Universidad de Alcalá

TEACHING GUIDE

Electronic Control

Degree in
Electronic Communications Engineering

Universidad de Alcalá

Academic Year 2022/2023

3rd Year - 2nd Semester

Approved by the School Board on June 3, 2022

TEACHING GUIDE

Course Name:	**Electronic Control**
Code:	**370002**
Degree in:	**Electronic Communications Engineering**
Department and area:	**Electrónica** **Electronic Technology**
Type:	**Compulsory**
ECTS Credits:	**6.0**
Year and semester:	**3rd Year, 2nd Semester**
Teachers:	Cristina Losada Gutiérrez
Tutoring schedule:	Check subject website
Language:	Spanish/English friendly

1. COURSE SUMMARY

The aim of this course is to introduce the students in the study of both continuous and discrete Electronic Control Systems.

In order to do that, they are studied the basic properties of the feedback control systems as well as the identification and modelling of the process to be controlled. Moreover, they are analyzed the concepts of stability, temporal response of dynamic systems, and the principles of the design of controllers using techniques based on the root locus, the frequency response and the state space. It is also addressed the simulation and implementation of electronic controllers applied to real prototypes.

For better understanding of the course, it will be required to have prior knowledge of the basic behavior of actual systems and other mathematical resources as the ones acquired in the subjects of Signals and Systems, Calculus I, Basic Electronics, Electronic Circuits and Digital Electronic Systems.

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_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_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.

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_CSE3 - Ability to perform the specification, implementation, documentation and set-up 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 Technology and Communications.

en_CSE6 - Ability to understand and use the theory of feedback and electronic control systems.

Learning Outcomes

After succeeding in this subject the students will be able to:

RA1. The student must be able to model and simulate feedback systems in both continuous and discrete time, applying that to different electronic communication prototypes.

RA2. The student must have acquired the ability to design and adjust control systems using techniques based on the roots locus, the frequency response and the state space.

RA3. The student must be able to implement the control systems studied, applying them to different real electronic prototypes.

3. CONTENTS

Contents Blocks	Total number of hours (indicative)
Unit 1. Introduction to control systems and modelling of dynamic systems. Open-loop and closed-loop control. Time-domain models. Transfer functions. Sampled systems. Block diagrams and their simplification. State-space models.	6 hours
Unit 2. Temporal and frequency response. Concept of absolute and relative stability. Analysis of the temporal and frequency response: transient-response and steady-state errors.	12 hours
Unit 3. Introduction to control systems design. Basic control actions. PID control and its variants. Design methods for digital controllers. Controller programming.	4 hours
Unit 4. Root-locus based controller analysis and design. Root-locus concept. Guidelines for Sketching a root-locus. Design of phase lead and phase lag compensators using root-locus. PID controllers using root-locus.	10 hours
Unit 5. Analysis and design of controllers in the frequency domain. Design of phase lead and phase lag compensators using the Bode plot. PID controllers in the frecuency domain.	4 hours
Laboratory practices. Study, simulation and implementation of feedback control systems for real prototypes.	20 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

In the teaching-learning process the following training activities will be held:

- Lectures.

- Practical classes: problems solving.
- Practical classes: laboratory.
- Tutorships: individual and/our group.
- Student word, before and after classes. This work will be supported by the information available for each topic at the course website.

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

- Individual or group work: this involves both the completion of the work and the presentation to the rest of the group to encourage debate .
- Attendance at conferences, meetings or scientific discussions related to the subject.

Throughout the course the student will be offered both theoretical and practical activities and tasks. Different practical tasks will be carried out in coordination with the teaching of the theoretical concepts; in this way the student can experiment and consolidate the acquired concepts, applying them to the control of real and/or simulated prototypes, both individually and in groups.

In order to carry out the laboratory practices, the student will have basic instruments (oscilloscope, power supply, signal generator, etc.), as well as a computer with software for the design and simulation of control systems. In this course, it is proposed that the practices be carried out in groups of two students.

Throughout the learning process in the course, the student will have to make use of different sources and bibliographic or electronic resources, in order to become familiar with the documentation environments that will be used professionally in the future.

The teaching staff will provide the necessary materials for the following of the course (theoretical fundamentals, exercises and problems, practice manuals, audiovisual references, etc.) so that the student can achieve the objectives of the course, as well as the expected competences.

Students will be provided throughout the semester with tutorship in group (if requested by the students themselves) or individual. Whether individually or in small groups, this tutorship will resolve doubts and consolidate the acquired knowledge. Also, it will help to make appropriate monitoring and assess the proper functioning of the mechanisms of teaching and learning.

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 (Regulations for the Regulation of Teaching Learning Processes, NRPEA, 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 Regulations for the Evaluation of Apprenticeships (approved by the Governing Council on March 24, 2011 and modified in the Board of Directors). Government of May 5, 2016) 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 evaluation process aims to assess the student acquisition degree and depth of the competences proposed in the subject. Consequently, the following evaluation criteria part of the process, will ensure that the student has the appropriate level of knowledge and skills:

- **CE1**: Knowledge of the fundamental properties of the control systems, the models and techniques of analysis and design used, as well as their correct application.
- **CE2**: Ability to solve control analysis and design exercises from a given set of specifications, in a justified manner.
- **CE3**: Ability to use simulation software tools, and to use them to solve problems and relate the obtained results to the theoretical concepts.
- **CE4**: Ability to design and implement electronic control circuits, and to measure their characteristics and fundamental parameters in the laboratory.
- **CE5**: Ability to document, adequately and reasonably, the theoretical / practical work carried out.

ASSESSMENT PROCEDURES (TOOLS)

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

- Theoretical-practical exercises (E) proposed throughout the course, to be solved using the concepts developed in the theoretical and practical classes, and using, if necessary, software support tools such as Matlab/Simulink. (20% of the final mark).
- Laboratory practices (PL), of compulsory attendance. The practices will cover the knowledge acquired in the theoretical part of the subject, applying them to the design and implementation of specific electronic control prototypes. Each student will defend, individually, the issues related with the practices carried out. (40% of the final mark).
- Final evaluation test (PEF) with several questions and/or problems that may cover the whole course syllabus. (between 40% and 60% of the final mark, depending on the evaluation model).

ASSESSMENT PROCEDURES (MARKING CRITERIA)

Ordinary Call. Continuous Assessment Model:

In the ordinary call of the continuous assessment model, the relationship between the assessment criteria, tools and their weight in the final mark, as well as the learning outcomes and objective competences of the subject, are the following.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CSE3, CSE6, TR2, TR3	RA1, RA2	CE1, CE2, CE3, CE5	E	20%
CSE3, CSE6, TR2, TR3	RA1, RA2, RA3	CE1, CE2, CE4	PEF	40%
CSE3, CSE6, CSE4, TR8	RA1, RA2, RA3	CE1 to CE5	PL	40%

Consequently with the assessment criteria (section 5.1), the student will pass the continuous assessment in the ordinary call by demonstrating an appropriate level in the acquisition of theoretical-practical and experimental skills. In order to accomplish this, the student must meet the following conditions:

- Have satisfactorily passed the assessment of competencies related to laboratory practices (PL), aimed at the design and implementation of electronic control prototypes. It will be understood that a student acquires these competences satisfactorily, if he attends the laboratory, he completes all the practices and his mark in the set of the related tests is equal or greater than 50% of the maximum.
- Have satisfactorily passed the assessment of the competences related to the theoretical tests (E + PEF). It will be understood that a student acquires these competences satisfactorily if his mark in the set of related tests is equal or greater than 50% of the maximum.
- Have obtained a weighted final mark of all continuous assessment equal to or greater than 5 out of 10.

The student within the continuous assessment model who does not participate in the process will be qualified as "Not Presented" in the ordinary call. It will be understood that the student has not participated in the continuous assessment procedure if he does not any of the tools described in section 5.2.

Ordinary Call. Final Assessment Model:

In the ordinary call of the final assessment model, the relationship between the assessment criteria, tools and their weight in the final mark, as well as the learning outcomes and objective competences of the subject, are the following.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CSE3, CSE6, TR2, TR3	RA1, RA2, RA3	CE1, CE2, CE4	PEF	60%
CSE3, CSE6, CSE4, TR8	RA1, RA2, RA3	CE1, CE2, CE3, CE4, CE5	PL	40%

In order to pass the subject according to this model, the student has to demonstrate an appropriate level in the acquisition of theoretical-practical and experimental skills, obtaining for it a minimum of 50% of the maximum mark both in the theoretical (PEF) and in the laboratory (PL) tests.

The student within the continuous assessment model who does not participate in the process will be qualified as "Not Presented" in the ordinary call. It will be understood that the student has not participated in the continuous assessment procedure if he does not any of the tools described in section 5.2.

Extraodinary Call.

In the extraordinary call, the relationship between the assessment criteria, tools and their weight in the final mark, as well as the learning outcomes and objective competences of the subject, are are identical to those indicated for the ordinary call, in its final evaluation model.

In the same way, the necessary conditions to pass the subject, as well as to be qualified as "No Presented" are those indicated for the ordinary call, in its final evaluation model.

Students who do not pass the subject in ordinary call, in both evaluation models, may anyway keep for the extraordinary call the mark of the following parts, if they demonstrate an appropriate level in the acquisition of theoretical-practical and experimental skills, respectively:

a. Evaluation of the theoretical part (E -in case of continuous evaluation model- + PEF), (60% of the mark).
b. Laboratory practices (PL), (40% of the mark).

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Documentation generated by teachers for the course, which will be provided to students directly, or posted on the course Web site.
- Textbook: K. Ogata. “Modern Control Engineering”. Ed. Prentice Hall. ISBN-13: 978-0136156734
- Textbook: G.F. Franklin. “Feedback Control of Dynamic Systems”. Ed. Addison-Wesley. ISBN-13: 978-0201527476
- Selected web sites related to the content of the module.

6.2. Additional Bibliography

Other reference textbooks

- J. Dorsey. "Continous and Discrete Control Systems)". Edits. McGraw Hill. ISBN-13: 978-0072505009
- R.C. Dorf y R.H. Bishop. “Modern Control Systems”. Edits. Prentice Hall. ISBN-13: 978-0134407623
- F. Golnaraghi, B.C. Kuo. “Automatic Control Systems. 10th Edition”. Edits. Prentice Hall. ISBN-13: 978-1259643835
- K. Ogata. “Discrete-Time Control Systems”. Edits. Prentice Hall. ISBN-13: 978-9332549661.

In Spanish:

- F. Espinosa, J.J. García, C. Matáix, F.J. Rodríguez, E. Santiso y E. López. “Análisis, diseño y realización de sistemas electrónicos de control continuo”. Servicio de publicaciones de la Universidad de Alcalá.
- F.J. Rodríguez, F. Espinosa, E. Santiso, J.J. García, E. López, A. Hernández y C. Mataix “Análisis, diseño y realización de sistemas electrónicos de control discreto”. Servicio de publicaciones de la Universidad de Alcalá.

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.