VNIVERSITAT DE VALÈNCIA

Course Guide
36422 Internet of things

COURSE DATA

Data Subject	
Code	36422
Name	Internet of things
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1406 - Degree in Data Science	School of Engineering	4	First term

Subject-matter

Degree	Subject-matter	Character
1406 - Degree in Data Science	7 - Signals	Obligatory

Coordination

Name	Department
PEREZ SOLER, JOAQUIN	242 - Electronic Engineering
TORRES PAIS, JOSE GABRIEL	242 - Electronic Engineering

SUMMARY

This course introduces the basic principles of the Internet of Things (IoT), the main standardized IoT architectures and the different types of sensors and actuators in IoT.

In addition, students will learn about IoT-specific communication networks and services, illustrating their application to different use cases in Industry 4.0.

Finally, a complete IoT project will be created using the PYNQ platform.

The theory classes will be taught in Spanish and the practical and laboratory classes will be taught according to the course description available on the degree's website.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is desirable that students have knowledge of programming in Phyton.
It is desirable that students have knowledge of processors and operating systems.

OUTCOMES

1406 - Degree in Data Science

- (CG01) Knowledge of basic subjects and technologies that enable students to learn new methods and technologies, and to provide them with versatility to adapt to new situations.
- (CG06) Ability to access and manage information in different formats for subsequent analysis in order to obtain knowledge from data.
- (CT02) To be able to complete technical, scientific, social and human training in general, and to organise self-learning with a high degree of autonomy.
- (CT04) To be responsible for ones own professional development and specialisation, applying the acquired knowledge in the identification of career opportunities and sources of employment.
- (CE10) Ability to digitally process signals and extract information from them.
- (CE11) Ability to design and implement data acquisition, its integration, transformation, selection, verification of its quality and veracity from different sources, taking into account its character, heterogeneity and variability.
- (CB1) Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.
- (CB5) Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

LEARNING OUTCOMES

The objective of the course is to analyze both the architectural principles and the different alternative technologies that can be used for the deployment of an IoT system. (CG01, CB1, CT02)

Also, to know the SMART applications based on data, to know the concept of Open Data and its sources. (CG01, CG06, CB1, CT02, CE10, CE11)

Likewise, it is necessary to know the different types of sensors and actuators existing in the market and to know the characteristics of streaming data. (CG01, CG06, CB1, CT02, CE10, CE11)

Finally, it is necessary to develop an IoT project based on PYNQ and programmed in Phyton. (CG01, CG06, CB1, CB4, CT02, CT04, CE10, CE11)

DESCRIPTION OF CONTENTS

1. Introduction to IoT and basic concepts

1. Internet of devices
2. Communication infrastructures for IoT (wireless communications, access networks and location systems)
3. Technologies for sensor and device networks (WiFi, Bluetooth/BLE, RFID/NFC, IPv6, 5G, GPS)
4. Heterogeneity and integration in systems for IoT
5. Current IoT application landscape

2. Standardized IoT architectures

1. Architectures for data acquisition nodes (Raspberry Pi, Arduino, PYNQ)
2. Software development environments for IoT (Android Things, Vivado, Jupiter).
3. Programming languages for IoT (C, Python)

3. Sensors and Actuators

1. Sensors and devices in common use
2. Hardware communication protocols (GPIO, ADC/DAC, UART, SPI, I2C)
3. Data acquisition in sensor and device networks
4. Data monitoring in IoT systems (HTTP)

4. IoT connectivity

1. Development of wireless sensor networks
2. IoT application programming (open data sources and streaming data)
3. Identification systems
4. Applied Analytics for IoT (Data Science, Computer Vision, Machine Learning)

5. Industry 4.0

1. Aplicaciones Smart (Smart-Cities, Smart-Tourism, Smart-Grid)

6. Development of an Internet of Things project

1. Development of an IoT project based on PYNQ with peripheral integration, data acquisition and data management

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	32,00	100
Laboratory practices	20,00	100
Classroom practices	8,00	100
Development of group work	10,00	0
Development of individual work	10,00	0
Study and independent work	10,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	20,00	0
Resolution of case studies	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The training activities will be developed according to the following distribution:

AF01. Theoretical activities: In the theoretical classes the subjects will be developed providing a global and integrating vision, analyzing in greater detail the key and more complex aspects, encouraging, at all times, the participation of the student.

AF02. Problem solving: As a complement to the theoretical activities, classroom discussion sessions will be held and problems and exercises previously worked on by the students will be solved. Group work will be encouraged in order to accustom the student to teamwork; typical in any practical development in Data Science.

AF03. Practical activities: Theoretical contents will be implemented and analyzed in small laboratory classrooms where students will have access to the appropriate equipment and software for this work.

AF04. Student's personal work: Outside the classroom, students will work on questions, problems and reports, as well as preparing for classes and exams (study). This task will be carried out individually and aims to promote autonomous work.

AF05. Assessment: Individual written assessment questionnaires/tests in the classroom with the presence of the teacher.
In terms of teaching methodology, the following will be followed:

MD1. Theoretical activities: Lecture development of the subject with student participation in the resolution of specific questions. Individual evaluation questionnaires. (CG01, CB1, CB4, CT02)

MD2. Practical activities: Learning by solving problems, exercises and case studies through which competences on the different aspects of the subject are acquired. (CG06, CB4, CT02, CE10)

MD3. Transversal competences: Visits to companies, attendance to courses, conferences, round tables and other types of activities organized and/or proposed by the CAT of the Degree. (CG06, CB1, CB4, CT02, CT04)

MD4. Laboratory and/or computer classroom work: Learning through activities carried out individually or in small groups and carried out in laboratories and/or computer classrooms. (CG06, CB4, CT02, CE10, CE11)

EVALUATION

In the first call, the subject will be assessed continuously, as follows:

- SE3 - Continuous assessment of each student, based on the participation and degree of involvement of the student in the teaching-learning process, taking into account regular attendance at the scheduled classroom activities and the resolution of questions and problems proposed periodically (20%). This activity is not recoverable (CB2, CG03, CT05).
- SE2 - Evaluation of practical activities based on the preparation of papers/memories and/or oral presentations (30%) (CB2, CB4, CB5, CG03, CG05, CG06, CE05, CE13).
- SE1 - Examination consisting of a project based on the learning and development of the subject, as well as the response to theoretical/practical questions (50%) (CB2, CB4, CB5, CG03, CG05, CT05, CE05, CE13).

In order to pass the course, a minimum mark of 4 (out of 10) must be obtained in the evaluation of the activities as well as in the practical activities and in the exam.

In the second sitting, a theory exam and a practical exam will be held, and the mark obtained in the first sitting for the continuous assessment of the activities will be maintained. The weighting of each part will remain the same as in the first sitting.

In any case, the evaluation system will be governed by the provisions of the Regulations of Evaluation and Grading of the University of Valencia for Degrees and Masters (https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639)".

REFERENCES

Basic

- C. Pfister. Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) . O'Really. 2011.
- Rob Barton, David Hanes, Gonzalo Salgueiro. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things. Cisco Press. 2017
- Louise H. Crockett, David Northcote, Craig Ramsay, Fraser D. Robinson, Robert W. Stewart. Exploring Zynq® MPSoC With PYNQ and Machine Learning Applications. Strathclyde Academic Media. 2019

Additional

- Jean-Philippe Vasseur;Adam Dunkels. Interconnecting Smart Objects with IP: The Next Internet. Morgan Kaufmann Publishers Inc. 2010
- Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle. From machine-to-machine to the Internet of things: introduction to a new age of intelligence. Kidlington Oxford: Academic Press. 2014
- Perry Lea. Internet of things for architects: architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security. Packt Publishing. 2018