COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	INFORMATICS AND COMPUTER ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE		**SEMESTER**	**9th**
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	
Labs		1	
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 general knowledge, Skills Development		
PREREQUISITE COURSES:	Knowledge from Wireless Sensor Networks		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	ENGLISH (Instruction, Examination)		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES (in ENGLISH)		
COURSE WEBSITE (URL)			

(2) LEARNING OUTCOMES

Learning outcomes

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

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

The course aims to provide a deeper understanding of the Internet of Things (IoT) ecosystem and the infinite possibilities offered today by modern IoT applications, focusing to the emerging technologies and required infrastructure for the efficient deployment and operation of IoT applications. The course analyzes the individual components of the IoT architecture (i.e. hardware, software, networking and security) and the interconnection between them. Also, special attention is paid in the programming and development technologies of IoT applications, the demonstration of important scenarios and use cases, and the application of all the above in real-life conditions and problems.

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

• recognize the basic features and capabilities provided by the Internet of Things and the IoT applications

• use programming technologies, platforms, integrated libraries, interfaces, and tools offered for the development of IoT applications

• apply methodologies for designing and analyzing systems and end-user applications
• understand the architecture of the applications and systems and the communication, interconnection, and interaction supporting mechanisms of the individual components
• evaluate and design integrated solutions that collaborate with the cloud infrastructure
• understand advanced concepts and explore modern trends in the expansion process of the IoT and the IoT applications (e.g., fog computing, mobile edge computing, Internet of Everything, etc.)

General Competences

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

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

• Retrieve, analyze and synthesize data and information, with the use of necessary technologies
• Teamwork
• Decision making
• Work in an interdisciplinary environment
• Produce new research ideas
• Promote free, creative and inductive thinking

(3) SYLLABUS

A. Introduction to IoT: Definitions, IoT key features and architectures, applications, IoT vs Web of Things (WoT), IoT challenges such as standardization, scaling, device size, power consumption, addressing, security/privacy, Quality of Service (QoS), mobility. Hardware/IoT Devices: smart devices, sensors/actuators, RFIDs, GPS, Cyber Physical Systems (CPS), BeagleBone Black, Arduino and Raspberry Pi platforms.

B. Wireless Sensor Networks and Wireless Sensor and Actuator Networks. Node structure and technology. Architecture and topologies. Physical layer standards

and protocols. Challenges regarding the distribution, the communication, and the organization. Routing protocols. Energy efficient data collection and processing algorithms. Algorithms for connectivity, localization, area coverage, and topology control. Power consumption and recharging nodes. Operating systems and intermediate software. Design and implementation issues. Programming tools. Simulators and emulators.

C. IoT application development protocols and platforms. IoT device communication/interconnection protocols. Architectures and network communication protocols. Addressing and information indexing. Descriptive and development application languages on various platforms. Simulators and emulators. Topics of device programming, interoperability, implementation-integration in application layer, indicative examples.

D. IoT Architecture and Resource Management. Distributed system architectures. Architectures of the future internet. Device connection based on the publish/subscribe model. Big data, cloud computing and data centers. Use of cloud computing and fog computing for the implementation of IoT services. Edge computing techniques.

E. Security in IoT. Network and other attacks on wireless sensor networks and IoT. Secure/reliable data transmission on wireless sensor networks. Secure device communication over the internet. Network security mechanisms in IoT applications.

F. IoT applications. e-health, Smart homes, Smart cities, Smart Grid, Precision farming, Transport/Logistics, Vehicular, etc. Other industrial applications. Mobile edge applications. Indicative application examples (case studies).

G. Other issues future directions. Intelligence and state awareness, device self-awareness. Internet of Everything ecosystem. Social Web of Things. Regulatory, legal and ethical subjects.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	• Use of ICT in Course Teaching • Use of the Open eClass system, with uploaded notes, lectures, exercises for practice and communication with students • Practical exercises based on IoT equipment.
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: 39 Tutorials: 13 Labs: 13 Project: 30 Independent Study: 43 **Total: 123**
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.	**I.** Written exams (accounts 50% of the total course mark) which consist of: - Short answer questions - Multiple choice questions - Real-life problems resolution **II.** Lab Projects (accounts 50% of the total course mark)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. P.Raj and A. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, March 2017.
2. A Bahga and V. Madisetti, “Internet of Things: A Hands-On Approach”, ISBN 978-0-99602-552-2, September 2014.
3. Hakima Chaouchi, The Internet of Things: Connecting Objects, Wiley, ISBN

978-1-84821-140-7, May 2010.
4. P. Waher, “Learning Internet of Things”, Packt Publishing, ISBN 978-178355-353-2, January 2015.
5. Daniel Kellmereit, Daniel Obodovski, “The Silent Intelligence: The Internet of Things”, DND Ventures LLC, September 2013.
6. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley, December, 2013.
7. Samuel Greengard, “The Internet of Things”, The MIT Press, March 2015.
8. Yang, Shuang-Hua, Wireless Sensor Networks: Principles, Design and Applications, Springer, 2014.
9. Fahmy Hossam and Mahmoud Ahmad, Wireless Sensor Networks: Concepts, Applications, Experimentation and Analysis, Springer, 2016.
10. Waltenegus Dargie and Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice, Wiley, 2010.
11. Ian F. Akyildiz and Mehmet Can Vuran, Wireless Sensor Networks, Wiley, 2010.
12. D. Norris, “The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black”, McGraw-Hill Education, ISBN 978-00718-352-0, January 2015.
13. M. Schwartz, “Internet of Things with the Raspberry Pi: Build Internet of Things Projects Using the Raspberry Pi Platform”, Kindle Edition, Amazon Digital Services, May 2015.
14. M. Schwartz, “Internet of Things with Arduino: Build Internet of Things Projects With the Arduino Platform”, Kindle Edition, Amazon Digital Services, March 2015.
15. C. Rowland, E. Goodman, M. Charlier, A. Light, A. Lui, “Designing Connected Products: UX for the Consumer Internet of Things”, O’Reilly Media, ISBN 978-144937-256-9, May 2015.