COURSE OUTLINE

1. GENERAL

SCHOOL:	Engineering		
ACADEMIC UNIT:	Industrial Design and Production Engineering		
LEVEL OF STUDIES:	Undergraduate		
COURSE CODE:	**8006**	**SEMESTER**	**8**
COURSE TITLE:	Internet of Things		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
Theory (Lectures)	3	3
Tutorial/Project	0.5	1
Laboratory	0.5	1
	4	**5**

COURSE TYPE:	Specialised general knowledge, skill development
PREREQUISITES COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/IDPE185

2. LEARNING OUTCOMES

Learning Outcomes

The course is a compulsory elective course (CE) of the 2nd Direction (Fundamental Sciences & Applied Technologies), aiming to introduce students the principles of Internet of Things (IoT), by offering them the necessary knowledge and skills to: a) architect, design and implement systems and applications, b) to analyze their overall performance as well as that of individual components, and c) to study techniques that will allow the development of innovative applications and system configurations for data collection, storage, process and analysis over heterogenous IoT platforms. In this context the course elaborates on the theoretical and practical extension of typical control systems with state-of-the-art technologies for remote management and monitoring of sensors and actuators, for data collection and analysis either at the network edges or at cloud environments, as well as for information visualization, decision making and resource management over IoT platforms. In this respect, communication and interoperability aspects among remote entities and subsystems (or applications) are also discussed, along with data security and information privacy issues related to diversified service scenarios (e.g. Smart Cities, Precision Farming, Cognitive Forestry, etc.). Upon successful completion of the course the student will be able to:

1. Understand the fundamentals of IoT architectures, the operational principles and the organization of Internet of Things systems and applications.
2. Knows, recognise and be aware of the tools used for the implementation and management of IoT systems, as well as the operation of the most widespread mechanisms for services and data provision/management over them.
3. Apply techniques for the analysis and the evaluation of the performance of IoTs, as well as

mechanisms and methods for optimised operation.

4. Analyse and determine the principal characteristics of information transfer, caching, analysis and management over IoT infrastructures.
5. Interconnect various types of sensors (e.g. environmental sensors, infrared sensors, ultrasonic sensors, RTC) and actuators (e.g. relays and motors) with microcontrollers, program and install wireless sensor networks (Wireless Sensor Networks) over popular data communication protocols (e.g. Bluetooth, Ethernet, WiFi).
6. Control nodes via internet and / or mobile devices and collect, process, visualize data related to sensor networks, as well as to propose solutions for the implementation and maintenance of IoT systems, and analysis of information that cross-through them by utilising international standards.

General Competences

- Search, analysis and synthesis of data and information, using the necessary technologies
- Adaptation to new situations
- Decision making
- Autonomous work
- Teamwork
- Work in an international environment
- Work in an interdisciplinary environment
- Promoting liberal, creative and inductive/deductive thinking

3. SYLLABUS

Theoretical Lectures

- Sensors' classification and technologies
- Actuators' classification and technologies
- Microcontrollers' technologies
- Fundamental communication protocols
- Network technologies and interconnection protocols
- Sensor network technologies
- Wireless networking and LPWAN communication
- Organization and management techniques for the network and processing infrastructure on the server side – virtualization of resources and the edge computing paradigm
- Decision making and data processing techniques
- Closed loop distributed systems
- Interfaces and interaction protocols with emphasis on mobile and web-based implementations
- Machine-to-Machine (M2M) message exchange protocols
- Interaction between physical and virtual worlds
- Security issues related to data exchange and systems interconnection
- industrial Internet of Things and service scenarios for Smart Cities and Precision Farming

Laboratory

Projects aim to support the theoretical part of the course with emphasis on topics related to the exploitation of hardware and software tools the analysis of IoT operational characteristics, for studying data collection and analysis, sensor activation and management, the effects of wireless communication channels, and the security issues in IoT environments. The laboratory part is also focused on the implementation of IoT applications in Arduino and Raspberry Pi environments using

various sensors and actuators related to the interconnection with the internet of different types of sensors (e.g. environmental sensors, infrared sensors, ultrasound sensors, RTC), as well as the interconnection with the internet of different types of actuators (e.g. relays and motors), including wireless communication utilising LoRaWAN standards, data collection, process, and analysis in edge-computing environments and sensor set-up and operation in simulated test conditions.

4. TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY</td><td>In-class face-to-face
Lectures
Practice exercises
Laboratories
Assignments & Presentations</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td><td>Use of ICTs theoretical teaching se of ICTs in lecturing
Use of ICTs in laboratory-based training
Use of ICTs for the communication with students via the e-class platform
Specialised software tools for experimentation
Support of the educational process via the e-class platform</td></tr>
<tr><td>TEACHING METHODS</td><td>
<table>
<tr><th>Method description / Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Tutorials</td><td>6</td></tr>
<tr><td>Laboratory work</td><td>12</td></tr>
<tr><td>Project-based assignments</td><td>9</td></tr>
<tr><td>Journal/paper reading & theoretical study</td><td>9</td></tr>
<tr><td>Non-guided personal study</td><td>75</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total (30h/ECTS)</td><td>150</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>Language of Assessment
Greek

Description
Written exams, laboratory evaluation and project evaluation

Student assessment methods
Written examination with short answer questions (Concluding)
Written exams with multiple choice questions (Concluding)
Written assignment (Formative)
Public presentation (Formative)
Laboratory/project work (Formative)
For the successful completion of the course the students must obtain a grade of ≥5.0 in both the final written</td></tr>
</table>

	examination and the laboratory work, as well as in the elaboration and public presentation of the project (theoretical study). The final grade of the course consists of: • Final written examination in the entire course content (65%), • Elaboration of theoretical project (10%) • Public presentation of the project (5%), • Elaboration of laboratory-based projects/work (20%). The assessment criteria are announced to students at the beginning of the semester and are published on the course webpage in the e-Class platform.

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",1stEdition, Academic Press, 2014.*
- *Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer*
- *Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.*
- *Internet of Things Protocols and Standards, http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.htm*
- *Mark Weiser (1991) The computer for the 21st century. Scientific American, pp. 94–104*
- *Paul Dourish and Genevieve Bell, 2008. Yesterday's Tomorrows: Notes on Ubiquitous Computing's Dominant Vision. Personal and Ubiquitous Computing.*
- *Prolog, Chapter 1, and Chapter 4 from David Rose (2014) Enchanted Objects: Design, Human Desire and The Internet of Things, Scribner.*
- *Chapter 16, Nabaztag, an Ambiguous Avatar, from Mike Kuniavsky (2010) Smart Things, Ubiquitous Computing User Experience Design, Elsevier*
- *Rogers Y, Hazlewood W, Marshall P, Dalton NS, Hertrich S, (2010) Ambient Influence: Can Twinkly Lights Lure and Abstract Representations Trigger Behavioral Change?, UbiComp 2010*
- *The Secret Life of Electronic Objects - A Dunne, F Raby (2002) Design Noir: The Secret Life of Electronic Objects*

- Related academic journals:

- *IEEE Communications Magazine*
- *IEEE Internet of Things Journal*
- *IEEE Sensor Journal*
- *International Journal of Sensor Networks*
- *Future Generation Computer Systems*
- *IEEE Access*
- *Internet of Things - Journal – Elsevier*
- *MDPI Sensors*

- *IEEE Communications Surveys and Tutorials*
- *Springer Internet of Things*
- *Personal and Ubiquitous Computing – Springer*
- *Pervasive and Mobile Computing – Elsevier*
- *Pervasive Computing, IEEE*