloud computing technologies and issues faced by users, administrators and developers. In the context of the course, the three most popular commercial cloud platforms available (Amazon, MS Azure, Google Cloud) are examined in detail, as well as the basic open software cloud computing development platform (OpenSack). Students are introduced to the techniques of installation, configuration and management of the resources of a computing cloud (computers, storage and networks) and in addition they introduced into cloud

computing technologies from a programmer's point of view, exploring topics such as: development of PaaS type applications (Platform as a Service) and SaaS (Software as a Service), microservices, task scheduling in cloud computing, software defined networks, etc.

Keywords: cloud technologies, cloud platforms, Platform as a Service, Software as a Service, microservices, software defined networks

Learning Outcomes

Upon successful completion of the course, student will be able to:

At the Knowledge level:

- understand the concepts: cloud computing, virtual machine, elasticity, software defined networks, platform as a service, software as a service, microservices
- distinguish the differences between private, public and hybrid cloud computing
- distinguish the differences between platform as a service and software as a service
- know the most well-known opensource and commercial cloud computing platforms, such as Amazon AWS, Microsoft Azure, Google Cloud, as well as their differences and similarities
- describe the most important security issues in the cloud
- know the differences between microservices and monolithic applications

At the Skill level:

- be able to create virtual resources on cloud platforms, such as virtual machines, storage, networks, etc.
- be able to design and develop applications on cloud platforms
- be able to design and develop applications on cloud platforms with a microservices architecture

At the level of Abilities:

- have the ability to select, depending on the needs of each project, the most suitable cloud platform for infrastructure and/or application development, taking into account cost, performance and speed/ease of development
- have the ability to manage and schedule tasks in cloud computing
- choose the most appropriate tools from cloud platforms for the most efficient management of big data
- have the ability to integrate machine learning technologies into applications developed in the cloud
- have the ability to design, implement, test, debug and document programs based on microservices.

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
- Adapting to new situations

- Decision-making
- Working independently
- Team Work
- Working in an international environment
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

The course is developed in the following 13 lectures:

i. Introduction to Cloud Computing, system categories, capabilities and architectures
ii. Service delivery models, Open Software Cloud Computing platforms – OpenStack. Hybrid cloud computing. Advanced cloud computing issues
iii. Management and configuration of virtual machines, flexibility
iv. Virtual network connections in a cloud computing environment, software defined networks. Security issues in the cloud.
v. Contracts for the provision of tasks, management and scheduling of tasks in cloud computing
vi. Cloud Platform: Microsoft Azure
vii. Application development on Microsoft Azure platform
viii. Cloud Platform: Google Cloud
ix. Application development on Google Cloud platform
x. Cloud Platform: Amazon AWS
xi. Application development on Amazon AWS cloud platform:
xii. Big Data management in the Cloud
xiii. Developing applications based on microservices architecture

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Supporting the learning process through the e-Class platform (for notification of the course regulations, for distribution of slides, laboratory exercises, supplementary material, announcements, links, bibliography, etc.). • During the lectures of the theoretical part, a projector and presentations in electronic form are used, which are also posted on the eclass from the beginning of the semester. • During the lectures, a computer is used for developing applications on cloud platforms.

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***
Theory Lectures	39
Project elaboration	43
Independent study of lectures and bibliography	43
Course Total	***125 hours (5 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.

A. Written final exam that includes:
- Multiple choice questions
- Short answer questions

B. Project elaboration

Remarks:
- The final grade results from the weighting of the theory and project grades with coefficients determined at the beginning of the semester and announced to the students via e-class. Indicatively it will be about 30% - 70%
- Projects are submitted electronically and students are asked to take an oral exam on them.
- The exam material and the evaluation process are communicated to the students during lectures and in the e-class platform.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Logan Song and Yu Meng, "The Self-Taught Cloud Computing Engineer: A comprehensive professional study guide to AWS, Azure, and GCP", Packt Publishing, ISBN-13: 978-1805123705, 2022
- Ben Piper and David Clinton, "AWS Certified Cloud Practitioner Study Guide With 500 Practice Test Questions: Foundational (CLF-C02) Exam (Sybex Study Guide) – 2nd edition", Sybex, ISBN-13: 978-1394235636, 2023

- Priyanka Vergadia, “Visualizing Google Cloud: 101 Illustrated References for Cloud Engineers and Architects”, Wiley, ISBN-13: 978-1119816324, 2022
- Jonah Carrio Andersson, “Learning Microsoft Azure”, O'Reilly Media, Kindle Edition, 2023
- Chandra Rajasekharaiah, “Cloud-Based Microservices: Techniques, Challenges, and Solutions”, Apress, Kindle Edition, 2023

- *Related academic journals:*

- IEEE Cloud Computing
- IEEE Transactions on Cloud Computing
- ACM Journal of Cloud Computing: Advances, Systems and Applications
- Springer International Journal of Cloud Computing

MSC-IICS-203. Big Data Management Systems

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	MSC-IICS-203	**SEMESTER**	2
COURSE TITLE	Big Data Management 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		2,5	
Seminars / Practice exercises			
Laboratory		0,5	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		3	5
COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Special background, Skills Development		
PREREQUISITE COURSES:	There are no prerequisite courses. Recommended background knowledge: Introduction to Databases		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No.		
COURSE WEBSITE (URL)	https://smart-ict.ece.uop.gr/ πρόγραμμα-σπουδών/εξάμηνοα/203-2/		

(2) LEARNING OUTCOMES

At the knowledge level:

1. understand the basic concepts of Big Data
2. understands the advantages of using new technologies with the management of big data,
3. distinguish between structured, semi-structured and unstructured data,
4. know the basic data sources and data types in big data area
5. know BD Data Models and BD NoSQL Systems Architecture,
6. understand the basic concepts of DB (Relational and NoSQL) and to know the available DBMS of the market,
7. know the basic principles of distributed management of Big Data,
8. know basic architectures of Big Data processing systems,
9. know the characteristics of NoSQL – NewSQL databases, with a comparison of their capabilities (e.g. column-oriented vs row-oriented databases) and familiarity with the most basic of them (e.g. MongoDB, Neo4j, Cassandra).

At the skill level:

1. to be able, considering the client's requirements, to apply data modeling techniques for planning, organizing and processing large volumes of data in basic NoSQL Databases.
2. use efficiently popular NoSQL DBMS software, in order to enter and create the DB of the application,
3. to properly use the languages of basic NoSQL DB Systems so that by using their queries, on the one hand, it defines the basic structural elements of the DB and, on the other hand, manages its data efficiently for the benefit of the application's requirements,
4. develop those knowledge acquisition skills that he needs to pursue further studies with a high degree of autonomy.

At the level of abilities:

1. understand the customer's requirements and help him to express them correctly in order to create a BD Diagramm that can fully meet his needs,
2. have the ability to apply the knowledge of design and implementation of NoSQL DB acquired in the design and implementation of real DB systems of the labor market,
3. have the ability to understand new knowledge and views arising from modern developments at the forefront of the cognitive field of NoSQL Databases for the purpose of both continuous professional development and in the context of research activity,
4. have the ability to solve problems in the context of the NoSQL Database cognitive field, 5. have the ability to apply his knowledge in a new or unknown environment, within a broader (or interdisciplinary) context, relevant to the cognitive field of Databases.

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

Others… *…….*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Production of free, creative and inductive thinking. • Working independently. • Project planning and management. • Working in an international environment.

(3) SYLLABUS

Theoretical courses consist of:

- Introduction to Big Data, Big data – Data Sources and Types, Data modeling in Big Data considering the client's requirements, to apply data modeling techniques for planning, organizing and processing large volumes of data in basic NoSQL Databases.
- Specific advanced capabilities of functional programming languages.
- The architecture of modern big data processing systems (eg MapReduce, Hadoop) and the corresponding integrated ecosystems.
- The characteristics of NoSQL - NewSQL databases, comparison of their capabilities (eg column-oriented vs row-oriented databases) and familiarization with the most basic of them (eg MongoDB, Neo4j, Cassandra).
- Applications of large volume data and the main related techniques, methods and technologies.
- Graphical processing of large volumes of data.

The laboratory courses consist of advanced applied training exercises and projects using a numerous NoSQL databasest like MongoDB, Neo4j, Cassandra.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Support of learning process through the e-Class platform (for notification of the course operating regulations, for distribution of slides, supplementary material, announcements, links and bibliography, etc.). • Slides (ppt) for teaching the theoretical part, which have been posted since the beginning of the semester in the eClass. • Freeware development tools. • Use of specialized Database development environment (such as Neo4j Graph Database).

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 nondirected study according to the principles of the ECTS

Activity	***Semester workload***
Lectures	2,5 x 13=32,5
Laboratory practice	0,5 x 13=6,5
Homework	83
Final exam (theory)	3
Course Total	***125 hours (5 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.

A. Written final exam that includes:

- Solve exercises
- Multiple choice questions
- Short answer questions

B. Preparation of laboratory exercises and project.

Remarks:

- The final grade results from the weighting of the theory and work grades.
- The exam material and the evaluation process are communicated to the students in the lecture hall and in the e-class.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Big Data: Concepts, Technology, and Architecture, 2021, Balamurugan Balusamy, Nandhini Abirami R, Seifedine Kadry, Amir H. Gandomi, ISBN: 1119701821 , Publisher Wiley.
- Βασίλειος Τ. Ταμπακάς, Εισαγωγή στις Βάσεις Δεδομένων, έκδοση 2η, 2017, ISBN: 978-9609427-66-1, Εκδόσεις Γκότση.
- Big Data. Using SMART Big Data, Analytics and Metrics To Make Better Decisions and Improve Performance, 2015, Marr~Bernard B., ISBN: 9781118965832, Publisher John Wiley & Sons Inc.
- Big Data- Principles and Best Practices of Scalable Realtime Data Systems, 2015, Marz~Nathan, Warren~James, ISBN: 9781617290343, Publisher Manning Publications.

MSC-IICS-211. Cyberphysical Systems

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**MSC-IICS-211**	**SEMESTER**	**2**
COURSE TITLE	CYBERPHYSICAL 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	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Specialised
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://smart-ict.ece.uop.gr/%cf%80%cf%81%cf%8c%ce%b3%cf%81%ce%b1%ce%bc%ce%bc%ce%b1-%cf%83%cf%80%ce%bf%cf%85%ce%b4%cf%8e%ce%bd/%ce%b5%ce%be%ce%ac%ce%bc%ce%b7%ce%bd%ce%bf-%ce%b1/211-2/

(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 goal of the course is to extend the knowledge already obtained during the Internet of Things course and introduce advanced topics on the design of end - to - end cyberphysical systems. In more details, modern techniques of cyberphysical system design and the respective challenges will

be presented. In that context, students will be taught robotics and computer vision technologies and how they interact with cyberphysical systems. Moreover, fundamental elements and architectures of cyberphysical systems will be also presented.

Keywords: Robotics, wireless sensor networks, cloud infrastructure, networked embedded systems

Educational Results

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

At knowledge level:

1. To understand modern technologies and their challenges on the design of cyberphysical systems
2. To understand robotics technology and computer vision along with the cyberphysical systems.
3. To describe the basic structural components of a cyberphysical system

At skills' level:

1. Familiarize with the design and development of cyberphysical systems
2. Familiarize with robotics and computer vision

At capabilities' level:

1. Select the proper techniques for designing a cyberphysical system
2. Select the proper structural components during the design of a cyberphysical system according to the application domain
3. Address common challenges that rise during the design of cyberphysical systems.
4. To simulate robotics and computer vision applications through the respective simulation software

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, analysis and synthesis of data and information using appropriate tools and technology
- Working individually
- Working in group
- Working in international environment
- Promoting free, creative and inductive thinking
- Promoting new research ideas

(3) SYLLABUS

What is the definition of a cyberphysical system? How it differentiates to the Internet of Things (IoT). Basic characteristics of a cyberphysical system. Comprehension of the challenges and the constraints that are introduced on such systems. Comprehension of the fundamental design, development and maintenance principles of cyberphysical system's

components. Presentation of the structural elements and the communication protocols of a cyberphysical system. Introduction to robotics and how they interact with other systems in the context of a cyberphysical system. Industrial cyberphysical systems and its role in industry 4.0.

The course lectures cover the following thematic areas:

• Introduction to cyber-physical systems Basic definitions, characteristics and applications of cyber-physical systems. Basic design principles. Challenges in Designing Cyberphysical Systems.

• Introduction to hardware design with FPGA (1) Introduction to hardware design concept. Presentation of state-of-the-art technologies and techniques and study of related challenges.

• Introduction to hardware design with FPGA (2) Application with specific examples in cutting-edge environments.

• Advanced Embedded Systems topics (1) Deep dive into ARM architecture. Managing interruptions, hardware and actions and showing specific examples in edge environments.

• Advanced Embedded Systems topics (2) Deep dive into ARM architecture. Managing outages, hardware and actions and showing specific examples in edge environments.

• Real-Time Operating Systems Introduction to the concept of real-time, understanding the related requirements and architecture of real-time systems. Presentation of relevant operating systems such as RTOS, FREERTOS. MbedOS etc

• Smart wireless sensor networks and IoT OS. Advanced topics of wireless networks, communication protocols, architectures and platforms. Presentation of related state-of-the-art operating systems

• CPSs Acceleration and Optimization Techniques (1). Dive into hardware and software optimization techniques aimed at accelerating processing speed, reducing power consumption and reducing memory requirements for complex CPS systems.

• CPSs Acceleration and Optimization Techniques (2) Application with specific examples in cutting edge environments.

• Cloud Computing Infrastructure Technologies Dive into infrastructure and cloud computing support technologies of complex and distributed CPS.

• CPSs Acceleration and Optimization Techniques (1). Dive into artificial intelligence and machine learning technologies and techniques for complex CPS systems.

• CPSs Acceleration and Optimization Techniques (2). Implementation with specific examples in cutting-edge environments.

• Advanced design topics and trends for future CPSs Presentation of topics such as Instruction Level Parallelism, DSPs, Multicores, Reconfigurable systems applied to CPS applications.

(4) TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Slides (ppt) of the presentation of the theoretical part of the course, which will be available from the beginning of semester through e-Class. • Guidelines for the exercises (one per exercise), which will be available from the beginning of the semester through e-Class. • Suggested solutions for each exercise will be provided following the completion of each exercise. • Support of teaching procedure through the e-Class platform (notification of the teaching procedure, distribution of slides, supplementary material, announcements, relative links and literature, provision of test and the final examination) • Specialized software relevant to the course.
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	48
Practical examples and exercises – focusing on problem solving	15
Study of lectures and bibliography	60
Project implementation	27
Course Total	***150 hours (6 ECTS)***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure*	A. Evaluation of theoretical part: Final written exam that includes: 4. Solving exercises

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.*	5. Multiple choice questions 6. Comparative evaluation of theory elements B. Evaluation of exercises/projects Written exams take place throughout the semester and include: 3. Solving exercises 4. Multiple choice questions Comments: • The final grade is the weighted result of the grades of theory and assignments. The weights will be defined and the beginning of each semester and they will be announced via e-Class. • The final exams are in Greek language • The examination process and the evaluation criteria are publicly available to the students through e-Class.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Rajeev Alur, «Principles of Cyber-Physical-Systems», The MIT Press, 2015
- S. Thrun, W. Burgard, D. Fox, «Πιθανοτική Ρομποτική», Ελληνική έκδοση, Εκδόσεις Κλειδάριθμος
- Koubaa, Anis, «Robot Operating System (ROS)»,The Complete Reference (Volume 3), Springer
- Dawson-Howe Kenneth, «A Practical Introduction to Computer Vision with OpenCV», 2014

- Related academic journals:

- ACM Transactions on Cyber-Physical Systems
- IEEE Transactions on Industrial Electronics

MSC-IICS-212. Interface Design for Intelligent Systems

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Graduate		
COURSE CODE	**MSC-IICS-212**	**SEMESTER**	**2**
COURSE TITLE	**Interface Design for Intelligent Services**		

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	2	
Seminars / Practice exercises	1	
Laboratory	0	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).	3	6

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Specialized
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://www.ece.uop.gr/

(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 purpose of the course is to train students in advanced interface and interaction design processes for applications covering mobile devices and interfaces with any smart device. As part of this course, the basic background of application design will be presented. Cognitive psychology topics necessary to support the theoretical background of understanding human behavior, and basic principles of user-friendly interfaces of use will be presented. The focus will then be on web and mobile design. Special reference will be made to tactile environments (touch screens) but also to design for different age groups (elderly, children) and people with disabilities.

Teaching includes subjects such as:

- Introduction to interaction design. Historical review of application design and interaction techniques.
- Theoretical models of knowledge and experience acquisition. The importance of attention in the design of interaction
- Cognitive references and sensory organs. Examples and applications
- The use of colors in app design.
- Usability and usability rating. Create a user experience using personas
- Web application design. Application design guidelines for smart devices and smart home/smart city applications.
- Design guidelines for special population groups (children, the elderly, people with disabilities).

The main objectives of the course are:

- understanding the theoretical models of knowledge and experience acquisition that influence interface design.
- Apply basic design principles, such as usability, aesthetics, and simplicity, to various user environments.
- understanding the use of colors in interface design and how they affect user perception.
- understanding usability assessment methods and creating a user experience through the use of personas.

Upon successful completion of the course the student will be able to:

<u>In terms of Knowledge:</u>

- He is fully aware of all the basic concepts necessary to Understand the theoretical models of knowledge and experience acquisition that affect interface design.
- Knowledge of the basic principles of usability and the ability to apply them in interface design.
- Knowledge of usability assessment methods and ability to apply them to design.
- Knowledge of the importance of adapted design for different age groups and people with disabilities.

<u>In terms of Skills:</u>

- Skill in applying basic usability principles to interface design
- Familiarity with the use of design tools and software that support interface design.
- Ability to assess user interfaces and create a User Experience using personas.
- Skill to propose innovative solutions in interface design, taking into account developments in technology.

<u>In terms of Competences:</u>

- ability to design interfaces that offer a pleasant and efficient user experience
- Ability to adapt design for various environments, such as the web, mobile devices, and smart home/smart city applications
- Ability to communicate effectively and collaborate with other professionals, such as developers and designers

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, analyze and synthesize data and information, using the necessary technologies
- Decision-making
- Autonomous work
- Teamwork

(3) SYLLABUS

1. Introduction - Basic concepts
2. Retrospective on Interaction Technologies
3. Icon Design
4. Cognitive models and concepts
5. Paint instructions
6. Basic Design Guidelines for Interactive Systems
7. Design on the Web
8. Wireframing
9. Mobile Design: Part A
10. Mobile Design: Part B
11. People
12. Breadcrumbs Design
14. Special design directives with Gestalt law

(4) TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Slides (ppt) for teaching the theoretical part, which are posted after each lecture in the e-Class. • Laboratory guides for the laboratory part (one for each laboratory exercise), which are posted for the preparation of the exercise in the e-Class. • Support of the learning process through the e-Class platform (for notification of the course regulations, for

<table>
<tr><td></td><td>distribution of slides, supplementary material, announcements, links and bibliography, for the conduct of any intermediate and final exams, etc.).
• Specialized software for designing integrated e-business applications (woo commerce) available to every student.</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>28,5</td></tr>
<tr><td>Laboratory practice</td><td>10,5</td></tr>
<tr><td>Lab exercises preparation</td><td>10,5</td></tr>
<tr><td>Project preparation</td><td>52,5</td></tr>
<tr><td>Study of Lectures Slides and Bibliography</td><td>48</td></tr>
<tr><td></td><td></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>150 hours (6ECTS)</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><u>Theoretical and Practical Part Assessment:</u>
Creation of an integrated application in a design program (choice of three different projects):
• Παραγωγή site map (20%)
• Design creation (30%)
• Create a functional mockup (50%)
<u>Notes</u>:
• The final grade results from the weighting of the above with weighting factors of 20%, 30% and 50% respectively.
• The evaluation is done in Greek.
• The evaluation process and evaluation criteria are published on the course website in e-Class.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Cooper, A., Reimann, R., & Cronin, D. (2007). About Face 3: The Essentials of Interaction Design. Wiley.
- Norman, D. A. (2013). The Design of Everyday Things. Basic Books.
- Rubin, J., & Chisnell, D. (2008). Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests. Wiley.

- Tondreau, B. (2019). Layout Essentials: 100 Design Principles for Using Grids. Rockport Publishers.
- Shneiderman, B., Plaisant, C., Cohen, M., & Jacobs, S. (2019). Designing the User Interface: Strategies for Effective Human-Computer Interaction. Pearson.
- Garrett, J. J. (2011). The Elements of User Experience: User-Centered Design for the Web and Beyond. New Riders.
- Nielsen, J., & Budiu, R. (2010). Mobile Usability. New Riders.

MSC-IICS-221. Advanced Educational Technologies Systems

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MSC-IICS-221**	SEMESTER	2
COURSE TITLE	**ADVANCED EDUCATIONAL TECHNOLOGIES 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	2	
Seminars / Practice exercises	1	
Laboratory		
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	3	5

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Specialized
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://bit.ly/3uTXCmG & https://eclass.uop.gr

(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 purpose of the course is to train students in modern technological trends and applications in education. The course focuses on new teaching approaches that use Information and Communication Technologies to develop innovative educational programs. Students explore new trends in educational technology, including virtual learning environments, distance learning platforms, MOOCs, educational management information systems, the use of language technologies in education, and educational

data analytics. Topics include the analysis of the advantages and challenges of online courses, the design of advanced learning content, the use of technological tools to improve the teaching process, but also the discussion of ethical issues that can arise from the use of these tools.

Keywords: Virtual learning environments, Distance learning platforms, MOOCs, Automated assessment, Online courses, Educational software technologies, Educational analytics, Ethical issues in educational technology.

Learning results

Students develop abilities to design and implement educational programs that take advantage of advanced technologies, while examining their impact on student learning and assessment. In addition, they analyze ethical issues and challenges arising from the use of advanced educational technologies. Upon completion of the course, students gain a deep understanding of the conditions that influence the effective integration of advanced technologies in the educational space. Particularly:

In terms of Knowledge:

- Understanding virtual and augmented learning environments and their capabilities.
- Understanding the operation of open educational environments and distance learning platforms.
- Understanding the capabilities of online courses and their challenges.
- Understanding the digital technologies for designing learning content.
- Understanding the operation of information systems for Education Administration.
- Understanding the use of language technologies in education.
- Understanding the use of educational analytics.

At Skill level:

- Analysis and evaluation of the effects of educational technology on learning.
- Management of digital educational materials and e-learning platforms.
- Application of educational software technologies in teaching.
- Implement virtual and augmented learning environments for hands-on experience.
- Application of ICT for the development of innovative educational programs, taking advantage of the possibilities provided by modern technologies for the personalization of learning, collaborative learning and interactivity.
- Use educational analytics tools to evaluate students' progress using technological tools.
- Development of skills in managing technological tools for teaching and assessment.

In terms of Skills:

- Use technological tools to improve teaching.
- Creating virtual learning environments.
- Evaluation of the effectiveness of ICT in education, based on criteria such as the achievement of learning objectives, student participation and teacher satisfaction.
- Leveraging ICT to improve the educational process, providing students with more engaging and effective educational experiences.
- Developing capabilities in the automated assessment of educational progress.
- Active role in the development of educational technology.
- Analysis and treatment of ethical issues arising from the use of advanced educational

technologies.

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, analyze and synthesize data and information using the necessary technologies.
- Adapt to new situations
- Working independently
- Team work
- Working in an international environment
- Production of new research ideas.
- Project planning and management
- Criticism and self-criticism
- Promote of free, creative and inductive thinking

(3) SYLLABUS

Brief description

The purpose of the course is to train students in modern trends in educational technology and the corresponding applications. In the context of the course, the current trends and perceptions in education will be presented with an emphasis on new teaching approaches that use Information and Communication Technologies for the development of innovative educational programs. Modern tools and systems used in education will be presented with an emphasis on online technologies and the example of the participatory internet (Web 2.0).

The teaching of the course includes the following subjects:

- Introduction to Educational Technology: Definitions and historical review of educational technology, Contemporary technological trends, ICT in education in Greece and internationally, The use of e-learning, Studies and statistics, The future of ICT in education, The international e-learning market of learning. Open educational environments: Massive Open Online Courses (MOOCs), Open Content, Open Educational Resources, Open hardware.
- Electronic learning (e-learning): Definition, Models of electronic learning, Asynchronous Virtual Classroom, Modern Virtual Classroom, Utilization of internet services for distance education, Electronic Classroom Management and Learning Management Systems (LMS), LMS Technology Background: LMS Specifications, Popular Open Source LMS. Educational lesson planning systems, Audio-visual video conferencing systems, Collaborative systems, Examples.
- Information systems for Education Administration: e-governance in Education Administration, The role of open educational data, Government e-services for Education Administration, Educational Networks for school, higher education and research. Panhellenic School Network Services for Education.

- Participatory Internet Services (Web 2.0) in Education: Communities of Practice, Blogs, Wikis, Media Sharing Services, Safe and Creative Internet Issues. Tools for authoring interactive videos, educational materials and evaluation.
- Emerging educational technologies: Cloud Services, Mobile Learning, Flipped Learning, Blended Learning, Gamification, Personalized Learning Environments (PLE)
- Online education platform architecture and components. A study of the online music education scenario. Open source tools and best practices.
- Real-time communication of participants in remote education applications. Requirements regarding the speed and quality of data transmission depending on the educational scenario. Network Architectures and Comparison of Open Source Platforms for Audiovisual Communication.
- Utilization of Large Language Models (Large Language Models) in Educational Technology
- Advanced 3D Educational Environments: Virtual Reality (VR), Augmented Reality (AR), Merged Reality (MR), Introduction to Educational Robotics (STEM).
- Advanced 3D Educational Environments: Virtual Reality (VR), Augmented Reality (AR), Merged Reality (MR), Introduction to Educational Robotics (STEM).
- Introduction to Educational Data Analytics for technology-supported teaching and learning: Theories, methods and technological applications for use in Learning, Teaching, Management of Educational Units and Systems, and Educational Research, Decision-Making Systems in Education through Educational Data Analytics, Big Data and Learning Analytics.
- Introduction to Educational Data Analytics for technology-supported teaching and learning: Theories, methods and technological applications for use in Learning, Teaching, Management of Educational Units and Systems, and Educational Research, Decision-Making Systems in Education through Educational Data Analytics, Big Data and Learning Analytics.

The theoretical part of the course is accompanied by laboratory exercises related to Educational Analytics.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Slides (ppt) for teaching the theoretical part, which have been posted since the beginning of the semester in e-Class. • Laboratory exercises in educational analytical and linguistic technology using open software. • Learning process support through the e-Class platform (to communicate course regulations, to distribute slides, supplementary material, notices, links and bibliography, to conduct the evaluation, etc.). • Elaboration of assignments by the students and posting in e-Class.

<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 (hours)</th></tr>
<tr><td>Lectures</td><td>26 (=13×2)</td></tr>
<tr><td>Seminars</td><td>13 (=13×1)</td></tr>
<tr><td>Laboratory Exercises (in Lab)</td><td>12 (=6x2)</td></tr>
<tr><td>Projects (homework)</td><td>18 hours</td></tr>
<tr><td>Lecture & bibliography study (at home)</td><td>23 hours</td></tr>
<tr><td>Preparing for Final Exam</td><td>30 hours</td></tr>
<tr><td>Final Exam</td><td>3 hours</td></tr>
<tr><td>Course total</td><td>125 hours (5 ECTS)</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><u>Evaluation</u>:
• Elaboration of an individual work of the semester, which concerns both the theoretical and the laboratory part of the course.
• Final written exam that concerns the theoretical part of the course and includes solving exercises, multiple choice questions and comparative evaluation of theory elements, graded difficulty.
<u>Remarks</u>:
• The final grade is obtained by weighting the theory and laboratory grades with weighting factors of 50% and 50%, respectively.
• The evaluation is done in the Greek language.
• The evaluation process and evaluation criteria are published on the course website in e-Class.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

Suggested Bibliography:

Related scientific journals:

<u>In Greek language</u>

- "Information Society: Infrastructures, Services and Impacts", Michael Paraskevas, Triantafillou Vasilios, Georgios Asimakopoulos, Kallipos 2015.
- "Educational Internet Environments" Tsiatsos Thrasyvoulos, Kallipos 2015.
- "Learning Theories & Educational Software", Stavros Dimitriadis, Kallipos 2015.
- "Online Distance Education: From Theory to Practice", Sofos Alivizos, Kostas Apostolos, Paraschou Vassilios, Kallipos 2015.

<u>In English language</u>

- “The New Science of Learning: How to Learn in Harmony with Your Brain”, Terry Doyle and Todd Zakrajsek, Stylus Publishing, 2019
- “Learning in the Cloud: How Disruptive Technologies Are Changing the Way We Learn”, Cathy Davidson and David J. Karp, Palgrave Macmillan, 2015.

MSC-IICS-222. Digital Skills for STEM Sciences

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**MSC-IICS-222**	**SEMESTER**	**2**
COURSE TITLE	Digital Skills for STEM Sciences		

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	3	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).	3	5

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Specialised, skills development.
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek or English if required
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://smart-ict.ece.uop.gr/

(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 aim of the course is to educate students on how to develop digital skills through STEM technologies. The course contents include the following topics: Computational thinking in education, Introduction to STEM theory & methodology, Design of STEM and ICT educational scenarios, Digital educational scenarios and their implementation on existing platforms, Design of STEM educational activities for people with special educational needs, Materials for educational activities, such as building materials, mechanical, electrical and electronic components, sensors, motors, buzzers,

screens, etc., STEM support software, such as designing and printing 3D models, simulating electrical circuits, etc., Development Platforms for educational activities, such as Arduino and Raspberry PI. Developing applications with Arduino, Educational Robotics.

Keywords: modeling, UML language, object-oriented programming, Java, class, graphical user interface, event-based programming, MVC

Learning Outcomes

Upon successful completion of the course, student will be able to:

At the Knowledge level:

- understand the concepts: Digital Dive and Information Literacy, Visual Literacy, Media Literacy, Computer Literacy, Network Literacy, Educational Robotics.
- know the interconnection of digital skills and the labor market, the European strategy for the cultivation of digital skills, the Grand Coalition for Digital Skills, the National Action Plan, Computational Science and Computational Thinking in Education, Computational Thinking in Programming.
- know the definition and types of Computational Thinking
- describe the parts of a teaching scenario

At the Skill level:

- be able to design educational STEM activities in Arduino using: LEDs and resistors, sensors (temperature, light, sound, distance, acceleration), data visualization, displays, servo motors.
- be able to design STEM educational activities in Micro:bit
- be able to design STEM and ICT teaching scenarios and for people with special educational needs
- efficiently use popular STEM support software, such as designing and printing 3D models, simulating electrical circuits, etc.
- efficiently use popular development environments (IDEs) such as TinkerCAD, Arduino IDE, https://makecode.microbit.org/, to design circuits in an emulator and write and run code.
- design and develop educational STEM activities in programming, with efficient use of the Jupyter Notebook template through the Google Collaboratory and Google Drive environments.
- design and develop STEM educational activities using Machine Learning technologies, and Google Teachable Machine
- design and develop STEM educational activities using FPGAs

At the level of Abilities:

- select and combine appropriate building materials, mechanical, electrical and electronic components, sensors, motors, buzzers, displays, etc., to create robotics educational activities
- choose, depending on the problem, the most appropriate platform for developing educational activities, such as Arduino, Raspberry PI, Micro:bit, FPGAs, etc.
- have the ability to integrate machine learning technologies into STEM educational activities
- solve robotic problems described in natural language.
- have the ability to design, implement, test, debug and document STEM software and circuits.
- evaluate the effectiveness of a STEM educational scenario
- understand the structure and operation of STEM software and electronic circuitry that she has not designed and programmed herself and adapt it to her needs.
- select and combine appropriate tools / libraries, to design and develop STEM educational

activities.

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
- Adapting to new situations
- Decision-making
- Working independently
- Team Work
- Working in an international environment
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

The course is developed in the following 13 lectures:

xiv. The cultivation of digital skills (e-Skills): Digital Dive and Information Literacy, Visual Literacy, Media Literacy, Computer Literacy, Network Literacy, Connecting digital skills and the labor market, European strategy for the cultivation of digital skills. The Grand Coalition for Digital Skills. The National Action Plan. Computational Science and Computational Thinking in Education: Computer Science in Education, Definition and Types of Computational Thinking, Computational Thinking and Programming.

xv. Arduino platform for development of STEM educational activities: Presentation of platform and its extensions as well as indicative educational scenarios/applications

xvi. The Arduino IDE Programming Environment, The Arduino IDE Libraries, Introducing Simple Applications for Beginners. TinkerCad simulator.

xvii. Developing educational STEM activities on Arduino: Basic applications with LEDs and resistors

xviii. Developing STEM educational activities on Arduino: Applications with sensors (temperature, light, sound, distance, acceleration).

xix. Development of STEM educational activities on Arduino: Data visualization, displays, servo motors.

xx. Developing STEM educational activities with Micro:bit and/or Raspberry PI

xxi. Educational Robotics. Design of STEM and ICT teaching scenarios and for people with special educational needs.

xxii. Developing STEM educational activities in programming: Using the Jupyter Notebook template within the Google Collaboratory and Google Drive environment. Data processing, analysis and visualization in the cloud.

xxiii.	Developing STEM educational activities in Machine Learning: Ingesting data, training machine learning models to recognize images, sounds, and other streams through a graphical environment. The case of the Google Teachable Machine
xxiv.	Developing STEM educational activities on Arduino: Developing machine learning models through cloud technologies and extracting code with functional specifications compatible with embedded devices (arduino).
xxv.	Introduction to FPGAs. Using FPGAs in developing STEM applications, FPGAs vs. microprocessors, boards with FPGAs, FPGA programming tools.
xxvi.	Case Study: FPGA Controlled Wheeled Robot.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Supporting the learning process through the e-Class platform (for notification of the course regulations, for distribution of slides, laboratory exercises, supplementary material, announcements, links, bibliography, etc.). • During the lectures of the theoretical part, a projector and presentations in electronic form are used, which are also posted on the eclass from the beginning of the semester. • During the lectures, a computer is used for designing circuits in an emulator and writing and executing code. • Use of specialized software integrated development environment (such as TinkerCAD, Arduino IDE, https://makecode.microbit.org/).
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***
Theory Lectures	39
Laboratory Exercises	26
Project elaboration	30
Independent study of lectures and bibliography	30

	Course Total	***125 hours (5 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.*	A. Written final exam that includes: • Multiple choice questions • Short answer questions B. Laboratory exercises elaboration C. Project elaboration <u>Remarks:</u> • The final grade results from the weighting of the theory, laboratory excercises and project grades with coefficients determined at the beginning of the semester and announced to the students via e-class. Indicatively it will be about 30% - 30% - 40% • Laboratory exercises and projects are submitted electronically and students are asked to take an oral exam on them. • The exam material and the evaluation process are communicated to the students during lectures and in the e-class platform.	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Jeremy Blum, "Exploring Arduino: Tools and Techniques for Engineering Wizardry – 2nd edition" Wiley, ISBN-13: 978-1119405375, 2019
- Paul Bradt and David Bradt, "Science and Engineering Projects Using the Arduino and Raspberry Pi: Explore STEM Concepts with Microcomputers", Apress, ISBN-13: 978-1484258101, 2020
- Ashwin Pajankar, Abhishek Sharma and Sandeep Saini, "BBC Micro:bit in Practice: A hands-on guide to building creative real-life projects with MicroPython and the BBC Micro:bit", Packt Publishing, ISBN-13: 978-1804610121, 2022
- Russell Merrick, "Getting Started with FPGAs: Digital Circuit Design, Verilog, and VHDL for Beginners", No Starch Press, ISBN-13: 978-1718502949, 2023

- Related academic journals:

- Springer International Journal of STEM Education

MSC-IICS-231. Business Intelligence

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MSC-IICS-231**	SEMESTER	2
COURSE TITLE	**BUSINESS INTELLIGENCE**		

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	2	
Seminars / Practice exercises	1	
Laboratory		
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	3	5

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Specialized
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://rb.gy/umu12b & https://eclass.uop.gr

(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 purpose of the course is to introduce students in Business Intelligence and assist them in understanding thoroughly decision support and business intelligence systems. It covers the application of these systems in business data analysis, strategy development, and the decision-making process. Students will learn about BI architectures, components, platforms, and the role of OLAP and OLTP. A key focus is on data visualization, teaching effective data presentation and interpretation techniques. The course also explores Business Performance Management, its integration with business intelligence, and key performance indicators. Additionally, it addresses collaborative decision-making,

knowledge management, and the use of recommendation systems in business intelligence. This comprehensive program is designed to equip students with both theoretical knowledge and practical skills for the dynamic field of business intelligence.

Keywords: Decision Support Systems (DSS), Business Intelligence (BI), Data Warehousing, Data Analysis, Strategy Development, OLAP (Online Analytical Processing), OLTP (Online Transaction Processing), Data Visualization, Dashboard Design, Business Performance Management (BPM), Key Performance Indicators (KPIs), Collaborative Decision-Making, Knowledge Management, Recommender Systems, Business Data Analysis, Business Strategy.

Learning Outcomes

Students develop abilities to analyze and interpret complex business data using advanced decision support and business intelligence systems. They gain proficiency in applying OLAP and OLTP for strategic decision-making and business performance evaluation. The course enhances their skills in data visualization and dashboard design, enabling them to effectively present and interpret data for informed decisions. Students also learn to implement key performance indicators and balanced scorecards in Business Performance Management. Furthermore, the course cultivates expertise in collaborative decision-making and knowledge management, equipping them with the skills to utilize recommender systems and other collaborative tools in a business context. These competencies prepare graduates to effectively navigate and lead in the dynamic and data-driven landscape of modern business.

Upon successful completion of the course the student will be able to:

In terms of Knowledge:

- *Understanding of Decision Support Systems*: Knowledge of how these systems aid in business decision-making processes.
- *Insights into Business Intelligence Systems*: In-depth understanding of BI platforms, architectures, and components.
- *Data Analysis Techniques*: Skills in analyzing business data for strategic insights.
- *Data Warehousing Knowledge*: Understanding of data warehousing concepts and their role in consolidating diverse data sources for business intelligence.
- *OLAP and OLTP Applications*: Learning the applications of Online Analytical Processing and Online Transaction Processing in business contexts.
- *Data Visualization Skills*: Ability to create and interpret visual data representations, including various types of charts and dashboards.
- *Business Performance Management* (*BPM*): Knowledge of BPM cycles, performance measurement systems, and key performance indicators.
- *Collaborative Decision-Making*: Skills in using collaborative tools and methodologies for decision-making in business settings.
- *Knowledge Management Techniques*: Understanding of how to manage, store, and share knowledge within an organization.
- *Use of Recommender Systems*: Learning about the development and implementation of recommender systems in business intelligence.

At Skill level:

- *Analytical Skills*: Enhanced ability to analyze and interpret complex business data for strategic decision-making.
- *Technical Proficiency in BI Tools*: Skills in using business intelligence platforms and tools for data analysis and reporting.

- *Data Warehousing Techniques*: Capability to implement and manage data warehousing solutions for effective data consolidation and retrieval.
- *Data Visualization and Dashboard Design*: Proficiency in creating insightful and interactive data visualizations and dashboards.
- *Strategic Planning Skills*: Ability to integrate business intelligence insights into strategic planning and performance management.
- *OLAP and OLTP Utilization*: Skills in applying Online Analytical Processing and Online Transaction Processing in business scenarios.
- *Performance Measurement Expertise*: Competence in developing and using key performance indicators and balanced scorecards.
- *Collaboration and Teamwork Abilities*: Enhanced skills in collaborative decision-making and teamwork within a business intelligence context.
- *Knowledge Management Skills*: Ability to effectively manage and utilize organizational knowledge for business intelligence purposes.
- *Problem-Solving Skills*: Improved capability to solve complex business problems using data-driven approaches and BI techniques.

In terms of Competences:

- *Decision Support Competence*: Ability to leverage decision support systems for effective business decision-making.
- *Business Intelligence Expertise*: Competency in understanding and applying various aspects of business intelligence in a corporate setting.
- *Data Analysis and Interpretation*: Proficiency in analyzing and interpreting complex data sets to derive meaningful business insights.
- *Data Warehousing Management*: Skills in managing data warehousing systems, ensuring efficient data storage, retrieval, and processing.
- *Advanced Visualization Techniques*: Competence in creating advanced data visualizations to communicate insights clearly and effectively.
- *Strategic Business Planning*: Ability to integrate data-driven insights into strategic business planning and performance management.
- *Operational Analysis Skills*: Skills in using OLAP and OLTP systems for in-depth operational analysis and reporting.
- *Performance Management Capabilities*: Expertise in developing and utilizing performance measurement tools like KPIs and balanced scorecards.
- *Collaborative Problem-Solving*: Competence in collaborative problem-solving and decision-making, essential for business intelligence projects.
- *Knowledge Management and Utilization*: Ability to manage and leverage organizational knowledge in decision-making processes and BI 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, analyze and synthesize data and information using the necessary technologies.

- Adapt to new situations
- Working independently
- Team work
- Production of new research ideas.
- Project planning and management
- Criticism and self-criticism
- Promote of free, creative and inductive thinking

(3) SYLLABUS

Brief description

The course is designed to provide students with a comprehensive understanding of how to analyze, interpret, and utilize business data for strategic decision-making. This course aims to develop skills in various business intelligence tools, data analysis techniques, and decision support systems. Over a series of lessons, students will explore the theoretical foundations and practical applications of business intelligence, preparing them for advanced roles in this dynamic field.

The teaching of the course includes the following subjects:

- *Introduction to Business Intelligence and Statistics and Quantitative Analysis*: Overview of BI, its importance, and its role in modern business and fundamentals of statistics and its application in quantitative analysis for business intelligence.
- *Decision Support Systems*: Understanding the principles and applications of Decision Support Systems in business.
- *Data Warehousing Concepts*: Exploring data warehousing, its architecture, and its significance in BI.
- *Data Mining and Analysis*: Techniques and tools for mining and analyzing large datasets.
- *Business Analytics and Data Science*: Integrating analytics and data science for deeper business insights.
- *OLAP and OLTP Systems*: Learning about Online Analytical Processing and Online Transaction Processing.
- *Data Visualization Techniques*: Principles of data visualization and dashboard design.
- *Business Performance Management*: Exploring the methodologies and tools for BPM.
- *Key Performance Indicators and Metrics*: Developing and implementing effective KPIs and metrics.
- *Advanced Topics in BI Architecture and Systems*: A deep dive into advanced BI architectures and systems.
- *Collaborative Decision Making and Knowledge Management*: Techniques for improving decision-*making and knowledge sharing in organizations*.
- *Business Intelligence in Practice*: Case studies and practical applications of BI in different industries.
- *Future Trends in Business Intelligence*: Exploring emerging trends, challenges, and future opportunities in BI.

The theoretical part of the course is accompanied by laboratory exercises related to Business Intelligence.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform.
Asynchronous distance learning support via e-Class platform.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Slides (ppt) for teaching the theoretical part, which are posted after each lecture in the e-Class..
• Laboratory exercises in Business Intelligence technology using free and open software.
• Learning process support through the e-Class platform (to communicate course regulations, to distribute slides, supplementary material, notices, links and bibliography, to conduct the evaluation, etc.).
• Elaboration of assignments by the students and posting in e-Class.</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 (hours)</th></tr>
<tr><td>Lectures</td><td>26 (=13×2)</td></tr>
<tr><td>Seminars</td><td>13 (=13×1)</td></tr>
<tr><td>Laboratory Exercises (in Lab)</td><td>12 (=6x2)</td></tr>
<tr><td>Projects (homework)</td><td>18 hours</td></tr>
<tr><td>Lecture & bibliography study (at home)</td><td>23 hours</td></tr>
<tr><td>Preparing for Final Exam</td><td>30 hours</td></tr>
<tr><td>Final Exam</td><td>3 hours</td></tr>
<tr><td>Course total</td><td>125 hours (5 ECTS)</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><u>Evaluation</u>:
• Completion of a Business Intelligence project utilizing open-source software, working with a dataset provided by the instructors (accounting for 70% of the final grade).
• A public presentation of the project, including a detailed walkthrough of the implementation and a question-and-answer session to demonstrate understanding and defend methodologies (accounting for 30% of the final grade).
<u>Remarks</u>:
• The final grade results from the weighting of the above with factors of 70% and 30% respectively.
• The evaluation is performed in the Greek language.
• The evaluation process and evaluation criteria are published on the course website in e-Class.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Dykes, B. (2020). Effective Data Storytelling: How to Drive Change with Data, Narrative, and Visuals. Wiley.

- Han, J., Pei, J., & Kamber, M. (2011). Data Mining: Concepts and Techniques (3rd ed.). Morgan Kaufmann.
- Kimball, R., & Ross, M. (2013). The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling (3rd ed.). Wiley.
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- Berson, A., & Dubov, L. (2011). Mastering Data Warehouse Aggregates: Solutions for Star Schema Performance. Wiley.
- Eckerson, W. W. (2010). Performance Dashboards: Measuring, Monitoring, and Managing Your Business (2nd ed.). Wiley.
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- Laursen, G. H. N., & Thorlund, J. (2010). Business Analytics for Managers: Taking Business Intelligence Beyond Reporting. Wiley.

MSC-IICS-232. Advanced Data Mining Techniques

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Graduate		
COURSE CODE	**MSC-IICS-232**	**SEMESTER**	**2nd**
COURSE TITLE	**Advanced Data Mining 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	2	
Seminars / Practice exercises	-	
Laboratory	1	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).	3	5

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	specialized
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://www.ece.uop.gr/

(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 introduces the students to the advanced topics of Data Mining and Analytics. The course is designed to introduce students into both the theoretical and applied knowledge of various topics of data mining, at advanced level.

Learning Outcomes

Upon successful completion of the course, student will be able to:

<u>At the knowledge level:</u>

- Know the most important techniques and tools for crawling/scrapping data in the Web or the

Social Networks.

- Understand in depth the techniques and tools for implementing data analysis at the Edge.
- Know the basic principles of Natural Language Processing (NLP) and its various applications in data analytics.
- Understand in depth the application and use of distributed big data processing engines (e.g. Hadoop/Spark) in data analytics.
- Apply in practice, the deep learning techniques in a various number of applications (e.g. image processing, NLP applications).
- Know in depth a various number of graph theoretic algorithms for data analytic purposes.
- Understand in depth (focused mainly at the application level) the most important features of NoSQL DBMS that can be used in data analysis.

<u>At the skill level:</u>

- Design and implement efficient software systems for data crawling/scrapping from various data sources.
- Support effiently the data alalytic procedure at the edge, using software systems and devices.
- Design, implement and perform in practice big data processing/analysis using the state of the art efficient distributed frameworks and ecosystems (e.g. Hadoop/Spark).
- Create and apply precise and efficient prediction models for data mining using the deep learning methods and tools.
- Design, implement and use graph models for data analysis.
- Use, at advance level, the NoSQL systems for data management and analysis.

<u>At the level of abilities:</u>

- Understand the specific data engineering requirements of big data processing and analysis and become able to design and implement efficient and integrated backend architectures supporting various processing types (e.g. real time or batch processing).
- Become able to combine, integrate and use efficiently the different stages of the modern data analytical process, namely e.g. data gathering, data management and data analysis.
- Understand the specific requirements of Digital Social Media data analysis and become able to design and implement efficient, precise and ethical Social Media analytics.
- Understand the challenges of Edge/Fog analytics and become able to combine and use efficiently the corresponding levels of data analysis (e.g. at the Edge, Fog or/and the Cloud level).

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 theoretical concepts, terms and technology
- Adapting to new situations
- Decision-making
- Working independently

- Team work
- Critical thinking development
- Inductive thinking development
- Ability to make an idea work through implementation
- Develop skills for applied research

(3) SYLLABUS

Theoretical courses consist of:

- Introduction to Big Data Analytics, Methods, Techniques, Tools. Backend Architecture. The scope and targets of data engineering.
- Data Gathering Technologies: Crawlers, Scrapers, Parsers. Techniques and Tools. Data effective detection, navigation, extraction, ethical criteria.
- Data Mining at the Edge. Fog/Edge Analytics.
- Natural Language Processing and Information Retrieval.
- Advanced study of Distributed frameworks for Big Data Analysis. Hadoop/Spark/HDFS. Spark SQL and Data Frames.
- Deep Learning and Distributed Systems, Modern neural network approaches, Deep Learning and NLP applications.
- Social Network Analytics. Graph Algorithms Techniques and Methods.
- Advanced features and application of NoSQL systems. Document and Graph Databases in Data Mining.

The laboratory courses consist of advanced applied training exercises and projects using a numerous analytic tools and equipment like Selenium, Hadoop/Spark Ecosystem, NoSQL DBs (MongoDB, Neo4j), Spark/pytorch, Nvidia platform and Python Programming Language in the following topics:

- Data Gathering from Web and Social Networks through APIs and Crawlers. Practical examples and real-world applications
- Design and implementation of integrated backend architecture for big data analysis. Integration and interoperability.
- Data Mining and NLP applications for Big Data. Advanced Use of Spark Engine and Pytorch System.
- Advanced use of NoSQL Systems for data mining and analysis.
- Data mining, artificial intelligence and machine learning at the Edge using the NVIDIA Jetson Nano platform

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning through a distance learning platform. Some lectures, which include a laboratory demonstration part, may be held live for those students who wish and simultaneously broadcast via a distance learning platform. Asynchronous distance learning support via e-Class platform.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	- Power Point presentations. - Laboratory exercises textbooks. Available in typed and digital form. - Freeware development software tools. - Further digital learning & educational/training material such as : exercise presentations older exam solutions & problems solved for theory and lab, announcements, homework collecting service, student registration &

	mail service, alerts, statistics, other educational services, etc The whole teaching staff is available at uop e-class (https://eclass.uop.gr/courses/2463/)
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	2 x 13=26
Laboratory practice	1 x 13=13
Homework	80
Final exam (theory)	3
Final exam (lab)	3
Course Total	***125 ώρες (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: Greek Evaluation: (c) Final examination in theory. It includes all educational material described in (3) (d) Written and/or practical examination in every laboratory exercise/project described also in (3). All students deliver a written report that includes their answers . A final exam written and/or oral, may also be available for consideration. Final grade=0,6x(a) + 0,4x(b) The whole evaluation procedure and criteria are known to all students from the beginning of the Academic Year.

(5) ATTACHED BIBLIOGRAPHY

- Data Mining - Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, The Morgan Kaufmann Series in Data Management Systems 2012.
- Data Mining: The Textbook, Charu C. Aggarwal, Springer 2015.
- Designing Data-Intensive Applications, Martin Kleppmann, O'Reilly Media, 2017.

- Big Data - PRINCIPLES AND BEST PRACTICES OF SCALABLE REAL-TIME DATA SYSTEMS, NATHAN MARZ, Manning Publications Co, 2015.
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- Resilient Distributed Datasets: A Fault-Tolerant Abstraction for In-Memory Cluster Computing, Matei Zaharia, Mosharaf Chowdhury, Tathagata Das, Ankur Dave, Justin Ma, Murphy McCauley, Michael J. Franklin, Scott Shenker, Ion Stoica University of California, Berkeley.
- Spark: Cluster Computing with Working Sets, Matei Zaharia, Mosharaf Chowdhury, Michael J. Franklin, Scott Shenker, Ion Stoica, University of California, Berkeley.
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- The Data Engineer's Guide to Apache Spark, Databricks.
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- Evaluating distributed IoT databases for edge/cloud platforms using the analytic hierarchy process, Abdulhameed Alelaiwi, J. Parallel Distrib. Comput, 124(2019)41-46.

MSC-IICS-THS. Master's Thesis

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	MSC-IIICS-THS	**SEMESTER**	**3**
COURSE TITLE	Master's Thesis		

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		30
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	General Background
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	<Link to MSc Regulation>

(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*

1) The student should be able to search, select, analyze and synthesize bibliographic data in a specific scientific field and topic
2) The student should be able to organize the theoretical/bibliographic material and become familiar with a specific way of writing a scientific text
3) The student can become familiar with the concept of plagiarism and its avoidance through the reproduction of bibliographic data
4) The student should become familiar with the use and citation of bibliographic references
5) The student should be able to organize and present his data to a wide audience

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, analysis and synthesis of data and information, using the necessary technologies
- Autonomous work
- Promotion of free, creative and inductive thinking

(3) SYLLABUS

The Master's Thesis aims to introduce the student to scientific research and/or scientific literature, with the communication of their results, both written and oral, in accordance with the rules applicable to the international scientific community. It has as its object the review of the scientific literature and the presentation of its results in a scientific subject.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face and remote consultation with a supervising professor to resolve issues
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Special Scientific Bibliography • Use of ICT in Communication with students • The teacher communicates with students via email and social networks • The evaluation of the course is done electronically through MO.DI.P. • Other tools depending on the type of the thesis
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-*	

Activity	***Semester workload***
Literature Study	200
Development	400
Writing of the thesis	150

directed study according to the principles of the ECTS	***Course Total***	***750 hours (30 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.*	• Conclusive • Public Presentation	

(5) ATTACHED BIBLIOGRAPHY

Depending on the thesis' subject