ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000510 - Cloud Computing For Iot

DEGREE PROGRAMME

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

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	593000510 - Cloud Computing For Iot
No of credits	4.5 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
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	2022-23

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Jessica Diaz Fernandez (Subject coordinator)	1119	yesica.diaz@upm.es	Sin horario. Sin horario
Fernando De Mingo Lopez	1122	fernando.demingo@upm.es	Sin horario. Sin horario
Bernardo Tabuenca Archilla	4010	bernardo.tabuenca@upm.es	Sin horario.

* 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

- Programming languages

- Version control

4. Skills and learning outcomes *

4.1. Skills to be learned

CB09 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

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.12 - Analizar las tecnologías de virtualización y el diseño de servicios basados en dichas tecnologías incluyendo contenedores y servicios en la nube

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

CG03 - Los alumnos demostrarán tener las destrezas necesarias para integrar y aplicar los conocimientos adquiridos de forma que puedan desarrollar soluciones innovadoras y servicios IoT en general

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

CT.02 - Capacidad para el trabajo en grupo y dirigir, organizar y supervisar equipos multidisciplinares.

4.2. Learning outcomes

RA18 - To design IoT application architectures that meet flexibility, scalability and performance requirements using technologies and virtualization and Cloud platforms

RA19 - To develop applications for IoT using the main support frameworks for software construction

RA17 - To evaluate the main strengths and weaknesses among different technologies and virtualization and Cloud platforms

RA20 - To use the most important Cloud platforms to develop and deploy 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

The exponential growth of data generated by IoT-based systems is a challenge. Cloud computing offers self-provisioning infrastructure and platform, which makes it the natural candidate for supporting the needs of IoT-based systems, i.e. data processing, data storing, and data analysis. Cloud services process such data satisfying flexibility, scalability and performance requirements. This course is focused on the study of cloud computing architectures and emerging technologies and platforms applied to IoT systems, such as containerization, serverless, and DevOps culture and automation practices (specifically, Continuous Integration and Continuous Delivery). The course adresses both the theoretical basis and different application scenarios.

5.2. Syllabus

1. Virtualization
    1.1. Concept
    1.2. Key features. Adavantages and disadvantages
    1.3. Software for virtualization
2. Containers
    2.1. Concept
    2.2. Key features. Adavantages and disadvantages
    2.3. Software for containerization
    2.4. Software for container orchestration
    2.5. Serverless
3. Cloud computing
    3.1. Overview
    3.2. Cloud service model
        3.2.1. Infrastructure as a Service
        3.2.2. Platform as a Service
        3.2.3. Software as a Service
    3.3. Cloud deployment model
        3.3.1. Private cloud
        3.3.2. Public cloud
        3.3.3. Hibrid cloud
    3.4. Cloud architecture and quality attributes
    3.5. Trends & Challenges
    3.6. Cloud providers: Microsoft Azure, Google Cloud, Amazon WS, etc.
    3.7. Cloud Computing, DevOps and IoT
4. Microsoft Azure
    4.1. Overview
    4.2. Azure Virtual Machines & Azure Containers

4.3. Azure DevOps

4.4. Other services: Azure App Service, SQL Service, Active Directory. Azure Storage

5. Cloud IoT services

5.1. IoT Reference Architecture

5.2. Azure IoT

5.3. Azure IoT Edge

6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	**1. Syllabus presentation, guidelines and software** Duration: 01:00 **1. Virtualization** Duration: 01:00	**Exercise: virtual machines** Duration: 01:30		
2	**2. Containers** Duration: 01:00	**Exercise: containers** Duration: 02:30		
3	**3. Serverless** Duration: 01:00 **3. Cloud Computing & DevOps as enablers of IoT** Duration: 02:00	**Exercise: serverless** Duration: 02:30		**[Progressive Evaluation] Exercise1 Virtual Machines and Containers (RA18)** Continuous assessment Not Presential Duration: 00:00
4	**4. Microsoft Azure** Duration: 01:00	**Exercise Azure** Duration: 02:30		
5		**Exercise Azure** Duration: 03:30		
6		**Exercise Azure DevOps Pipelines** Duration: 03:30		
7	**5. Cloud IoT services (Azure IoT)** Duration: 02:00	**Exercises Azure IoT** Duration: 03:30		
8	**5. Cloud IoT services (Azure IoT Edge & DevOps)** Duration: 01:00	**Exercises Azure IoT Edge** Duration: 02:30		
9		**Exercises Azure IoT Edge** Duration: 03:30		**[Progressive Evaluation] Exercise2 Cloud IoT (RA18, RA20)** Continuous assessment Not Presential Duration: 00:00

10		**Lab assigment: development and deployment of an IoT app** Duration: 03:30		
11				**[Progressive Evaluation] Oral presentation of the lab assignment (RA17)** Continuous assessment Presential Duration: 03:30
12				
13				
14				
15				
16				
17				**[Global Evaluation] Exercise 1 Virtual Machines and Containers (RA18)** Final examination Not Presential Duration: 00:00 **[Global Evaluation] Exercise 2 Cloud Computing (RA18, RA20)** Final examination Not Presential Duration: 00:00 **[Global Evaluation] Test (RA17)** Final examination Presential Duration: 01:00 **[Global Evaluation] Report of the Lab assigment (RA18, RA19, RA20)** Final examination Not Presential Duration: 00:00

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.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	[Progressive Evaluation] Exercise1 Virtual Machines and Containers (RA18)		No Presential	00:00	10%	5 / 10	CG02 CE.12
9	[Progressive Evaluation] Exercise2 Cloud IoT (RA18, RA20)		No Presential	00:00	10%	5 / 10	CE.12 CG02
11	[Progressive Evaluation] Oral presentation of the lab assignment (RA17)		Face-to-face	03:30	20%	/ 10	CB09 CB10 CT.01 CT.02 CG03

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	[Global Evaluation] Exercise 1 Virtual Machines and Containers (RA18)		No Presential	00:00	10%	5 / 10	CG02 CE.12
17	[Global Evaluation] Exercise 2 Cloud Computing (RA18, RA20)		No Presential	00:00	10%	5 / 10	CG02 CE.12
17	[Global Evaluation] Test (RA17)		Face-to-face	01:00	20%	5 / 10	CE.12
17	[Global Evaluation] Report of the Lab assigment (RA18, RA19, RA20)		No Presential	00:00	40%	5 / 10	CB10 CE.12 CT.02 CG03 CG02

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
[Referred Exam] Test (RA17)		Face-to-face	01:00	20%	5 / 10	CE.12
[Referred exam] Exercise1 Virtual Machines and Containers (RA18)		Face-to-face	00:00	10%	5 / 10	CG02 CE.12
[Referred exam] Exercise2 Cloud IoT (FA18, RA20)		Face-to-face	00:00	10%	5 / 10	CG02 CE.12
[Referred exam] Report of the Lab assigment (RA18, RA19, RA20)		Face-to-face	00:00	40%	5 / 10	CB10 CG02 CE.12 CG03
[Referred Exam] Oral presentation of the lab assignmen		Face-to-face	01:00	20%	5 / 10	CB09 CB10 CT.01 CG03

7.2. Assessment criteria

PROGRESSIVE EVALUATION

Exercise 1 and Exercise 2 have minimum grade (5). These grades are stored until the referred (re-sit) examination (included) of the current course.

The oral presentation of the lab assignment does not have minimum grade.

GLOBAL EVALUATION

Final Grade = 0.1 x Exercise1 + 0.1 x Exercise2 + 0.2 x Test + 0.4 Report of the Lab assigment + 0.2 x Oral presentation of the Lab assignment

To pass the course a grade of 5 out of 10 must be obtained.

Note that Oral presentation of the Lab assignment is a mandatory activity to be performed **during** the course (the teaching period - week 11).

Exercise1 and Exercise 2 may be submitted by all students, both those who have not passed the minimum grade in Progressive Evaluation and those who want to try to improve their grade. For the calculation of the final grade, the highest grade obtained will be considered.

These grades are stored until the referred (re-sit) examination the current course.

REFERRED EXAMINATION

Final Grade = 0.1 x Exercise1 + 0.1 x Exercise2 + 0.2 x Test + 0.4 Report of the Lab assigment + 0.2 x Oral presentation of the Lab assignment

To pass the course a grade of 5 out of 10 must be obtained.

* The transversal competence / soft skill CT.01 (Capacidad de uso de la lengua inglesa para el trabajo en contextos internacionales) is evaluated through the oral presentation of the lab assignment (10% of the score).

** The transversal competence / soft skill CT02 (Capacidad para el trabajo en grupo y dirigir, organizar y supervisar equipos multidisciplinares) is evaluated through the realization of the lab assignment (10% of the score). The report should include an effort table (hours per student). Also the use of an agile project management tool (team and tasks management) (e.g. trello.com) from which you must capture your status in several milestones throughout the implementation of the practice.

**** The solutions to the tests will not be published due to the limited degree of variability of the questions.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Cloud Computing	Bibliography	Cloud Computing By: Lizhe Wang; Rajiv Ranjan; Jinjun Chen; Boualem Benatallah Publisher: CRC Press Pub. Date: December 21, 2017 Print ISBN-13: 978-1-4398-5641-3
The Docker Book	Bibliography	THE DOCKER BOOK CONTAINERIZATION IS THE NEW VIRTUALIZATION https://dockerbook.com/
Microsoft Azure Essentials: Fundamentals of Azure	Bibliography	Microsoft Azure Essentials: Fundamentals of Azure, Second Edition Michael S. Collier and Robin E. Shahan
Microsoft Azure Essentials: Azure Web Apps for Developers	Bibliography	Microsoft Azure Essentials: Azure Web Apps for Developers
Aula con dispositivos audiovisuales	Equipment	
Laboratorios con recursos informáticos para la realización de las prácticas	Equipment	
Moodle	Web resource	https://moodle.upm.es/titulaciones/oficiales