Universidad de Alcalá

TEACHING GUIDE

Next-Gen Intelligent and Sustainable Systems

Degree in
Electronic Communications Engineering (GIEC)
Telecommunication Technologies Engineering (GITT)
Telematics Engineering (GIT)

Universidad de Alcalá

Academic Year 2021/2022

4th Year - 2nd Semester (GIEC+GITT)

Approved by the School Board on July 6, 2021

4º Curso - 2º Cuatrimestre (GIT)

TEACHING GUIDE

Course Name:	**Next-Gen Intelligent and Sustainable Systems**
Code:	**350055 (GIEC+GITT+GIT)**
Degree in:	**Electronic Communications Engineering (GIEC)** **Telecommunication Technologies Engineering (GITT)** **Telematics Engineering (GIT)**
Department and area:	**Teoría de la Señal y Comunicaciones** **Teoría de la Señal y Comunicaciones**
Type:	**Optional (Generic) (GIEC+GITT)** **Optativa (Genérica) (GIT)**
ECTS Credits:	**6.0**
Year and semester:	**4th Year - 2nd Semester (GIEC+GITT)** **4º Curso - 2º Cuatrimestre (GIT)**
Teachers:	Pilar Martín Martín
Tutoring schedule:	Consultar al comienzo de la asignatura
Language:	English

1. COURSE SUMMARY

The main objective of this course is to introduce the students to 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 another important concept for the building design: energy friendly. We will analyze the concept of PassivHaus standards and the technologies behind them.

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…

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

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.

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

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the

Annex to the Orden CIN/352/2009:

en_TR1 - Knowledge, understanding and ability to apply the necessary legislation during the development of the profession of Technical Engineer of Telecommunication and ease of handling specifications, regulations and mandatory rules.

en_TR3 - Aptitude to solve problems with initiative, decision making, creativity, and to communicate and to transmit knowledge, skills and workmanship, comprising the ethical and professional responsibility of the activity of the Technical Engineer of Telecommunication.

en_TR5 - Easy to handle specifications, regulations and mandatory standards.

en_TR7 - Know and apply basic elements of economics and human resources management, organization and planning of projects, as well as legislation,regulation and standardization in telecommunications

en_TR8 - Capacity of working in a multidisciplinary and multilingual team and of communicating, both in spoken and written language, knowledge, procedures, results and ideas related to telecommunications and electronics.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU3 - Ability to manage information.

en_TRU4 - Autonomous learning skills.

en_TRU5 - Team work.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/352/2009:

en_CST2 - Ability to apply the techniques on which telecommunication networks, services and applications are based, both in fixed and mobile environments, personal, local or at a great distance, with different bandwidths, including telephony, broadcasting, television and data, from the point of view of transmission systems.

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 intelligence.

3. CONTENTS

Contents Blocks	Total number of hours
Block 0. Current and prospective overview. Course organization Basic concepts. The cohesion of new technologies with existing ones. Course organization.	4 hours
Block 1. Common Telecommunications Infrastructure adapted to new technologies (CTI) & Sustainable Systems for Energy friendly buildings CTI 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. **Block 4. Blockchain Technology. Cryptocurrency** Definition of Blockchain. Applications. Cryptocurrencies. Laboratory practice.	12 hours 12 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours)
Number of hours of student work:	92
Total hours	150

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 competencies 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

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines (last modified in the Governing Board of October 31, 2019) as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level at which the skills have been acquired by the student. For that purpose, the following are defined:

- CE1: The student is able to carry out an individual or teamwork on current issues related to the subject and draw conclusions about their validity and characteristics.
- CE2:The student presents the studies carried out with the structural organization.
- CE3:The students can defend and debate the conclusions of their studies with correctness and adequate argumentation.

GRADING CRITERIA. ORDINARY CALL

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 Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
en_TR1-en_TR3-en_TR5_en_TR7-en_TR8-en_TRU1-en_TRU2-en_TRU3-en_TRU4-en_TRU5	RA1, RA2	CE1, CE2, CE3	TA1	25 %
en_TR1-en_TR3-en_TR5_en_TR7-en_TR8-en_TRU1-en_TRU2-en_TRU3-en_TRU4-en_TRU5	RA3	CE1, CE2, CE3	TA2	25%
en_TR1-en_TR3-en_TR5_en_TR7-en_TR8-en_TRU1-en_TRU2-en_TRU3-en_TRU4-en_TRU5	RA4	CE1, CE2, CE3	TA3	25%
en_TR1-en_TR3-en_TR5_en_TR7-en_TR8-en_TRU1-en_TRU2-en_TRU3-en_TRU4-en_TRU5	RA5	CE1, CE2, CE3	TA4	25%

The non-continuous evaluation (final exam assessment) is based 100% on 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.

GRADING CRITERIA. 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.

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

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
en_TR1-en_TR3-en_TR5_en_TR7-en_TR8-en_TRU1-en_TRU2-en_TRU3-en_TRU4-en_TRU5	RA1, RA2,RA3,RA4,RA5	CE1, CE2, CE3	PEF	100 %

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Due to the nature of this course based on very new advanced 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.

6.2. Additional Bibliography

Disclosure Note

The University of Alcalá guarantees to its students that, if due to health requirements the competent authorities do not allow the total or partial attendance of the teaching activities, the teaching plans will achieve their objectives through a teaching-learning and evaluation methodology in online format, which will return to the face-to-face mode as soon as these impediments cease.