Universidad de Alcalá

TEACHING GUIDE

Electronic Instrumentation

Degree in
Telecommunication Technologies Engineering (GITT)

Universidad de Alcalá

Academic Year 2025/2026

4th Year - 1st Semester (GITT)

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Electronic Instrumentation**
Code:	**350043 (GITT)**
Degree in:	**Telecommunication Technologies Engineering (GITT)**
Department and area:	**Electrónica** **Electrónica**
Type:	**Optional (Specialized) (GITT)**
ECTS Credits:	**6.0**
Year and semester:	**4th Year - 1st Semester (GITT)**
Teachers:	Enrique Santiso Gómez
Tutoring schedule:	Consultar al comienzo de la asignatura
Language:	Spanish/ English Friendly

1. COURSE SUMMARY

The course addresses the concepts related to electronic measuring instruments, both with regard to their use, and their characterization and design. The different structures of such systems, methods of calibration, uncertainty calculation, different sensors and electronic circuits needed to extract and condition the information captured by these sensor are studied.

For the proper use of the course it is necessary that the student has previous knowledge and skills acquired in the subjects of theory and circuit analysis, as well as those related to electronics.

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/351/2009:

en_TR2 - Knowledge of basic subjects and technologies that enables to learn new methods and technologies, as well as to provide versatility that allows adaptation to new situations.

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_TRU1 - Capacity of analysis and synthesis.

en_TRU4 - Autonomous learning skills.

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/351/2009:

en_CSE1 - Ability to build, operate and manage capture, transportation, representation, processing, storage, management and presentation of multimedia information systems, from the point of view of the electronic systems.

en_CSE3 - Ability to perform the specification, implementation, documentation and tuning of equipment and systems, electronic, instrumentation and control, considering both the technical aspects and the corresponding regulatory regulations.

en_CSE4 - Ability to apply electronics as a support technology in other fields and activities, and not only in the field of Information and Communications Tecnology.

en_CSE8 - Ability to specify and use electronic instrumentation and measurement systems.

en_CSE9 - Ability to analyze and solve interference and electromagnetic compatibility problems

Basic, general and transversal competences.

This subject contributes to the acquisition of the following basic, general and transversal competences defined in section 3 of the Annex to Order CIN/352/2009:

TR2 - Knowledge of basic subjects and technologies, enabling him/her to learn new methods and technologies, as well as being versatile enough to adapt to new situations.

TR3 Ability to solve problems with initiative, decision-making, creativity, and to communicate and

transmit knowledge, skills and abilities, understanding the ethical and professional responsibility of the activity of the Telecommunications Engineer.

TRU1 - Capacity for analysis and synthesis. TRU4 - Capacity for autonomous learning.

Professional Competences

This subject provides the following professional competence(s) as defined in section 5 of the Annex to Order CIN/352/2009:

CSE1 - Ability to construct, exploit and manage systems for the capture, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of electronic systems.

CSE3 - Ability to carry out the specification, implementation, documentation and fine-tuning of electronic, instrumentation and control equipment and systems, considering both technical aspects and the corresponding regulatory standards.

CSE4 - Ability to apply electronics as an enabling technology in other fields and activities, and not only in the field of Information and Communications Technologies. CSE8 - Ability to specify and use electronic instrumentation and measurement systems.

CSE9 - Ability to analyse and solve interference and electromagnetic compatibility problems.

Learning outcomes

On successful completion of this subject/teaching, students will be able to: RA1. develop the physical-electrical model of a measurement and actuation system. RA2. Use sensors used in the measurement of physical quantities.

RA3. Design the electronic circuits necessary to capture and process the information provided by sensory elements.

RA4. Identify and solve electromagnetic interference problems arising from the use and wiring of electronic subsystems.

RA5. Analyse the characteristics of commercial electronic circuits and select the most appropriate ones for each application.

3. CONTENTS

3.7.- Signal filtering 4 hours

Contents Blocks	Total number of hours
1.- Introduction to Instrumentation Systems	9 hours
1.1.- Instrumentation systems	2 hours
1.2.- Errors and uncertainty of an instrument	4 hours
1.3.- Parameters of measurement systems	2 hours
1.4.- Calibration of Instruments	1 hours
2.- Sensors	7 hours
2.1 Force sensors	2 hours
2.2.- Temperature sensors	4 hours
2.3.- Sound pick-up devices: microphones. Other sensors.	4 hours
3.- Circuits for signal conditioning and sensors	1 hours
3.1.- Measurement of impedances	18 hours
3.2.- Voltage and current references	2 hours
3.3.- Types of signals	4 hours
3.4.- Microphone Conditioning	2 hours
3.5.- Instrumentation and isolation amplifiers	1 hours
3.6.- Analogue telemetering	2 hours
3.7.- Signal filtering	1 hours
Electromagnetic Interference and Electrical Safety and Electromagnetic Compatibility Regulations.	2 hours
Laboratory: Measurement electronics.	18 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 following training activities will be carried out in the teaching-learning process:

- Theoretical classes and solving examples.
- Practical classes: laboratory, demonstrations and solving exercises.
- Tutorials: individual and/or group.

In addition, the following complementary resources, among others, may be used:

- Individual or group work.
- Attendance at conferences, meetings or scientific discussions related to the subject.

Throughout the course, students will be offered both theoretical and practical activities and tasks. Different practices will be carried out in coordination with the teaching of theoretical concepts, so that the student can experience the concepts acquired. The subject's laboratory will be available for the practical exercises, with the material and instruments necessary for the development of the contents.

Throughout the learning process of the subject, students will have to make use of different bibliographic or electronic sources and resources, so that they become familiar with the documentation environments that they will use professionally. In addition, the teaching staff will provide their own materials developed specifically for the subject (documents of theoretical foundations, collections of exercises and problems, practice manuals, audiovisuals, etc.) so that the student can meet the objectives of the subject, as well as achieve the expected competences.

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 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.

Ordinary Call

Continous Assessment:

Continuous assessment:

Consisting of laboratory practicals and different written tests on the material taught during the course.

Assessment through final exam:

It will consist of the completion of the laboratory practices during the course and a final exam.

Extraordinary Call

Consisting of a written test that complements the laboratory practicals carried out during the course, and a second theory/problem test. Students who have passed the assessment tests related to the laboratory practicals or those related to all the theory tests in the ordinary exam session may, if they so wish, keep their grade in this exam session.

5.2. EVALUATION

EVALUATION CRITERIA

The Assessment Criteria must address the degree of acquisition of competences by the student. To this end, the following are defined.

SC1. That the student is able to solve problems of specification, implementation, documentation and fine-tuning of electronic instrumentation systems.

SC2. That the student integrates the conceptual knowledge explained in the different theory subjects in order to solve the practical problems that arise.

SC3. That the student clearly and reasonably defends his/her proposals for the resolution of the problems posed.

SC4. That the student is able to generate correctly written, clear and precise documentation on the work carried out in the laboratory.

GRADING TOOLS

This section details the evaluation instruments that will be applied to each of the evaluation criteria.

- Partial Evaluation Test (PEI): An intermediate evaluation test referring to the theory classes and exercises, approximately halfway through the term, consisting of several short, conceptual questions.

- Laboratory practicals (PL): these will cover the knowledge imparted during the theory classes, and in which the student will have to design and/or characterise different electronic circuits, as well as use and programme a data acquisition card. The results of the practicals will be presented in the corresponding report.

- Final evaluation test (PEF): This test will consist of a final project, where it will be necessary to integrate and apply the different concepts covered during the course.

- Laboratory evaluation tests (PEL): The student, individually, will solve questions related to the development of laboratory practices.

As the laboratory is considered essential for the acquisition of the objective skills of the subject Electronic Instrumentation, the passing of different types of compulsory practicals may be considered an essential element of the assessment, both in the ordinary and in the extraordinary call (Learning Assessment Regulations (approved by the Governing Council on 24 March 2011 and modified on 5 May 2016, Article 6, paragraph 4). For students who have opted for the final assessment, in those practicals that the teachers of the subject consider that the student can do without attending the laboratory, attendance will not be compulsory, but they must be passed through the procedure provided for this purpose. In the first two weeks of class, students who opt for non- continuous assessment may request a reasoned exemption from attending the laboratory practicals from the teachers of the subject. The

teachers determine on the basis of the information provided by the student whether he/she has the capacity (material, equipment, infrastructure, etc.) to carry out the placement on his/her own.

The aim of the intermediate tests is:

- To allow the student to know throughout the learning process, with a real and objective test, which are the evaluation and qualification criteria that were presented to him/her at the beginning of the subject.

- To allow the learner to evaluate at the end of each block the learning process he/she has carried out as well as the competences and skills acquired.

- To provide teaching staff with a measure of the quality of the process of implementation and development of the subject.

The intermediate tests do not free up material for the final exam, since the aim of the latter is to assess the overall acquisition of the subject's objective competences. And one of these competences, of vital importance in this subject, is the ability to apply and interrelate all the knowledge acquired jointly and in a coordinated manner in the resolution of a problem.

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TRU1, TRU4, CSE3, CSE4, CSE8, CSE9	RA1, RA2, RA3, RA4, RA5	SC1, SC2, SC3	PEI	30%
			PEF	40%
		SC1, SC2, SC3, SC4	PEL	15%
			PL	15%

In the ordinary call-final evaluation, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TRU1, TRU4, CSE3, CSE4, CSE8, CSE9	RA1, RA2, RA3, RA4, RA5	SC1, SC2, SC3	PEF	70%
			PEL	15%
		SC1, SC2, SC3, SC4	PL	15%

Extraordinary call

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TRU1, TRU4, CSE3, CSE4, CSE8, CSE9	RA1, RA2, RA3, RA4, RA5	SC1, SC2, SC3	PEF	70%
			PEL	15%
		SC1, SC2, SC3, SC4	PL	15%

Students will be considered to have passed the course (demonstrating the acquisition of theoretical and practical competences) if the following requirements are met:

- Have satisfactorily passed the laboratory assessment. This requires attendance at the laboratory, completion of all the practical exercises and obtaining a mark for the laboratory as a whole (PL and PEL) equal to or higher than 40% of the maximum possible mark.

- They have satisfactorily passed the assessment of the theoretical tests. This is achieved if their mark in all the associated tests is equal to or higher than 40% of the maximum possible mark.

- The final weighted mark of all the evaluation tests is equal to or higher than 5 out of 10.

Students who follow the continuous assessment model will be considered absent in the ordinary exam if they do not carry out any of the activities foreseen in this assessment or if they have absences of more than 10% of the total number of hours taught.

The teaching-learning methodology and the assessment process will be adapted as needed, in accordance with the guidelines of the Diversity Support Unit, to implement curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Notes and presentations provided during the course, and documentation available on the website of the electronic device manufacturers.

6.2. Additional Bibliography

- Introduction to measurement electronics I. J. Díaz, J.A. Jiménez, F.J. Meca. Publisher: Servicio de Publicaciones de la Universidad de Alcalá, 1994. Block 3 of contents.

- Introduction to measurement electronics II. J. Díaz, J.A. Jiménez, F.J. Meca. Publisher: Servicio de Publicaciones de la Universidad de Alcalá, 1995. Blocks 2 and 3 of contents.

- Electronic Instrumentation. M.A. Pérez et al. Publisher: Thomson, 2004. Blocks 1, 2 and 3 of contents.
- Industrial Instrumentation. A. Creus. Publisher: Marcombo, 1995. Blocks 1 and 2 of contents.
- Handbook of measurement science, Vol.1 and 2. Coordinator: P.H.Sydenhan, Publisher: Wiley&Sons, 1986. Content blocks 1 and 2.
- Introduction to Electromagnetic Compatibility. Author: Clayton R. Paul. Publisher: JOHN WILEY & SONS, 1992. Section 3.6 of contents.

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.