ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000501 - Embedded Platforms And Communications For Iot

DEGREE PROGRAMME

59AH - Master Universitario En Internet Of Things (iot)

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	593000501 - Embedded Platforms And Communications For Iot
No of credits	4.5 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	59AH - Master Universitario en Internet Of Things (Iot)
Centre	59 - Escuela Tecnica Superior De Ingenieria Y Sistemas De Telecomunicacion
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Vicente Hernandez Diaz	A4412	vicente.hernandez@upm.es	Sin horario. Schedules are subject to possible changes. Please, confirm the latest version with the lecturer

Miguel Chavarrias Lapastora (Subject coordinator)	A4204	miguel.chavarrias@upm.es	Sin horario. Schedules are subject to possible changes. Please, confirm the latest verion with the lecturer
Eduardo Juarez Martinez	A4204	eduardo.juarez@upm.es	Sin horario. Schedules are subject to possible changes. Please, confirm the latest version with the lecturer
Guillermo Azuara De Pablo	A4206	g.azuara@upm.es	Sin horario. Schedules are subject to possible changes. Please, confirm the latest version with the lecturer.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Application of processor interrupts

- Programming and debugging using the C language (with emphasis on structures, pointers and memory management)

- Application of the Von Neumann's computer architecture

- Application of processor peripherals

4. Skills and learning outcomes *

4.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CE.01 - Evaluar las arquitecturas HW/SW existentes y diseñar plataformas embebidas para desarrollar soluciones IoT integrando diversas capas SW que manejen sensores, actuadores y dispositivos de comunicación

CE.02 - Diseñar y desarrollar redes de sensores integrando nodos heterogéneos con diferentes sistemas de comunicación inalámbricas para desarrollar aplicaciones IoT

CG01 - Los alumnos demostrarán tener una visión del estado actual, las necesidades y los problemas que se plantean en el mundo de la IoT, así como de las arquitecturas y estándares más utilizados

CG02 - Los alumnos serán capaces de aplicar métodos y tecnologías avanzadas que les permitan abordar necesidades y problemas en aplicaciones IoT

CT.01 - Capacidad de uso de la lengua inglesa para el trabajo en contextos internacionales

4.2. Learning outcomes

RA24 - To integrate a wireless technology and the communication protocols for a hardware platform in an IoT specific application

RA22 - To combine the development tools for the integration of all software elements required to use a hardware platform in an IoT solution

RA21 - To establish the building or selection criteria of embedded hardware platforms for the integration of a specific IoT application

RA23 - To use the interfaces for the connection of sensors, actuators and communication modules in a hardware/software platform supporting IoT applications

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

Brief Description of the Course

The main goal of this course is to introduce the hardware and software architectures frequently used in hardware embedded platforms for IoT applications. More specifically, the description of the essential hardware resources, architecture details and sensor and actuator interfaces are covered. In addition, the integration, development and debugging of software IoT applications are studied in detail.

5.2. Syllabus

1. IoT Introduction
    1.1. General Introduction
    1.2. Technology Solutions
    1.3. Use-case Description
    1.4. Platform Architecture
    1.5. Demo
2. Mbed/Keil: the Software Perspective
    2.1. Mbed & Keil Vision
    2.2. I/O with Mbed
    2.3. Mbed Operating System
    2.4. Hands-on Lab
3. Hw Architectures and I/O Interfaces: the Hardware Perspective
    3.1. STM32 Hw Description
    3.2. Serial Interfaces: I2C
    3.3. Serial Interfaces: SPI
    3.4. Serial Interfaces: RS-232
4. Project

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Lesson 1: General Introduction** Duration: 02:00 Lecture **Lesson 1: Technology solutions** Duration: 01:00 Lecture **Lesson 1: Use-case description** Duration: 01:30 Lecture			
2	**Lesson 1: Platform Architecture** Duration: 03:00 Lecture	**Lesson 1: Demo** Duration: 01:00 Lecture		
3	**Lesson 2: Mbed Operating System** Duration: 03:00 Lecture	**Lesson 2: Mbed & IDE** Duration: 01:00 Laboratory assignments		
4	**Lesson 2: I/O with Mbed** Duration: 02:00 Laboratory assignments **Lesson 3: STM32 Hw Description** Duration: 02:00 Additional activities			
5		**Lesson 2: Hands-on Lab** Duration: 02:00 Laboratory assignments **Hands-on exercises to assess proficiency** Duration: 02:00 Additional activities		**Lesson 2: Hands-on exercises to assess proficiency** Group work Progressive assessment Presential Duration: 02:00
6		**Lesson 3: Serial Interfaces: SPI** Duration: 01:00 Laboratory assignments **Lesson 3: Serial Interfaces: I2C** Duration: 02:00 Laboratory assignments **Lesson 3: Serial Interfaces: RS-232** Duration: 01:00 Laboratory assignments		

7	**Lesson 4: Course Project** Duration: 02:00 Additional activities			**Lesson 4: Preliminary Report Assessment on Course Project** Group work Progressive assessment Presential Duration: 02:00
8		**Lesson 4: Course Project** Duration: 04:00 Laboratory assignments		
9		**Lesson 4: Course Project** Duration: 02:00 Additional activities		**Lesson 4: Project initial validation** Group work Progressive assessment Presential Duration: 02:00
10		**Lesson 4: Course Project** Duration: 04:00 Laboratory assignments		
11		**Project assessment** Duration: 02:00 Additional activities		**Lesson 4: Project assessment** Problem-solving test Progressive assessment Presential Duration: 02:00 **Lesson 4: Report assessment on course project** Group work Progressive assessment Not Presential Duration: 01:00
12				
13				
14				
15				
16				
17				

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
5	Lesson 2: Hands-on exercises to assess proficiency	Group work	Face-to-face	02:00	15%	0 / 10	CE.01 CG02 CT.01 CG01 CB06 CB10
7	Lesson 4: Preliminary Report Assessment on Course Project	Group work	Face-to-face	02:00	15%	0 / 10	CG02 CE.01 CT.01 CG01 CE.02 CB06 CB10
9	Lesson 4: Project initial validation	Group work	Face-to-face	02:00	20%	0 / 10	CG02 CE.01 CT.01 CG01 CE.02 CB06 CB10
11	Lesson 4: Project assessment	Problem-solving test	Face-to-face	02:00	35%	0 / 10	CG02 CE.01 CT.01 CG01 CE.02 CB06 CB10
11	Lesson 4: Report assessment on course project	Group work	No Presential	01:00	15%	0 / 10	CG02 CE.01 CT.01 CG01 CE.02 CB06 CB10

7.1.2. Global examination

No se ha definido la evaluacion sólo por prueba final.

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Course Project Exam	Other assessment	Face-to-face	03:00	80%	0 / 10	CT.01 CG01 CE.02 CB06 CB10 CG02 CE.01
Proposed Exercises Exam	Other assessment	Face-to-face	02:00	20%	0 / 10	CG02 CE.01 CT.01 CG01 CB06 CB10

7.2. Assessment criteria

Assessment

The progressive assessment will be carried out based in the following components:

- Exercises proposed for each course lesson
- A final project consisting of use-case building around the selected platform

The course grade will be composed of the following elements:

- Assessment of the proposed exercises: 15% (1.5 points)
- Assessment of the final project: 85% (8.5 points)

The assessment "Lesson 4: Project initial validation" will be held during the development of the final project. If this assessment is failed, it can be re-evaluated in the final test of the project.

Resit ("Examen Extraordinario") assessment

The resit assesment will consist of the following components:

- Course Project Exam: it is a written and practice exam
- Oral exam about the exercises proposed along the course

The grade will be composed of the following elements:

- Course Project: 80% (8 points)
- Oral exam: 20% (2 points)

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Fast and Effective Embedded Systems Design (Second Edition) Rob Toulson, Tim Wilmshurst	Bibliography	
The Designer's Guide to the Cortex-M Processor Family (2016 Second Edition) Trevor Martin	Bibliography	
Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed, Perry Xiao	Bibliography	
IoT Platform	Equipment	
UPM Moodle site	Web resource	

mbed studio	Others	mbed sutdio IDE, available online in URL: https://os.mbed.com/studio/

9. Other information

9.1. Other information about the subject

The subject is related to Sustainable Development Goals number 9 and 12.

The deployment of IoT applications directly impacts the development of new industrial applications, improving the quality of life to minimise the environmental impact. In this course, we focus on developing IoT embedded systems that minimised the use of resources and energy consumption.