UNIVERSIDAD POLITÉCNICA DE MADRID

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS DE MINAS Y ENERGÍA

LEARNING GUIDE

ELECTRONICS AND CONTROL

DEGREE IN MINERALURGICAL AND METALLURGICAL ENGINEERING OF RAW MATERIALS

ACADEMIC YEAR	CODE	COURSE	CREDITS	TYPE	SEMESTER
2026-27	65005002	3	4.5 ECTS	COMPULSORY	FIRST SEMESTER

LANGUAGE
SPANISH

ASSIGNED CENTER
E.T.S. DE INGENIEROS DE MINAS Y ENERGÍA

ASSIGNED DEPARTMENT
ENERGÍA Y COMBUSTIBLES

COORDINATOR
LUIS JAVIER SAN JOSE GALLEGO - luisjavier.sanjose@upm.es

REQUIRED PREREQUISITES

REQUIRED COURSES

—

RECOMMENDED PRIOR KNOWLEDGE

RECOMMENDED COURSES

- AMPLIACION DE MATEMATICAS (65001011)
- ELECTROMAGNETISMO (65001012)
- ELECTROTECNIA (65001013)
- PHYSICS I (65001006)
- PHYSICS II (65001007)
- CALCULUS I (65001002)
- CALCULUS II (65001003)

OTHER RECOMMENDATIONS

The course is placed in the third year of the degree, at a stage when students have already acquired basic knowledge of physics, mathematics and electrical engineering. This makes it possible to approach the study of electronic circuits and control systems from an applied perspective. In this regard, it is recommended that students have previously taken subjects related to electrical engineering, electromagnetism and Calculus I and II, as these provide the necessary foundation for the analysis of circuits and dynamic systems.

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It is also recommended that students have a certain level of skill and knowledge in the resolution of electrical circuits.

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RESULTS

RD-1393/2007

Competences

CON11 Conocer y comprender los fundamentos del sistema eléctrico de potencia: generación de energía, red de transporte, reparto y distribución, así como sobre tipos de líneas y conductores. Conocimiento de la normativa sobre baja y alta tensión.Conocimiento de electrónica básica y sistemas de control. TIPO: Conocimientos o contenidos

HAB8 Aplicar los conocimientos adquiridos para identificar, formular y resolver problemas dentro de contextos amplios y multidisciplinarios, siendo capaces de integrar conocimientos, trabajando en equipos multidisciplinares. TIPO: Habilidades o destrezas

HAB5 Capacidad de análisis de la problemática de la seguridad y salud en los proyectos, plantas o instalaciones. TIPO: Habilidades o destrezas

Learning Outcomes

RA27 Entender las ideas principales de textos complejos que traten de temas tanto concretos como abstractos, incluyendo los de carácter técnico dentro de su campo de especialización

DESCRIPTION

The course Electronics and Control aims to introduce students to the fundamentals of analogue and digital electronics, as well as to the basic principles of automatic control, providing the necessary tools to understand the operation of electronic systems used in industrial and energy installations.

In the current context of engineering, electronics and control are fundamental disciplines for the design, operation and supervision of technological systems. Energy generation systems, industrial processes and automated equipment require the use of electronic devices, sensors, actuators and control systems capable of ensuring efficient, safe and reliable operation.

From an educational perspective, the course contributes to the development of competences related to the analysis and resolution of technical problems, the basic design of electronic systems and the study of the dynamic behaviour of controlled systems. It also introduces students to the use of simulation and analysis tools, which are essential in current professional practice. The course also has a significant practical component, through laboratory sessions focused on the design, simulation and analysis of electronic circuits and control systems. In this way, students are able to understand the operation of real electronic components, circuits and systems, as well as their application in the industrial and energy sector.

Overall, the course provides a fundamental basis for subsequent subjects related to automation, instrumentation, industrial control and energy systems, contributing to the comprehensive training of

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engineers in the field of applied technology.

The teaching methodology is based on a combination of lectures, problem-solving classes and laboratory sessions. These activities are complemented by the student's independent work, which takes the form of reports and other assessable tasks.

The course mainly consists of the following parts/aspects:

- Introduction to control electronics.
- Analogue and digital electronics.
- Principles of automatic control.

TOPICS

1. Introduction to electronics

1.1. Concepts & applications

1.2. Electronics in industry. Measurement and control

1.3. Types of signals. Manipulation, amplification and filtering

2. Components

2.1. Passive components: resistor, capacitor, inductor

2.2. Diodes, characteristic curves. Types and applications. Power supply

2.3. Active components, transistors, characteristic curves

3. Analogue electronics

3.1. Amplification. Differential and operational amplifiers. Feedback

3.2. Basic circuits with operational amplifiers

3.3. Filters. Frequency response

4. Digital electronics

4.1. Logic signals. Codes

4.2. Boolean algebra and logic gates

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4.3. Combinational circuits

4.4. Sequential circuits

4.5. Sequential circuits

5. Microprocessors and analogue-to-digital conversion

5.1. Introduction to the microprocessor. Minimal system. Programmed logic versus wired logic

5.2. Structure and operation of a microprocessor

5.3. Analogue-to-digital and digital-to-analogue conversion

6. Automatic control

6.1. Introduction. Open-loop and closed-loop systems. Examples

6.2. Concepts of accuracy, speed, stability and robustness

6.3. Classical control. PID control

6.4. Introduction to advanced control methods

ACTIVITIES

Assessment activity Learning activity

WEEKS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 00m	Classroom (scheduled)	Normal

METHODOLOGY
Lecture

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Topics 1.1, 1.2, 1.3

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 00m	Classroom (scheduled)	Normal

TOPICS: T1

METHODOLOGY: Lecture

Topics 2.1 to 2.3

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	03h 00m	Classroom (scheduled)	Normal

TOPICS: T2

METHODOLOGY: Lecture, Problem-solving class

Topics 3.1, 3.2

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 30m	Classroom (scheduled)	Normal

TOPICS: T3

METHODOLOGY: Lecture

Topics 3.1, 3.2

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 15m	Classroom (scheduled)	Normal

TOPICS: T3

METHODOLOGY: Problem-solving class

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Practice 1

WEEKS: 1 2 **3** 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 00m	Laboratory	Reduced

TOPICS: T2

METHODOLOGY: Laboratory assignments

Progressive Assessment Exam 1

WEEKS: 1 2 **3** 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	00h 15m	Classroom (scheduled)	Progressive	5%	0

TOPICS: T2 T1

METHODOLOGY: Written exam

Progressive Assessment Exam 1

WEEKS: 1 2 **3** 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	00h 15m	Other	Normal

TOPICS: T1 T2

METHODOLOGY: Other activities

Topic 3.3

WEEKS: 1 2 3 **4** 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	03h 00m	Classroom (scheduled)	Normal

TOPICS: T3

METHODOLOGY: Problem-solving class

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Practicum Report 1

WEEKS: 1 2 3 **4** 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
Not in person, without teacher	07h 00m	Progressive, Global	4%	0

TOPICS: T2

METHODOLOGY: Work in group

Practice Exam 1

WEEKS: 1 2 3 **4** 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	00h 30m	Other	Progressive, Global	6%	0

TOPICS: T2

METHODOLOGY: Problem-solving exam

Topic 3.3

WEEKS: 1 2 3 4 **5** 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 00m	Classroom (scheduled)	Normal

TOPICS: T3

METHODOLOGY: Problem-solving class

Topic 4.1

WEEKS: 1 2 3 4 **5** 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 00m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Lecture, Problem-solving class

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Topic 4.2

WEEKS: 1 2 3 4 5 **6** 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 30m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Lecture

Topic 4.2

WEEKS: 1 2 3 4 5 **6** 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	00h 45m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Problem-solving class

Practice 2: Simulation Tools

WEEKS: 1 2 3 4 5 **6** 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	00h 30m	Classroom (scheduled)	Reduced

TOPICS: T3

METHODOLOGY: Other activities, Lecture

Progressive Assessment Exam 2

WEEKS: 1 2 3 4 5 **6** 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	00h 15m	Classroom (scheduled)	Normal

TOPICS: T3, T4

METHODOLOGY: Other activities

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Progressive Assesment Test 2

WEEKS: 1 2 3 4 5 **6** 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	00h 15m	Classroom (scheduled)	Progressive	5%	0

TOPICS: T3, T4

METHODOLOGY: Written exam

Topic 4.3

WEEKS: 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 30m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Lecture

Topic 4.3

WEEKS: 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 30m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Problem-solving class

Practicum Report 2

WEEKS: 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
Not in person, without teacher	08h 00m	Progressive, Global	10%	0

TOPICS: T3

METHODOLOGY: Work in group

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Topic 4.4

WEEKS: 1 2 3 4 5 6 7 **8** 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 00m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Lecture

Topic 4.4

WEEKS: 1 2 3 4 5 6 7 **8** 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 00m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Problem-solving class

Topic 4.4

WEEKS: 1 2 3 4 5 6 7 8 **9** 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 45m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Problem-solving class

Progressive Assesment Test 3

WEEKS: 1 2 3 4 5 6 7 8 **9** 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	00h 15m	Classroom (scheduled)	Normal

TOPICS: T4

METHODOLOGY: Other activities

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Progressive Assesment Test 3

WEEKS: 1 2 3 4 5 6 7 8 **9** 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	00h 15m	Other	Progressive	5%	0

TOPICS
T4

METHODOLOGY
Written exam

Topic 4.4

WEEKS: 1 2 3 4 5 6 7 8 9 **10** 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 00m	Classroom (scheduled)	Normal

TOPICS
T4

METHODOLOGY
Problem-solving class

Topic 4.5

WEEKS: 1 2 3 4 5 6 7 8 9 **10** 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 00m	Classroom (scheduled)	Normal

TOPICS
T4

METHODOLOGY
Lecture

Topics 5.1, 5.2

WEEKS: 1 2 3 4 5 6 7 8 9 10 **11** 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	03h 00m	Classroom (scheduled)	Normal

TOPICS
T5

METHODOLOGY
Lecture

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Topic 5.3

WEEKS 1 2 3 4 5 6 7 8 9 10 11 **12** 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 15m	Classroom (scheduled)	Normal

TOPICS
T5

METHODOLOGY
Lecture

Topic 5.3

WEEKS 1 2 3 4 5 6 7 8 9 10 11 **12** 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	00h 30m	Classroom (scheduled)	Normal

TOPICS
T5

METHODOLOGY
Problem-solving class

Progressive Assesment Test 4

WEEKS 1 2 3 4 5 6 7 8 9 10 11 **12** 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	00h 15m	Classroom (scheduled)	Normal

TOPICS
T5 T4

METHODOLOGY
Other activities

Progressive Assesment Test 4

WEEKS 1 2 3 4 5 6 7 8 9 10 11 **12** 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	00h 15m	Other	Progressive	5%	0

TOPICS
T4 T5

METHODOLOGY
Written exam

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Topics 6.1, 6.2

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 **13** 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 00m	Classroom (scheduled)	Normal

TOPICS: T6

METHODOLOGY: Lecture

Topics 6.1, 6.2

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 **13** 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 00m	Classroom (scheduled)	Normal

TOPICS: T6

METHODOLOGY: Problem-solving class

Topics 6.3, 6.4

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 **14** 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	02h 45m	Classroom (scheduled)	Normal

TOPICS: T6

METHODOLOGY: Lecture, Problem-solving class

Progressive Assesment Test 5

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 **14** 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	00h 15m	Classroom (scheduled)	Normal

TOPICS: T6

METHODOLOGY: Other activities

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Progressive Assesment Test 5

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 **14** 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	00h 15m	Other	Progressive	5%	0

TOPICS: T6

METHODOLOGY: Written exam

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 **E**

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	08h 00m	Other	Retake (Extraordinary)	10%	0

METHODOLOGY: Problem-solving exam

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 **E**

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	08h 00m	Other	Retake (Extraordinary)	10%	0

METHODOLOGY: Problem-solving exam

Final Exam. Problem

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 **E**

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	01h 30m	Other	Retake (Extraordinary)	40%	2

TOPICS: T3 T4

METHODOLOGY: Written exam

ASSESSED OUTCOMES: HAB8

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Theoretical and practical exam

WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	01h 30m	Other	Retake (Extraordinary)	40%	2

TOPICS
T1 T2 T3 T4 T5 T6

METHODOLOGY
Written exam

ASSESSED OUTCOMES
CON11 HAB5 HAB8 RA27

WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 00m	Classroom (scheduled)	Normal

METHODOLOGY
Other activities

WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	GROUP
In person	01h 00m	Classroom (scheduled)	Normal

METHODOLOGY
Other activities

Final Exam. Problem

WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	01h 00m	Other	Progressive	27.5%	2

TOPICS
T3 T4

METHODOLOGY
Written exam

ASSESSED OUTCOMES
HAB8

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Theoretical and practical exam

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	01h 00m	Other	Progressive	27.5%	2

TOPICS: T1 T2 T3 T4 T5 T6

METHODOLOGY: Written exam

ASSESSED OUTCOMES: CON11 HAB8 HAB5 RA27

Final Exam. Problem

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	01h 00m	Other	Global	40%	2

TOPICS: T4 T3

METHODOLOGY: Written exam

ASSESSED OUTCOMES: HAB8

Theoretical and practical exam

WEEKS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E

FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT	WEIGHT	MINIMUM GRADE
In person	01h 00m	Other	Global	40%	2

TOPICS: T1 T2 T3 T4 T5 T6

METHODOLOGY: Written exam

ASSESSED OUTCOMES: CON11 HAB5 HAB8 RA27

WEEKLY SCHEDULE

Assessment activity | Learning activity | Week with activity | E Exam period

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Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	E
	•															
Topics 1.1, 1.2, 1.3	•															
Topics 2.1 to 2.3		•														
Topics 3.1, 3.2			•													
Topics 3.1, 3.2			•													
Practice 1			•													
Progressive Assessment Exam 1			•													
Progressive Assessment Exam 1			•													
Topic 3.3				•												
Practicum Report 1				•												
Practice Exam 1				•												
Topic 3.3					•											
Topic 4.1					•											
Topic 4.2						•										
Topic 4.2						•										
Practice 2: Simulation Tools						•										
Progressive Assessment Exam 2						•										
Progressive Assesment Test 2						•										
Topic 4.3							•									
Topic 4.3							•									

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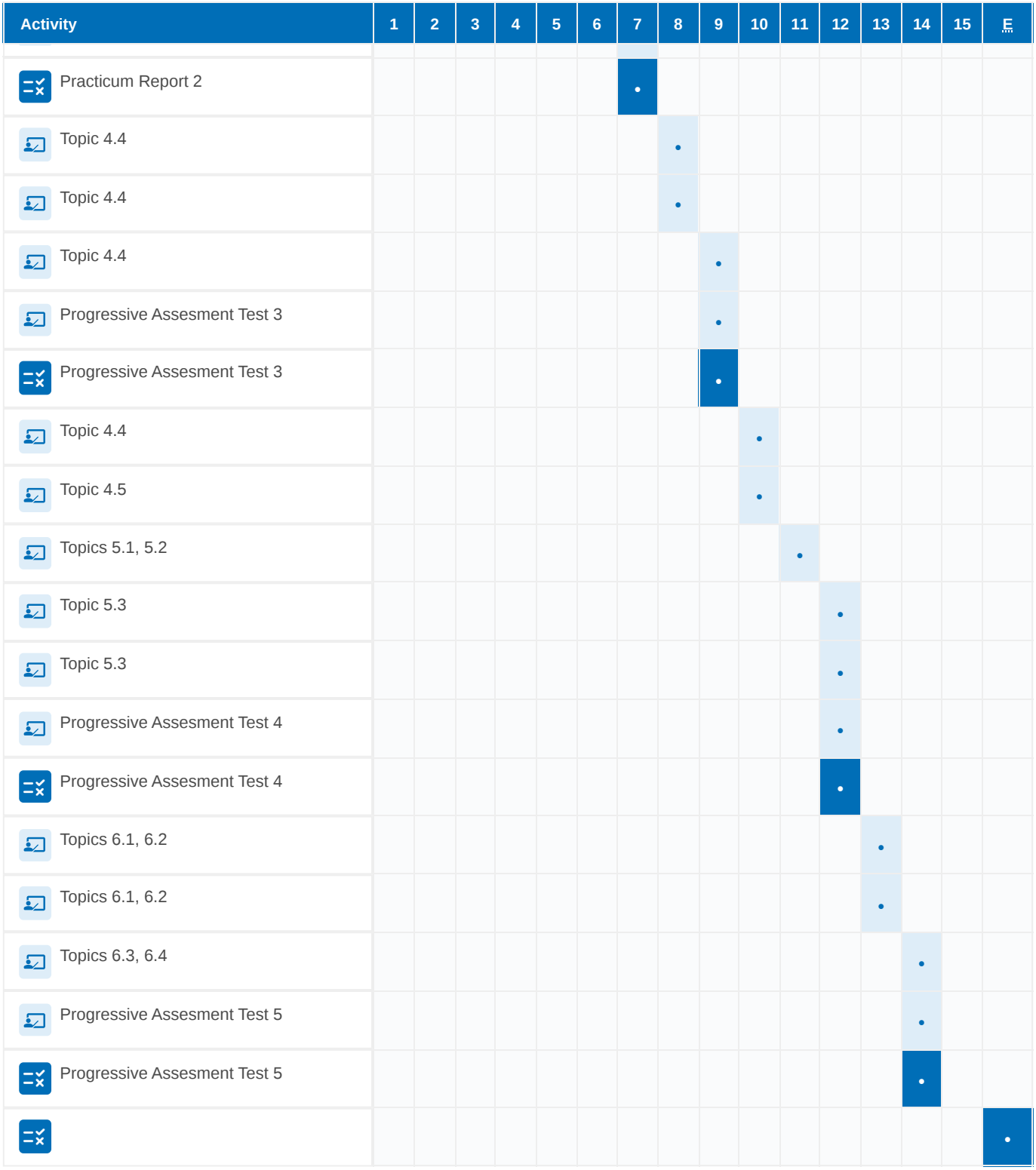

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Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	E
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Final Exam. Problem																•
Theoretical and practical exam																•
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Final Exam. Problem																•
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Final Exam. Problem																•
Theoretical and practical exam																•

ASSESSMENT CRITERIA

General criteria

In accordance with the **Regulations on the Assessment of Learning in Official Bachelor's and Master's Degree Programmes at the Universidad Politécnica de Madrid**, approved by the Governing Council at its meeting of 30 April 2026 and applicable from the 2026–2027 academic year, within the framework established by Royal Decree 822/2021 of 28 September, the assessment of learning in each course unit of a degree programme has the following objectives:

To measure the learning outcomes achieved in the course, in accordance with the specific assessment criteria and indicators defined for each of them.

To inform students about the progress of their learning in the course, in accordance with the established learning outcomes.

To guide teaching action in order to help students achieve these learning outcomes.

The current regulations establish that, in all courses of the official bachelor's and master's degree programmes of the Universidad Politécnica de Madrid, assessment systems must be implemented based on general principles that

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promote learning and the acquisition of competences. These systems include progressive assessment, with tests and activities distributed throughout the teaching period, as well as the possibility of a final examination at the end of that period.

Following the approach set out in the UPM regulations, assessment in this course will be carried out through a set of activities designed to evaluate both the acquisition of theoretical knowledge and the development of practical competences.

Assessment is carried out through a progressive assessment system, complemented by a global assessment, in accordance with the provisions of the course learning guide.

The assessment process includes different activities that make it possible to evaluate both continuous learning and the student's ability to apply the knowledge acquired to the resolution of technical problems. The final grade will be obtained according to the percentages established in the corresponding weighting table, with the grade for the ordinary examination session being the higher of the grade obtained through progressive assessment and that obtained through global assessment. Likewise, attendance at the laboratory sessions, preparation of the reports and completion of the examination for Practical Session 1 will be compulsory in order to pass the course.

The assessment activities include the following:

Class exercises (CE), consisting of short progressive assessment tests carried out with prior notice — at least 15 days in advance — throughout the course, covering the contents explained in previous sessions. These tests will include theoretical questions and short practical exercises, to be completed within a limited time, approximately 10 to 15 minutes. They will take place during class time, will be individual in nature and will be solved in the class session following the date of the exercise. Five exercises are expected to be carried out during the semester, with the lowest mark being discarded for the calculation of the average grade. No minimum mark will be required for this activity. Each class exercise will account for 5% of the final grade.

The assessment of laboratory practical sessions will be carried out using different instruments. The first laboratory practical session will be assessed by means of a written report prepared in groups, with each group corresponding to the working group formed for the laboratory session. The report must address the results observed/measured in the laboratory and, in addition to reflecting the work carried out in person during the corresponding session, must demonstrate the acquisition of skills/competences related to laboratory work in electronics and to the general competences of the course described above. In addition, a written examination will be carried out on the first practical session, covering practical knowledge/skills acquired in the laboratory, equipment used, measurements, values and signals.

The second practical session will be assessed by means of a report presenting the results obtained through the simulation of an amplifier-based filter in LTSpice. This report must also be prepared in groups. In the case of the second practical session, an optional project-based learning activity will also be introduced, consisting of a laboratory seminar for the practical implementation of the filter assigned to each group.

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In both practical sessions, the reports must present an appropriate structure and format, include the models developed and present the experimental and simulation results obtained. The reports will be prepared outside class, while the examination will take place in person during class time and will last 30 minutes. In the case of practical activities, no minimum mark will be required in order to pass the course.

First laboratory practical session (L1): preparation of a group report, which will be marked out of a maximum of 4 points, complemented by an individual examination on the practical session, marked out of a maximum of 6 points.

Second laboratory practical session (L2): assessment will be carried out exclusively through the submission of a group report, which will be marked out of a maximum of 10 points.

Final examination: the overall theoretical-practical assessment will be carried out through an examination including two written tests, which will take place on the official dates of the ordinary and extraordinary examination sessions established in the academic calendar. It will be common to both progressive assessment and global assessment.

• Theoretical-practical examination (ExTP): consisting of between 8 and 10 short questions related to the application of concepts and theoretical reasoning.

• Problems examination (ExP): consisting of the resolution of a practical calculation problem. In both cases, answers must be properly reasoned, and numerical results must be obtained through appropriate and clearly justified procedures. A minimum mark of 2 points will be required to pass these tests.

Finally, should students decide not to choose progressive assessment — which includes the marks of the four best class exercises (CE) in the final grade — they may opt for global assessment. This will consist of the mark obtained in the final examination, a written test comprising two differentiated parts: short theoretical questions/brief exercises and a long problem (ExTP and ExP), weighted together with the mark obtained in both practical sessions.

Overall, this assessment system makes it possible to evaluate conceptual understanding, problem-solving ability and the development of experimental skills in a balanced manner, while also encouraging continuous work and active student participation throughout the course.

COMPULSORY PRACTICAL SESSIONS

Two practical sessions will be carried out, each marked from 0 to 10 points.

Both practical sessions are compulsory for both types of assessment. In order to pass the course, students must have attended the laboratory session, submitted the report and completed the examination for Practical Session 1. In the case of Practical Session 2, students must have attended the lecture in which the necessary concepts are presented to solve the type of amplifier-based filters that will be assigned to the different groups, and must have submitted the report. Attendance at the subsequent seminar/laboratory session for practical implementation will not be assessed or compulsory under any circumstances.

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Practical Session 1 will take place in the laboratory, and the mark will be based on a combination of a report, worth 4 points, and an examination, worth 6 points.

Practical Session 2 will be mainly simulation-based.

The laboratory practical sessions and reports will be carried out in groups of up to three students. The examination is individual. Regardless of the type of assessment, the practical sessions account for a total of 20% of the final grade, with each practical session accounting for 10%.

Assessment criteria for the regular exam period. Progressive assessment

Assessment criteria

PROGRESSIVE ASSESSMENT

With prior notice of at least 14 days, the CE activities will be carried out during class time. These will consist of short theoretical-practical questions on the material covered since the previous test, or from the beginning of the course in the case of the first test. They will be answered individually in writing.

Between 5 and 7 class quizzes will be carried out and will form part of the progressive assessment.

For the calculation of the grade, the lowest marks will be discarded; that is, the 4 best marks out of the N tests completed will be taken into account. The total weighting of the CE activities in the final grade is 20%.

The final grade is calculated according to the following formula:

N = 0.2 × average(best 4 CE marks) + 0.04 × ExP1 + 0.06 × L1 + 0.1 × L2 + 0.3 × ExTP + 0.3 × ExP

(Note: The weighting of ExTP and ExP in the formula changes from 27.5% to 30%, since only the 4 best marks from the class exercises are taken into account.)

Activities

- Progressive Assessment Exam 1 (5%)
- Practicum Report 1 (4%)
- Practice Exam 1 (6%)
- Progressive Assesment Test 2 (5%)
- Practicum Report 2 (10%)
- Progressive Assesment Test 3 (5%)
- Progressive Assesment Test 4 (5%)
- Progressive Assesment Test 5 (5%)
- Final Exam. Problem (27.5%)
- Theoretical and practical exam (27.5%)

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Assessment criteria for the regular exam period. Global assessment

Assessment criteria

ORDINARY GLOBAL ASSESSMENT

The CE marks will not be taken into account. The grade will therefore be composed of the marks obtained in L1, L2 and the Final Examination, which, as previously indicated, is a written test consisting of two parts:

A) A theoretical/practical test consisting of 8 to 12 short questions, marked from 0 to 10 points.

B) A practical calculation exercise, marked from 0 to 10 points.

The examination is common to both progressive assessment and assessment by final examination only. The final grade will be the higher of the grade obtained through progressive assessment and that obtained through global assessment.

The formula for calculating the final grade in this case will be:

$N = 0.06 \times ExP1 + 0.04 \times L1 + 0.1 \times L2 + 0.4 \times ExP + 0.4 \times ExTP$

Activities

- Practicum Report 1 (4%)
- Practice Exam 1 (6%)
- Practicum Report 2 (10%)
- Final Exam. Problem (40%)
- Theoretical and practical exam (40%)

Assessment criteria for the retake (extraordinary) exam period

Assessment criteria

EXTRAORDINARY EXAMINATION SESSION

The mark for the practical examination may optionally be the one obtained for progressive assessment. The CE marks will also be retained, with the final grade being the higher of the grades obtained using the two formulas indicated for progressive assessment and global assessment:

$N = \max(N1, N2)$

$N1 = 0.2 \times \text{average(best 4 CE marks)} + 0.04 \times ExP1 + 0.06 \times L1 + 0.1 \times L2 + 0.3 \times ExTP + 0.3 \times ExP$

$N2 = 0.06 \times ExP1 + 0.04 \times L1 + 0.1 \times L2 + 0.4 \times ExP + 0.4 \times ExTP$

Activities

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- Informe y examen práctica 1 (10%)
- Informe práctica 2 (10%)
- Final Exam. Problem (40%)
- Theoretical and practical exam (40%)

RESOURCES

Bibliography

Principios de electrónica

Circuitos Electrónicos digitales II

Ingeniería de Control Moderna

The Art of Electronics

Web

Moodle

Otros recursos

Equipment

Laboratorios

Other resources

Herramientas de simulación

Bibliography

Generadores y filtros activos

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Electrónica digital, principios y aplicaciones

Electronic Devices

SUSTAINABLE DEVELOPMENT GOALS

Industry, Innovation and Infrastructure

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