Universidad de Alcalá

TEACHING GUIDE

Intelligent and Sustainable Solutions for the Modern Society

Transversal Subject
Universidad de Alcalá

Academic Year 2023/2024
2nd Semester

Approved by the School Board on June 12th, 2023

TEACHING GUIDE

Course Name:	**Intelligent and Sustainable Solutions for the modern society**
Code:	**100193**
Degree in:	
Departament:	**Signal Theory and Communications**
Area:	**Signal Theory**
Type:	**Transversal**
ECTS Credits:	**6**
Year and semester:	**2nd Semester**
Teachers:	**Pilar Martín Martín**
Tutoring shedule:	**To be determined on the first class**
Course Name:	**Intelligent and Sustainable Solutions for the modern society**

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1. COURSE SUMMARY

The main objective of this course is to introduce the students in the field of a new generation of Intelligent systems (**NextGen).** It will provide them the basic knowledge for their professional future.

The course is structured in four main parts:

- Common Telecommunications Infrastructure (CTI) & Suitable systems for PassivHaus,
- Internet of Things (IoT) & Smart Technologies,
- Blockchain Technology,
- Machine Learning and Artificial Intelligence (AI).

Telecom Infrastructure is an exciting and happening area that specializes in building telecom networks. A CTI is a Common Telecommunications Infrastructure and its final goal is to provide telecommunications services (radio, television, and internet) inside buildings and design the equipment installation. It is interesting the knowledge of how ICTs are designed since they are a very important part of our life. In this way, the incorporation of new technologies will be easier. We will talk about Digital Home as an integrated network of digital systems that will make our life easier. However, the new regulations are talking about other important concept for the building design: energy friendly. We will analyze the concept of PassivHaus standards and the technologies behind it.

Information and Communication Technologies (ICT) deliver services to the user, regardless of his location, joining effectiveness and efficiency to improve his quality of life. ICT contributes currently to the high development of innovative services in a large area of applicability: waste management and treatment and energy efficiency (**Smart Grid**), an open and participative government (**Smart Government**), a cooperative and communicative society (**Smart Society**), intelligent cities using traffic control, healthcare, tourism, education, culture or public safety (**Smart City**), and intelligent homes that improve the quality of life (**Smart Home**). In the latter case, it is important to know how to modify the current common telecommunication infrastructures in order to incorporate the new technologies. All of these examples manage several or many devices interconnected with the Internet: **Internet of Things** (**IoT), machine to machine (M2M**), **Peer-to-peer (P2P), LoRa, SigFox…**

The course will analyze the needs, the proposed solutions, and the possible problems associated with each of the different applications. For example, it will describe concepts such as **Bitcoin and Blockchain**. Although Blockchain is generally associated with Bitcoin and other cryptocurrencies, these are just the tip of the iceberg, Blockchain is a new decentralized technology without intermediaries for the storage of any type of information, such as health records could be unified and stored in the blockchain.

New next-generation applications came in order to be able to consume and digest data from a wide variety of sources and act on them in real-time. This requisite represents a major challenge as the traditional platforms cannot handle the massive

volumes and agile data movement required. For that reason, this course will introduce **Big Data, Machine Learning, and Artificial Intelligence (AI)**. Big Data will be responsible for the adequate and intelligent storage of the data, later by using machine learning techniques can be extracted patterns of behavior that are repeated: patterns of consumption, criminals ... This technique is also used in artificial vision.

This course includes laboratory lectures in order to make it easier and practical to understand the concepts that are explained in the theory.

For optimal follow-up of the course, it is recommended that the student have basic engineering knowledge.

2. SKILLS

The expected learning outcomes, expressed in the form of knowledge, skills and abilities that students should have achieved, are as follows:

This course also contributes to acquiring the following generic and cross-curricular skills proposed by UAH for its degrees:

• TRU1: Capacity for analysis and synthesis
• TRU2: Oral and written communication.
• TRU3: Information management capacity.
• TRU4: Autonomous learning.
• TRU5: Teamwork.

2.2. Learning Outcomes

After succeeding in this course, the students will have the:

- RA1. Knowledge of the current regulation for TCI. Ability to apply the new technologies to this regulation together with the economic considerations. The student contrasts the advantages and disadvantages of different technological alternatives for the deployment or implementation of new generation communication systems.
- RA2. Knowledge of sustainable technologies as a better way to save the environment and cost-efficient.
- RA3. Knowledge of new Information and Communication Technologies (ICT) for an improvement in the life quality of the society.
- RA4. Knowledge of the new decentralized Blockchain data storage technology.
- RA5. Basic knowledge of machine learning and artificial intelligent.

3. CONTENTS

Content Blocks	Total number of hours
Block 0. Current and prospective overview. Course organization Basic concepts. Cohesion of new technologies with existing ones. Course organization.	• 4 hours
Bloc 1. Common Telecommunications Infrastructure adapted to new technologies & Sustainable Systems for Energy friendly buildings ICT regulations. Implementation in different types of homes. Incorporation of the digital home. Main construction concepts in passive houses. Standards PassivHaus. Laboratory practice.	• 16 hours
Block 2. Internet of Things (IoT) & Smart ICTs (Information and Communication Technologies) Definition of ICT. Different areas of ICT application: Smart City, Smart Grid, Smart Home, Smart Government. Definition of IoT. IoT platforms. Machine to machine (M2M), Peer-to-peer (P2P), LoRa, SigFox… Laboratory practice.	• 12 hours
Block 3. Machine learning and Artificial Intelligent Definition of Big Data. Database management. Application of learning techniques. Definition of Computer Vision and algorithms. Laboratory practice.	• 12 hours
Block 4. Blockchain Technology. Cryptocurrency Definition of Blockchain. Applications. Cryptocurrencies. Laboratory practice.	• 12 hours

4. TEACHING-LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credit Distribution

Number of on-site hours:	28 hours in large group 28 hours in small group 2 exams hours
Number of hours of student work:	92 hours
Total hours:	150 hours

4.2. Methodological strategies, teaching materials and resources

The formative activities that are going to be considered during the teaching process are the following:

· **Theoretical lessons:** During these classes, the teacher will present and explain the contents of the course. In that way, the student will acquire the specific competences of the subject.
· **Individual or group projects** with the corresponding exposition and debate in class, contrasting ideas among the students.
· **Software simulations and Hardware laboratory classes:** The practical classes will be held in the laboratory. The teacher will provide the students with a project script and the student will have a place with the appropriate software and hardware to carry out the different proposed activities. For each of the projects, the students will deliver a memory that includes the work done and the proposed solutions to solve the problem. The delivery date will be set by the teacher at the beginning of the session.
· **Individual or group tuitions:** the teacher could solve doubts or brainstorm matters related to the course. The students will have the possibility to establish a more personal relationship so that they could address questions impossible to discuss in a greater group. These tuitions may be requested via email with the address of the institution or in-person.

5. ASSESSMENT: Procedures, evaluation, and grading criteria

The evaluation aims to specify what is going to be assessed in relation to the competences to be acquired. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary call

Students have two ordinary assessment models: continuous or final assessment.

Continuous assessment has been designed to encourage progressive and continuous study by the student, and so that the student has an idea of his degree of progression in learning the subject, so it is advisable to choose this type of call. However, in accordance with the regulations of the University of Alcalá, a final evaluation model is made available to the student.

The regulations in the UAH about the learning assessment processes (approved by the Governing Council on March 24, 2011), in Article 10, paragraph 2, says that students will have a period of fifteen days to request their intention to avail themselves of the final evaluation model, citing the reasons they deem appropriate. The evaluation of the learning process of all students who do not apply in this regard or have it denied will be carried out, by default, in accordance with the continuous evaluation model.

Continuous evaluation

The continuous assessment is based on the completion of a set of four deliverables of practical cases proposed by the teacher in each of the parts of the subject. Students will be considered to have passed the course following the continuous assessment if they have completed the four TA deliverables necessary throughout the semester and the final grade obtained as a weighted sum of the grade of each of them is equal to or greater than 5 out of 10.

The number of deliverables may vary from one academic year to another. But in no case will a deliverable have a weight greater than 40% of the final grade for the subject.

On the other hand, the student will be considered not presented in the continuous assessment model when they do not deliver any of the TA deliverables.

In the ordinary call through continuous evaluation, the relationship between the criteria, instruments and qualification is as follows:

Skill	Learning outcome	Grading criteria	Grading tool	Contribution to the final mark
TRU1-TRU2-TRU3-TRU4-TRU5	RA1, RA3	CE1, CE2, CE3	TA1	25%
TRU1-TRU2-TRU3-TRU4-TRU5	RA3, RA2	CE1, CE2, CE3	TA2	25%
TRU1-TRU2-TRU3-TRU4-TRU5	RA3, RA4	CE1, CE2, CE3	TA3	25%
TRU1-TRU2-TRU3-TRU4-TRU5	RA3, RA5	CE1, CE2, CE3	TA4	25%

Non-Continuous evaluation (final exam assessment)

Those students who are accepted to the final evaluation system (exclusively by final test) will obtain 100% of the grade by taking a final test. This final test will consist, at the student's choice, either in an exam where the student will explain their knowledge about the subject or the delivery of simplified TA deliverables proposed by the

teacher. Its objective is to evaluate that the student has acquired an integrated knowledge of the subject.

Students will be considered to have passed the subject following the final assessment if they have completed the four necessary simplified TA deliverables and their final grade as a weighted sum of the grade of each of them is equal to or greater than 5 out of 10 or if they selected final exam, the grade must be equal to or greater than 5 out of 10.
The student will be considered not presented in this call when they do not take the final assessment test or submit the simplified TAs.

In the ordinary call, for students not covered by the continuous assessment system, the relationship between the criteria, instruments and qualification is as follows.

Skill	Learning outcome	Grading criteria	Grading tool	Contribution to the final mark
TRU1-TRU2-TRU3-TRU4-TRU5	RA1- RA5	CE1, CE2, CE3	PEF	100%

Extraordinary call

Students who do not pass the ordinary call (be it continuous or final assessment) will have the right to an extraordinary call consisting of a test of the same characteristics as that carried out by the students evaluated through the final test in the ordinary call, from which it will be obtained 100% of the rating.

In the extraordinary call, the relationship between the criteria, instruments and rating is:

Skill	Learning outcome	Grading criteria	Grading tool	Contribution to the final mark
TR1-TR2-TR3-TR4_TR5-TRU1-TRU2-TRU3-TRU4-TRU5	RA1- RA5	CE1, CE2, CE3	PEF	100%

6. BIBLIOGRAPHY

- Due to the nature of this course based on very new advance technologies, the documentation provided by the teacher will be articles from scientific magazines, newspaper articles, current reports, web pages ...
- However, the basic bibliography to be used will be the one generated throughout the course.

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.