UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course:	INSTRUMENTATION AND TRANSDUCERS ELECTRONIC	**Code:**	310910
Type:	CORE COURSE	**ECTS credits:**	4.5
Degree:	2349 - MASTER DEGREE PROGRAMME IN TELECOMMUNICATION ENGINEERING	**Academic year:**	2021-22
Center:	308 - SCHOOL POLYTECHNIC OF CUENCA	**Group(s):**	30
Year:	1	**Duration:**	C2
Main language:	Spanish	**Second language:**	
Use of additional languages:		**English Friendly:**	Y
Web site:		**Bilingual:**	N

Lecturer: **RAUL ALCARAZ MARTINEZ** - Group(s): **30**

Building/Office	Department	Phone number	Email	Office hours
E. Politécnica Cuenca (0.03)	INGENIERÍA ELÉCTRICA, ELECTRÓNICA, AUTOMÁTICA Y COMUNICACIONES	926054053	raul.alcaraz@uclm.es	The tutorial timetable will be published on the notice board

Lecturer: **CESAR SANCHEZ MELENDEZ** - Group(s): **30**

Building/Office	Department	Phone number	Email	Office hours
0.05	INGENIERÍA ELÉCTRICA, ELECTRÓNICA, AUTOMÁTICA Y COMUNICACIONES	926053743	cesar.sanchez@uclm.es	The tutorial timetable will be published on the notice board

2. Pre-Requisites

No prerequisites, except those imposed by the general curriculum, will be required. However, it is highly recommended to have basic knowledge of theory and analysis of electronic components and circuits, as well as instrumentation systems and the use of sensors.

3. Justification in the curriculum, relation to other subjects and to the profession

The electronic instrumentation of measurement and control is present in the most diverse areas of our world. This area of study is increasingly important in research laboratories, industry, hospitals, the automotive sector, IOT, and UVAs, among others. This course provides the necessary knowledge to understand the technology, operation and conditioning of electronic systems of measurement and control with emphasis on integrated systems, as well as the necessary competencies for the development of different types of systems and applications.

Consequently, this course is related to most subjects of the degree, since electronic measurement systems are an important basis for the development of different areas of work in telecommunications engineering.

4. Degree competences achieved in this course

Course competences

Code	Description
E14	The ability to apply advanced knowledge of photonics and optoelectronics, as well as high-frequency electronics.
E15	The ability to develop electronic instruments such as transducers, actuators and sensors.
G01	The ability to conceptualise, calculate and design products, processes and facilities in all fields of Telecommunications Engineering.
G04	The ability to perform mathematical modelling, calculations and simulations in technology centres and engineering companies, particularly in tasks involving research, development and innovation in all areas related to Telecommunications Engineering and related multidisciplinary fields.
G07	The ability to launch, lead and manage the manufacturing processes of electronic and telecommunications equipment, guaranteeing the safety of people and assets, the final quality of products, and their standardisation.
G08	The ability to apply acquired knowledge and solve problems in new or unknown settings within wide and multidisciplinary environments while being capable of integrating knowledge.
G11	The ability to know how to communicate their conclusions and the latest supporting knowledge or data to both specialised and non-specialised audiences clearly and free from ambiguity.
G12	The ability to have the learning skills which allow them to continue studying in a largely self-directed or autonomous way.
G14	The ability to have knowledge and understanding which provides a basis or opportunity to be original in the development and/or application of ideas, often within a research context.
G15	The ability to integrate knowledge and face the complexities of making assessments based on information which, whether incomplete or limited, includes reflections on the social and ethical responsibilities in the application of their knowledge and judgements.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Knowledge and respect of professional ethics and deontology.

Development of virtual instrumentation systems: environments, architectures and associated standards.

Determination of the design requirements of a circuit starting from the specifications at the system level.

Design of analog circuits applying low noise and precision techniques.
Design and development of advanced electronic instrumentation systems.
Application of advanced techniques of analog design oriented to the development of instrumentation blocks.
Analysis and synthesis of technical documentation.
Knowledge of the fundamentals, characteristics and applications of sensors and actuators in advanced electronic instrumentation.
Correct use of oral and written expression to convey ideas, technologies, results, etc.
Understanding of technical documentation in English and mastery of specific vocabulary in this language.

6. Units / Contents

Unit 1: Design and development of electronic instrumentation systems

- **Unit 1.1** Measurements, metrology and patterns
- **Unit 1.2** Calibration, traceability, accreditation and homologation
- **Unit 1.3** Architectures and technologies
- **Unit 1.4** Analogue design oriented to the development of instrumentation blocks
- **Unit 1.5** Noise and interference reduction techniques
- **Unit 1.6** Real-time acquisition systems
- **Unit 1.7** Smart instrumentation
- **Unit 1.8** High-level software
- **Unit 1.9** LAB 1. VIRTUAL INSTRUMENTATION

Unit 2: Sensors, transducers and actuators

- **Unit 2.1** Characterization and classification
- **Unit 2.2** Design of advanced conditioning systems for sensors
- **Unit 2.3** Microsensors, micro-actuators. Smart sensors
- **Unit 2.4** LAB 2. SENSORS CONDITIONING

Unit 3: Protocols and communication interfaces

- **Unit 3.1** Compact and distributed systems
- **Unit 3.2** Instrumentation and field buses
- **Unit 3.3** LAB 3. COMMUNICATION PROTOCOLS AND INTERFACES

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	E14 E15 G01 G04 G07 G08 G12 G14	0.51	12.75	N	-	Theory concepts will be covered along several sequential and active lectures.
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	E14 E15 G01 G04 G07 G08 G11 G12 G14	0.15	3.75	N	-	The instructor and students will cooperate to solve some problems.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	E14 E15 G01 G04 G07 G08 G11 G12 G14 G15	0.54	13.5	N	-	Attendance to the laboratory is not mandatory but highly advisable. If possible, those students who are unable to attend to the laboratory will be provided with sufficient material to develop the proposed hands-on experiments.
Writing of reports or projects [OFF-SITE]	Guided or supervised work	E14 E15 G01 G04 G07 G08 G11 G12 G14 G15	0.9	22.5	Y	Y	Students will be required to complete a technical inform for each hands-on activity. This document will include theoretical analysis, simulation and measurement on the analyzed electronic circuits. If needed, every hands-on activity could be retaken in a special timetable, agreed with the instructor. Plagiarism detection in every technical inform will entail a score of 0 points for all students involved in this fraud.
Project or Topic Presentations [ON-SITE]	Individual presentation of projects and reports	E14 E15 G01 G04 G07 G08 G11 G12 G14 G15	0.06	1.5	Y	Y	Skills associated with the hands-on experiments will be assessed through a single oral examination. In this test, student will have to reply some questions, as well as to modify in-situ the developed circuits. If needed, this activity could be retaken in a similar test on a different hands-on experiment. Every fraudulent activity in these examinations will entail a score of 0 points.
Individual tutoring sessions [ON-SITE]	Combination of methods	E14 E15 G01 G04 G07 G08 G11 G12 G14 G15	0.03	0.75	N	-	Resolution of doubts and supervision of individual learning progress of students.
Other on-site activities [ON-SITE]	Assessment tests	E14 E15 G01 G04 G07 G08	0.06	1.5	Y	Y	Theory concepts will be assessed through several written examination. If needed, these exams could be

		G11 G12 G14 G15					retaken in a single test. Every fraudulent activity during these exams will entail a score of 0 points.
Study and Exam Preparation [OFF-SITE]	Self-study	E14 E15 G01 G04 G07 G08 G11 G12 G14 G15	2.25	56.25	N	-	Out-of-class study to prepare course's activity and final exams.
		Total:	**4.5**	**112.5**			
Total credits of in-class work: 1.35			**Total class time hours: 33.75**				
Total credits of out of class work: 3.15			**Total hours of out of class work: 78.75**				

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Test	40.00%	40.00%	Written tests and/or resolution of problems or cases. A minimum score of 4 points (over 10) is required in each exam to pass the course.
Laboratory sessions	60.00%	60.00%	The hands-on experiments will be assessed through technical informs and oral examination. In global terms for all experiments, a minimum score of 4 points (over 10) is required to pass the course.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

To pass the course, students will have to satisfy the next requirements:
- All laboratory tasks will have to be submitted and orally defended. No minimum mark will be required for any hands-on experiment, both the weighted average score for all of them will have to be higher than 4 points (on a scale of 10 points).
- A degree on every theory test higher 4 points (on a scale of 10 points) will be required.
- A final mark on the course higher than 5 points (on a scale of 10 points) will be required.

Non-continuous evaluation:

Those students unable to follow regularly the course will have to contact by email with the instructor. Moreover, every student will be able to choose a non-continuous evaluation whenever she/he has participated in activities awarded with less than 50% of the semester score and regular lessons have not yet finished. Nonetheless, in no case those activities submitted for assessment during previous weeks will not be re-evaluated.

To pass the course, students will have to satisfy the same requirements as before, i.e.:
- All laboratory tasks will have to be submitted and orally defended. No minimum mark will be required for any hands-on experiment, both the weighted average score for all of them will have to be higher than 4 points (on a scale of 10 points).
- A degree on every theory test higher 4 points (on a scale of 10 points) will be required.
- A final mark on the course higher than 5 points (on a scale of 10 points) will be required.

Specifications for the resit/retake exam:

In this second opportunity to pass the course, 100% of the semester score could be achieved. Thus, two assessment activities will be conducted, i.e.:
- A single final written exam covering all theory concepts. This examination will be awarded with 40% of the semester score and a minimum score of 4 points (over 10) will be required to pass the course.
- New submission and oral defense of the technical informs for all or some hands-on experiments proposed along the course. These activities will be re-worked in a special timetable agreed with the instructor. In global terms, these activities will be awarded with 60% of the semester score and minimum mark of 4 points (over 10) will be required to pass the course.

Finally, to pass the course a final weighted score of 5 points (over 10) is required. In case of failing the course, global score for theory or laboratory (if it is higher than 4 points) will be maintained for the next offering, unless the student voluntarily decides to retake the corresponding set of assessment activities.

Specifications for the second resit / retake exam:

If students passed laboratory or theory activities in the preceding course, only an exam covering hands-on experiments or theory concepts will have to be tackled. Otherwise, students will have to take two exams, one covering theory concepts and another assessing laboratory skills. The grading scheme will award 40% of the final mark on the course for theory exam and 40% for laboratory test. For both examinations, a minimum mark of 4 points (over 10) will be required to pass the course. Moreover, the final weighted average mark will have to be equal or higher than 5 points (over 10).

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Writing of reports or projects [AUTÓNOMA][Guided or supervised work]	22.5
Project or Topic Presentations [PRESENCIAL][Individual presentation of projects and reports]	1.5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.75
Other on-site activities [PRESENCIAL][Assessment tests]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	56.25

General comments about the planning: All theory and laboratory activities will be sequentially conducted along the semester. Moreover, a detailed schedule of the course containing deadlines for all assessment activities will be published in the learning platform (Campus Virtual) before the course starts.

Unit 1 (de 3): Design and development of electronic instrumentation systems

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5.75
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1.25
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	6

Unit 2 (de 3): Sensors, transducers and actuators	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	4

Unit 3 (de 3): Protocols and communication interfaces	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	3.5

Global activity	
Activities	**hours**
Writing of reports or projects [AUTÓNOMA][Guided or supervised work]	22.5
Project or Topic Presentations [PRESENCIAL][Individual presentation of projects and reports]	1.5
Other on-site activities [PRESENCIAL][Assessment tests]	1.5
Class Attendance (theory) [PRESENCIAL][Lectures]	12.75
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3.75
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	13.5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	0.75
Study and Exam Preparation [AUTÓNOMA][Self-study]	56.25
Total horas:	112.5

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Gerard Meijer	Smart Sensor Systems	Wiley		978-0-470-86691-7	2015	
	http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0470866918.html					
National Instruments	National Instruments Instrument Control Fundamentals Series	National Instruments Technical Notes			2013	FREE resource for instrument control knowledge
	http://www.ni.com/white-paper/4359/en/					
Pallás Areny, Ramón	Sensores y acondicionadores de señal	Marcombo Boixareu		84-267-1344-0	2003	
Pérez García, Miguel Ángel (1964-)	Instrumentación electrónica /	Paraninfo,		978-84-283-3702-1	2014	
Pérez García, Miguel Ángel (1964-)	Instrumentación electrónica : 230 problemas resueltos /	Garceta,		978-84-15452-00-3	2012	
Reverter, Ferran	Circuitos de interfaz directa sensor-microcontrolador /	Marcombo,		978-84-267-1502-9	2008	